DEVELOPING COLLABORATIVE INTERNATIONAL BIOTECHNOLOGY ENTREPRENEURSHIP PROGRAMS

Christopher Cullis
Case Western Reserve University (UNITED STATES)

Abstract

The proportion of bioscience PhDs that enter the academic workforce is steadily declining with only three or four in every hundred PhD students in the United Kingdom landing a permanent staff position at a university. It's only a little better in the United States [1]. Those who do enter academia essentially become CEOs of a small business, even if they do not necessarily recognize this. However, the resources for encountering solutions to the myriad of experiences encountered in the workforce are not a staple of graduate education in the biosciences. The Society for Bioenterprise Education and Research (SIBER, www.SIBER.bio) is an international organization with the goal of educating the next generation of Bioentrepreneurs, whether they be in academia or the commercial sector. This simple-sounding goal belies the complexities of science-business interaction. The translation of scientific discoveries and technological breakthroughs requires a multi-disciplinary, creative workforce. The participants in SIBER have experience of a range of modalities for educating this workforce through a combination of degree programs and appropriately designed and targeted courses, many documented here (Technology Transfer and Entrepreneurship Volume 4, Number 2, 2017). One such example, the MS in Biotechnology Entrepreneurship at Case Western Reserve University combines course-based instruction with a year-long internship in a small start-up company, real or nascent [2, 3]. The students are also connected to the various business incubators where they are able to both network and identify employment opportunities following graduation. The challenges in developing such programs in science departments with the approved discipline-based academic rigor coupled to the broader educational goals will be considered.

Keywords: Biotechnology Entrepreneurship, Graduate Education, The Society for Bioenterprise Education and Research, International Collaboration, Curriculum.

1 INTRODUCTION

The aims of graduate education in the biological sciences have been evolving since academic positions are now at a premium. In fact, the academic position is the alternative career, rather than being the primary focus of graduate, and especially PhD education, which had been the case for many years. This is resulting in the need for academic scientists to revise their view of the outcome of training students. However, a primary hurdle is that academic scientists do not normally see their function as training students with an entrepreneurial bent, a view which is frequently coupled with a lack of understanding and exposure to non-academic (industrial or commercial) thinking and demands. This view is frequently compounded by the bias that such non-academia positions are intellectually inferior and, therefore, consciously or sub-consciously discourage their students from considering an industrial career.

Biotechnology entrepreneurship education falls between the cracks of science departments and business schools. Science faculty do not usually have the appropriate industrial contacts or networks to expose their students to industrial thinking. On the other hand, business schools rarely see entrepreneurship in science as part of their primary portfolio, and since science faculties do not see training in entrepreneurship as part of their remit so the topic is generally missing from the curriculum.

Trying to implement an increase in the awareness of biotechnology entrepreneurship into the curriculum has a problem with who takes ownership of the process. Since this area is centered around scientific discovery and translation into practice, it is essential that the programs are based in science departments. However, these departments are not the most suitable settings to introduce topics such as new venture creation, commercialization, venture finance and transactions or patent law. Conversely, the normal courses for students in management or law schools who are going to be professionals in these areas are not necessarily suited for the starting science entrepreneur.

Therefore, there is a need to change the paradigm for graduate education in order to enable a wider choice of career opportunities. Unfortunately there are a number of obstacles in the path of such
initiatives. Firstly and foremost is the issue of where the academic home and academic structure for such programs should be placed. Secondly, is the responsibility for staffing the courses that form the core of such programs. Thirdly, is the distribution of the revenue generated from the tuition. Fourthly, how are individuals who are unaffiliated with the academy, but essential to the enterprise, valued and included in the programs? Finally, is it necessary to be located within a regional biocluster as a pre-requisite for developing a program in biotechnology entrepreneurship in order to have the appropriate environment for delivering the program components?

2 ACADEMIC ISSUES BIOTECHNOLOGY ENTREPRENEURSHIP PROGRAMS

2.1 Academic home and final qualification

As noted above, these programs are science at their core and therefore need to be based in science departments. The primary credentials for such programs are either MS degrees or certificates. Here the focus will mainly be on degree programs, but shorter concentrations could still be considered under the same umbrella. What are the components of a biotechnology entrepreneurship program? Clearly, they need to include the appropriate underpinning of what constitutes modern biotechnology, and what are the cutting edge technologies. This science can be delivered through the scientific home, but does it need to be (or even should it be) delivered through regular faculty. Most departments that can offer such programs will need to have connections to practitioners involved in the biotechnology industry, either through technology incubators, venture funding activities or both. Institutions that have high profile and prolific biomedical research activities are almost required to have a translational pipeline. It is this pipeline that can be the source of experiences for the students in the biotechnology entrepreneurship and a resource for faculty to deliver the required translation.

The nature of the qualification will, to some extent, determine the structure of the program. For example, if the outcome is an MS degree with a final thesis, then the nature of the thesis is of primary importance. The program at Case Western Reserve University has a final thesis, and this is developed on the basis of a year-long internship. Unlike a standard research thesis, the biotechnology entrepreneurship thesis has to combine both components — a rigorous evaluation of the science underpinning a technology and an evaluation of the entrepreneurship opportunity including the patent landscape, freedom to operate and even a final exit strategy. The development of these components of the theses is normally overseen through the inventor/developer of the technology who is not usually a faculty member. Therefore, the academic director of the program has to be the de facto advisor for all the students in the program. The number of available opportunities for students to carry out these evaluations tends to be the primary constraint on the practical size of the program.

2.2 Course offerings

The didactic sections of the programs have two distinct flavors, one the science and the other the management/law expertise. Since the home of the programs is generally in a science department, the science course can be accommodated as part of the normal departmental offerings. One potential problem relates to the size of each cohort recruited into the program. At Case Western Reserve University, the current program recruits a maximum of 10 students per year. Therefore, even when the program is at its maximum, the core courses have low enrollment. In the case of the management/law courses, this becomes even more of an issue. The simple expedient of having the biotechnology entrepreneurship students take the regular course offerings for students majoring in these areas is that they are not necessarily at an appropriate level or focus. However, it can be difficult to develop new courses taught in another unit with a small enrollment as the economics become prohibitive. Although, as noted earlier, the topics in the core courses for the biotechnology entrepreneurship program, either science or management, have relevance to the wider student body irrespective of their future employment. Therefore, the development of courses for a broader non-major audience can make an attractive offering across the institution. In particular, some of the offerings in biotechnology entrepreneurship will be ideally suited for inclusion (either as is or adapted for shorter iterations) into graduate professional development programs. The topic of the length of courses, with respect to credit hours, will be addressed in section 2.4.

2.3 Revenue sharing

The two extremes of university financing are either complete central control or a Responsibility Centered Management (RCM) models. Normally there is a mixture of both types with the balance
being towards one of the models. In both cases, the distribution of resources tends to silo administrative units. It has already been established that the natural home for the biotechnology entrepreneurship students would be in the biological sciences departments, normally in either a College of Arts and Sciences or a School of Medicine. Delivering instruction in the science can easily be part of the portfolio of the home departments. However, for the non-science courses, the burden will fall on faculty or schools that are not associated with the home departments of the students. Therefore, there is a need for distribution of tuition to these units for students in such biotechnology entrepreneurship programs. At Case Western Reserve University, an RCM budget model is mainly employed, in which all the tuition for a graduate student was assigned to the home department/school for that student, irrespective of what courses were being taken. Therefore there was no incentive for other departments to provide courses for a program, or even accept students into their courses since no revenue would accrue. Recently this model has been modified such that a portion of the graduate student tuition followed the course map, and the remainder was distributed to the home department of the student. This has facilitated the availability of courses across the institution for all graduate students and reduced barriers to developing collaborative courses and programs.

2.4 Non-regular faculty contributions

Biotechnology entrepreneurship programs usually include practical experience in the biotechnology industry. Therefore it is necessary to have mentors for the students who can guide them through the processes of evaluating inventions, protecting them and making market evaluations. In general the ideal environment is in an already established start-up enterprise, or in a biotechnology incubator. In Cleveland, a number of entities are involved in the biotechnology entrepreneurship space. For the students in the Case Western Reserve University MS in Biotechnology Entrepreneurship, the incubator BioEnterprise (https://www.bioenterprise.com) is a frequent employer of interns. The students get to usually get to work on an early stage proposal to determine if the technology has potential, what is the competing patent landscape and what are the opportunities for moving it forward. The inventor of the technology, along with the staff at BioEnterprise, usually plays a pivotal role in guiding the students program. These internships are expected to last for 1 year when the student can become really immersed in the technology and make a significant contribution towards it possible commercialization. The inventor/mentor is then also a member of the final thesis committee and participates in the thesis defense. The Department and Graduate school agreed to the rules for the degree program to include one member of the thesis committee not necessarily being a member of the university faculty to accommodate these individuals. The long immersion of the students in their internships has an important outcome – many of the students’ first employment after graduating is in the organization in which they interned. In fact, some of the students’ theses were also submitted as successful Small Business Innovative Research (SBIR) proposals that funded their first employment.

The provision of short courses that take advantage of the expertise in biotechnology needs more development. The first iterations of non-specialist courses has been piloted at Case Western Reserve University in the form of a one-credit patent law course for the biotechnology students. Previously, these students had to enroll in the patent law course designed for the law students, which was not completely appropriate. However, a law faculty member has now developed a one credit course, which is actually taught under the auspices of the College of Arts and Sciences. It obviously gets enrollment from the Biotechnology students, but also is attractive to PhD students and Post-doctoral fellows. In the future, it is possible that this course will be include an undergraduate offering for science majors as another introduction to what opportunities are available after graduation. Using this model, the intention is to develop a series of one-credit courses led by bioentrepreneurs, venture capitalists and regulatory affairs experts to broaden the curriculum. These courses could be delivered in person of as on line offerings.

2.5 Local Biotechnology Environment

A practical internship is a feature of most, if not all, of the biotechnology entrepreneurship programs. Therefore, access for the students to such opportunities is an essential component of the programs. However, the internship does not necessarily need to be local. At Case Western Reserve University students had taken internships across the USA and even a couple that did them in India. The thesis defense then had the mentor for the internship join virtually and such experiences were completely successful.
3 THE SOCIETY FOR BIOENTERPRISE EDUCATION AND RESEARCH

Where does the Society for Bioenterprise Education and Research (SIBER), which is a 501C3 non-profit, fit into this narrative? As noted on the web site (www.SIBER.bio), the goal is simple - to educate the next generation of Bioentrepreneurs. While the goal is simple, the challenge is not. As noted earlier, the complexities of intersection between science and business cannot be underestimated. The scientific discoveries and technological breakthroughs have to be translated into sustainable and profitable products and services. These translational activities require an extended timeline and face a myriad of regulatory hurdles to clear. The workforce necessary to complete this translation has to have a multi-disciplinary and creative outlook and expertise, where each person is capable of meeting unforeseen challenges, functioning in multiple roles while delivering the highest industry standards. The membership is truly global, where each affiliated program has its own unique flavor of educational experience, but all have a common theme. However, by their very nature, these programs tend to be relatively small, and not all the necessary expertise may be available within a single program. Therefore, by collaborating and taking advantage of the communications possibilities, the programs can concentrate on their local pockets of expertise and tap into the larger community to extend the opportunities for their students. The MOUs that will cover the extended collaborations, and how to transfer resources (if an uneven use of courses occurs) are being developed. However, one of the obvious characteristics of this collaborative group is entrepreneurship, so creative solutions will be developed. The organization will provide a set of resources for new programs to shorten the development time and act as examples for skeptical faculty/institutions. Finally, the collaboration within SIBER will also facilitate the interaction between students across the globe, both virtually and, given resources in person.

4 CONCLUSIONS

The main focus has been on the educational underpinnings for students graduating from the biotechnology entrepreneurship programs. However, it needs to be recognized that many of the same skills needed to move from an academic setting to a commercial one are also required by any academic researcher. A new faculty member needs to view her/his position as that of a sole proprietor where they are required to manage the business (research and teaching), be their own marketing manager and raise funds, while still having the personnel management skills to effectively oversee and develop the “company” workforce (Post-docs, graduate students and technicians). The availability of the sections of the programs described here to all science graduate students will not only improve the overall translation of research but contribute to the success of new faculty members within the academic setting whether just starting out being independent or moving out of academia as their career progresses. For all students are most universities providing opportunities for graduate students to train for an industrial or entrepreneurial career, or is this not part of the mission of the academy? If not, should it be? The aim of SIBER is to be an agent of change and support for the development of such programs.

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REFERENCES

