



UK Agricultural and Medical Biotechnology Program

2022 Periodic Program Review

Review Committee site visit April 24 - 27, 2022

Review Report Submitted on May 17, 2022

Review Committee

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Executive Summary

All reviewers concur that the Agricultural and Medical Biotechnology (AMBT) program offers significant value to the College, University, and State. The committee heard from students, advisors, faculty, research mentors, graduates, and stakeholders, all of whom enthusiastically praised the program. Specific aspects of the program that were judged to be particularly strong include: high-quality, motivated students; curriculum flexibility; an authentic mentored research project; highly motivated faculty with a sincere interest in student learning; inter-departmental and inter-college collaboration; well-planned courses that support all aspects of biotechnology and research; and strong preparation for future careers and graduate/professional programs in Biotechnology, Medicine, Pharmaceutical Sciences, Veterinary Sciences and the Food, Agricultural, Natural Resource, and Human (FANH) Sciences. Providing opportunities for student research, as this program does, is a high-impact educational practice that has been shown to increase retention of underrepresented students in STEM. The transdisciplinary nature of the program directly advances the goals of the University of Kentucky's Quality Enhancement Plan. Undergraduates in this program participate in research, and publish research papers, in trans-disciplinary fields. Finally, AMBT graduates comprise a well-trained job force, ready to take their places in cutting edge fields and areas of projected economic and job growth.

The AMBT program has grown to 236 students during the 2021-2022 academic year, now comprising the third-largest major in the college, yet compared to majors of comparable size, AMBT has very limited staffing and resources. Our committee identified several opportunities for growth and program enhancement, including opportunities for external funding, improved outreach to faculty in other colleges to provide more student research opportunities, improved coordination with graduate programs through enhanced articulation and development of University Scholars Programs, and development of an alumni network to enhance student professional development.

The most important challenges to AMBT identified by the Program Review Committee concern staffing and space. The resources of the single Academic Program Coordinator are currently stretched tightly, leaving little room for program growth and enhancement. Furthermore, the program does not have a physical location, leading to poor brand recognition and difficulties for students to obtain information and help. Some class sizes are limited because of limited teaching laboratory size or availability. The program also needs graduate teaching assistant support.

Our committee made recommendations for the AMBT program based on both the challenges and the opportunities we identified. Major recommendations are to add a second Academic

Coordinator, TA support, and office and teaching laboratory space. Further recommendations include, for example: introducing an annual advisor meeting to communicate advising resources and provide for advising uniformity; tweaking the AMBT courses to support finding mentors early, incorporate quantitative skills and biotechnology applications, enhance support and academic development of underprepared students; and revise the ABT course Learning Outcomes to ensure course consistency. We also recommend creating an alumni network and an industry advisory board.

In summary, the AMBT Program is a highly successful transdisciplinary education program that serves the University and State and supports the development of accomplished and successful graduates. To maintain its excellence and grow to serve more students, faculty, and stakeholders, it requires additional resources.

Brief description of review committee process

- Prior to the review, all committee members received and studied the Self-study Report submitted by faculty and staff of the Agricultural and Medical Biotechnology Program.
- The committee received their charge from Dean Cox, and Dr. Lee, Associate Dean for Faculty Resources, Planning and Assessment, conducted listening sessions with program faculty, staff, students, and stakeholders April 25 – 26.
- On Wednesday, April 27, the committee held working sessions and drafted talking points about the program's strengths, challenges, opportunities, and potential committee recommendations.
- Immediately following the working sessions, the committee presented draft recommendations to CAFE leadership.
- The Committee Chair, Dr. Mark Williams, worked with the committee to prepare this report, which all members of the committee have approved.

We begin this report with a brief list of program strengths, challenges, and opportunities that the committee observed through review of the self-study and listening sessions. This is followed by committee recommendations for the program to consider and act on over the upcoming six-year program review cycle. Throughout this report, the committee has noted specific UK Strategic Plan goals we feel the program's strengths, challenges, and opportunities are aligned with—as well as alignments found among our recommendations.

Strengths

- The independent research project is a hallmark of the ABMT program. Students are well prepared for the rigors of scientific research in their independent projects and also in their post graduate careers. Student research projects are in socially relevant areas such as aspects of food security and human health (University Strategic Plan Goals SF2, II1, II3)
- Interdepartmental and intercollegiate collaboration provides a variety of lab engagement options, allowing students to experience multiple research facilities and research foci in other colleges, including the College of Medicine, College of Arts and Sciences, the College of Agriculture, Food, and Environment, and the College of Pharmacy. Students are also well prepared for off-campus research opportunities at partner institutes and industries (e.g. - Alltech, Pioneer, DSM, local distilleries and distilling related research institutions). (SF2, SF3, II1, II2, II3)
- Curriculum flexibility: After taking the required science core courses, each student's upper-division curriculum is personalized to support the student's interests, research topic, and career goals. Students provided overwhelming positive feedback about this aspect of the program. (SF1, SF2, II1, II2)
- Courses are well designed and provide students with the knowledge and tools needed to conduct research, and critically assess experimental results. Writing and presentation skills are emphasized, developing critical scientific communication skills. (SF2, II2)
- Based on the experiences of prior students, graduates of the program are well-positioned to succeed in careers and graduate/professional programs. (II3)
- The program attracts academically talented, motivated and enthusiastic students who genuinely care about each other. Students are willing to look after each other in both an academic and social environment. This is made evident by the impact of the ABT Club and its regular activities that promote student success and camaraderie. (II1)
- Faculty have expertise and enthusiasm in their teaching areas and have sincere commitment to student learning. Faculty enjoy engaging the students in the learning process, work with students as learning partners, and are highly invested in student outcomes. (II2)

- AMBT students are of high value to the university. The program contributes to student participation in high-value educational practice (research) and provides research mentors with a trained and capable student workforce. (II1)
- AMBT students are of high value to the state. AMBT contributes a well-trained job force in cutting edge fields and areas of projected economic and job growth particularly beneficial for the commonwealth of Kentucky. This includes innovative agronomic advancement and biomedical research at partner institutions and industries important in Kentucky. (II1, II2, II3)
- Support given underrepresented students in college can have more impact on their persistence in STEM than their entering scores and related metrics. Mentored research is an excellent example of increased support through mentoring. Additionally, the strong, engaging and socially relevant AMBT programming contributes to retention of underrepresented students. (MPOC1, MPOC3)
- There is a very strong sense of community among the students, staff and faculty. At a large university like the University of Kentucky, it is possible for a student to feel adrift and isolated; this is particularly true for students moving to Lexington from rural areas of the state. AMBT provides a safe and welcoming “harbor” for these students. The investment of time and mentorship of research mentors through the independent project also provides an excellent opportunity for enhancing retention of under-represented or minority groups in the program. (II2, MPOC1, MPOC3)

Challenges

- There is a lack of staff to support the current program, and additional personnel support is critical to facilitate much needed engagement with stakeholders and tenable program growth.
- The program requires a commitment from departmental chairs (e.g. Entomology, Plant and Soil Science, Plant Pathology) to provide faculty for the AMBT Program.
- There is a need for larger teaching labs or additional course sections (and instruction capacity) in order to grow enrollment.
- AMBT lacks the structured resources typically available to departments.
- There is a perceived lack of research mentors for student 395 projects, and a lack of a codified system utilizing academic advisors to find a research mentor.
- Advising quality may not be equal across cohorts, and students mention a lack of continuity when advisers change.

- Both mentors and students reported a lack of clarity on expectations for ABT395, particularly with the indication that ABT395 is a single semester course. Codifying expectations for both students and mentors will assist in normalizing expectations.
- Lack of space is problematic in all areas of the program, including space for academic staff, classroom options, and laboratory teaching space. The program also lacks a central location identified as the “home” of AMBT.
- TA financial support is lacking due to the nature of the multidisciplinary program resulting in a financial burden on the affiliated departments. As the program grows, this will be an important issue to address, particularly with large laboratory courses and multiple sections.
- Some students enter the program under-prepared and either do not complete the program due to the outstanding rigor, or extend their time to graduation due to delay in completing required courses. (OP1)
- Students indicated a lack of consistency among different sections of the same course, taught by different instructors. There is a need for a “course coordinator” to provide equitable training across multiple sections.
- The majority of learning outcomes for courses, and some of the program learning outcomes, are not measurable. Some courses are missing learning outcomes entirely, and others have what appears to be objectives, not measurable outcomes. Most of the current outcomes would not be acceptable for university-level assessment.
- Students and faculty indicated that some students are not prepared for their research that involves bioinformatics and quantitative data analyses.
- There is a lack of connections with industry throughout Kentucky for students who want to do internships and eventually work in industry.

Opportunities

- Advocate for additional support from the university, as AMBT is ideally aligned with the UK Quality Enhancement Plan’s emphasis on transdisciplinary education programs and should be well positioned to receive support. (II2)
- Given appropriate support from administration, grow the AMBT program to provide these excellent education and research opportunities for additional students and contribute to the university’s emphasis on transdisciplinary education. (MPOC1)

- The biotechnology training and application to agriculture and medicine are key strengths of the program, and strategies are to introduce applied biotechnology (e.g. CRISPR/Cas9, genomic health data sets), bioinformatics (e.g. UNIX command) into the curriculum to support student trajectories beyond graduation from the program.
- Apply for an undergraduate training grant that leverages the program's excellent culture and infrastructure for undergraduate research. (II1, MPOC1)
- Develop University Scholars Programs that allow AMBT students to feed into other graduate and professional programs.
- Evaluate opportunities with in-state industry and partner institutions to identify paths for graduating students to advance their careers within the Commonwealth of Kentucky. (II2)
- Leverage the robust and high achieving AMBT alumni network for student mentorship opportunities and philanthropic outreach.
- Work with the UK Office of Philanthropy to identify a significant donation to endow the program.
- Emphasize Michael Goodin's legacy in the AMBT program, potentially by securing funds for a graduate assistantship or distinguished speaker series in his name. (MPOC3, MPOC4)

Committee Recommendations

1. Add a second staff academic coordinator for AMBT students and investigate opportunities for an AMBT office suite to clarify where students can access advisors and program leadership, and enhance program visibility and branding. The AMBT program shall work with the CAFE Office of Diversity to ensure equitable search practices in identifying and interviewing candidates for this position. (SF2, SF4, OP2, OP4, MPOC1)
2. Identify opportunities to increase TA lines for ABT Courses. (SF2, SF4, OP2)
3. Develop an Industry Advisory Board for AMBT Program to increase visibility among potential research mentors campus-wide and among private industry partners. (SF2, SF4, OP2, OP3, OP4, II1)
4. Develop an Alumni network organization for mentorship and professional development of current students (could work with ABT club). (SF1, SF2, SF4, OP2, OP3, OP4)
5. Develop University Scholars Programs with appropriate UK graduate programs. (SF2, SF4, OP2, OP3)

6. Codify articulation agreements and course alignments—and investigate Academic Common Market considerations—to enhance Farm to Pharm Program. (SF2, SF4, OP2, OP3, OP4)
7. Request college support to seek outside funding (philanthropic and governmental) for undergraduate education and research initiatives. Consider development of an external advisory board for establishment of undergraduate training program grants. (SF2, SF4, OP2, OP3, OP4, II1)
8. Host an annual advisor meeting to update advisors with current curricular and process details, make advisors aware of changes in scheduling, provide FAQ information, and provide professional development opportunities for advisors (including identification of mental health support resources for students and employees). (SF1, SF2, SF3, OP1, OP2, OP3, MPOC3)
9. Coordinate an annual all AMBT faculty and staff workshop/retreat to do the following (UK Strategic Plan all SF goals)(not necessarily in the same year):
 - a. Update and assess consistency of course assessments and learning outcomes across ABT courses and sections. (SF2, OP2)
 - b. Codify a standardized process for students to find research mentors early in the curriculum, and provide lab tours (maybe as part of ABT 101/201). (SF2, SF4, OP2)
 - c. Identify ways to incorporate quantitative skills and modern biotechnology techniques and applications in the curriculum. (SF2, SF4, OP2)
 - d. Develop opportunities for upper-division students to do peer-mentoring and lab instruction for credit. (SF2, SF4, OP2)
 - e. Provide information for professional development opportunities in mental health support and DE&I dimensions. Collaborate with CAFE Office of Diversity for training materials and resources. (SF2, SF3, OP1, OP2, MPOC1, MPOC3)
 - f. Identify and implement mechanisms to enhance support and academic development of underprepared students. (SF1, SF4, OP1, OP2)
10. Work with college administration to identify opportunities for including additional teaching lab spaces in new buildings where possible. (SF2, SF4, OP2, II3)

Opportunities for college leadership consideration outside the purview of a single academic program.

The College of Agriculture, Food and Environment is in a strong position to clarify and communicate support of university and state goals through methods used within multidisciplinary programs of the college, of which AMBT is an exceptional example. The

following are provided as potential talking points that may be useful in communication around AMBT impact on priorities expressed in university strategic planning, economic impact state-wide, and Quality Enhancement Plan reporting to the Southern Association of Colleges and Schools Commission on Colleges.

Values of trans-disciplinary education

The most pressing problems facing the world today involve food and water availability, sustainable energy, population health, environmental degradation, and climate change. These are all trans-disciplinary problems, and solutions must be crafted at the intersection of disciplines. The AMBT Program embodies a trans-disciplinary approach to education and problem solving. The involvement of faculty from multiple departments and colleges, partnerships with stakeholders in industry, and the integration of curriculum and research, exemplify a well-designed and successful approach to trans-disciplinary education.

High-impact educational practices

The AMBT curriculum specifically integrates high impact educational practices, including instruction in science process skills and literacy, and student research. Participation in research has been shown to improve students' academic performance and persistence to graduation, give them a greater sense of integration into the academic community, and raise the likelihood of enrollment in graduate and professional school. Early integration into the academic community—"becoming a scientist"—is a strong predictor of student success. Research mentors of AMBT students all commented favorably on how AMBT students entering their laboratory programs already thought like scientists, and were therefore well prepared for scientific research.

Research opportunities, an engaging and socially-relevant curriculum, and social/mentoring support have been identified as critical factors for recruiting and retaining minority students in STEM. With its focus on building a strong academic community, early involvement in research, student research that addresses socially-relevant problems, and the increased mentoring that comes with participation in a mentored research project, the AMBT program already has the infrastructure needed to attract and retain minority students. With the addition of thoughtful social mentoring and appropriate academic support, the established practices of the AMBT program will result in highly successful graduation rates of underrepresented minority students, and the program is positioned to be very competitive for external education grants.