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Editorial Open Access

Challenges for Training at the Interface

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Editorial

Before bioengineering became an established field, it struggled in its survival as an interdisciplinary training area at the interface between engineering and biology. As biological and medical applications penetrate into other traditional fields, new cross-disciplinary research emerges, and new interdisciplinary training is then required for students working in those areas. While research activities at the interface may be judged or recognized in their quality and impact through the typical products (e.g. articles, patents, and grants), the associated educational program, which usually needs a much longer time scale to implement and to evaluate, becomes much more difficult in assessing their impact. This presents great challenges for development and maintenance of training programs at the interface between biology and one (or multiple) existing traditional discipline.

In curriculum design, balance between depth and breadth usually is the critical component that demands the maximum attention and analysis for any graduate and undergraduate program. As a result, it is particularly challenging for an interdisciplinary area whose scope is broader by its nature and whose knowledge foundation is yet to be well defined. Core knowledge for a well-established discipline usually consists of materials accumulated and purified for hundreds of years, leading to many courses as a cornerstone of training in that discipline. For an interdisciplinary training program that interfaces with such a discipline, the requirement of all such core knowledge clearly leaves little time for cross-disciplinary training, let alone potential curriculum on new knowledge emerging from the interface. Interdisciplinary research inherently necessitates broad education (e.g. familiarity or full understanding of many concepts in multiple disciplines), in addition to requiring focussed education for an individual student to posses one or multiple specialized skills as a domain expert.

Classical institutional administrative structure provides another hurdle on training at the interface. An interdisciplinary program, often emerging from a collaborative effort from researchers in different departments, usually has a discipline department as a host. As a result, the majority view of that department will dictate how innovative it is and what is the level of "deviation" from the discipline training model. In view of the fact that the department was created as an identity for teaching purpose, it depends on what a graduate student can teach after obtaining the graduate degree which strongly affects the structure of a training program and its core curriculum. A question often asked is, "Without taking a course in a core knowledge area, how could a student teach such course after graduation?" This question is likely to be asked again when the student is looking for a tenure-track job in an interdisciplinary area that does not have its own department. The non-traditional training path puts them at disadvantage because they have never taken certain core courses, implying deficiency in achieving the educational mission of that department.

How do we deal with such challenges for training at the interface between biology and other traditional and well-established fields? Is it possible to provide training with sufficient breadth required for interdisciplinary research along with necessary depth intrinsic to many subjects of the disciplines?

A balance between flexibility and rigid requirement on its curriculum seems to be at the core in dealing with this challenge. As knowledge is constantly expanding and the time for training is finite and limited, what training can provide is a solid foundation for students to stand on and to learn by themselves whenever needed. A good mixture of more choices within one traditional core along with rigorous exercises on multi-discipline fundamentals is crucial to interdisciplinary training. This enables students for better future contextual learning after receiving their pre-determined didactic training. Planting many seeds with diverse curriculum can give rise to a forest of knowledge that grows as a student becomes an independent learner in research.

At the administrative level, a training program without a home department is becoming increasingly popular in many institutions. Of course, such structure may lead to new complications like course offering and count of teaching loads, etc. On top of all of these, one most critical element in developing novel and cutting-edge interdisciplinary training programs require a combination of participants having respect for traditions and cultures within disciplines and their peers having appreciation and open-mindedness of the interdisciplinary research and training.

"Invention is discernment, choice … Among chosen combinations the most fertile will often be those formed of elements drawn from domains which are far apart" as French mathematician Henri Poincaré wrote more than a century ago. As creativity and innovation, often arising from unexpected combinations of seemingly unrelated knowledge elements from many areas, are becoming a driving force for economic growth and better medicine, the training philosophy and model must be adapted to best train the next generation such that they have the capability of doing whatever and wherever their creativity and innovation takes them.

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