EASTERN ILLINOIS UNIVERSITY *report summary form updated: 1/26/2022*

Eight-Year Program Review IBHE Report Summary: see attached Resources page

PROGRAM REVIEW REPORT SUMMARY

1. Eastern Illinois University

2. M.S. Chemistry

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5. OVERVIEW

EIU's MS program seeks to further expand student's knowledge across the major subdisciplines in the field, and, for thesis-based students, develop their research skills in pursuing and defending a research project. The program prepares students for employment in the chemical field, either directly or after completion of a PhD program, and the thesis option consists of four core 3-credit courses, three 1-credit courses (intro to research, critical reading, and seminar), and two elective lecture courses. In IL, EIU is 1 of only 15 schools to grant MS degrees in chemistry, and 1 of 5 without also offering a PhD program. The overall number of MS degrees in the USA conferred has remained relatively constant in past twenty years (2,098 in 1998 vs 2,310 in 2023). Less than 10% of students entering EIU's MS program do not successfully complete the degree. Of the 33 matriculates in the thesis-based program over this period, 70% were international students where EIU was their first US institution of higher learning, and another 15% were EIU undergraduate matriculates. It should be noted that 6 MS Biology students were mentored by chem faculty, but they were not included in these results. Currently 57% of tenure/tenure track faculty have major external grants, with a total of 15 grants awarded for over $1.6 million during this review period. Over 50% of the faculty have received a College, Graduate School, or University award for their research mentorship, and 78% of the matriculates presented their research at least once, with 64% were listed as an author on a peer-reviewed article. Of the 13 tenure/tenure-track faculty active in Fall 2016, 5 retired and 3 left; these were replaced by 3 hires (one of which left after 2 years). Currently 2 subdisciplines (analytical and physical) have only 1 faculty member, but at least now all 5 areas are covered. Student learning objectives include (1) mastery of fundamental principles at an advanced level in selected areas of chemistry; (2) critically analyzing a breadth of chemical problems and experimental results; (3) communicating scientific material effectively in speaking and writing; (4) conducting original research; (5) properly utilizing chemical information and database sources; and (6) understanding and following professional ethics guidelines in the field. Significant changes in the program include development of a non-thesis MS option, inclusion of an ethics goal, and admission of exit surveys. The program continued to have difficulty with filling all graduate assistantship positions, due to visa issues. It is important to realize that, in the field of chemistry, and especially for international students, students can only pursue the degree if they have financial support in the form of a graduate assistantship. Future plans for the degree include further revision of the non-thesis program to allow (1) completion totally online, and (2) entrance and successful completion by students with a chemical background but not necessarily a chemistry degree.

6. MAJOR FINDINGS AND RECOMMENDATIONS

a. Description and assessment of any major changes in the program:

(1) changes in the overall discipline or field

The field of chemistry continues to become more interdisciplinary and merging into other disciplines, with increases in chemical physics, chemical biology, and computational chemistry, as well as deeper specializations, as evidenced by over 13 new ACS journals on applied/technical subjects. Additional changes include the increased number of open-access journals, use of AI and technology in all aspects, increased regulations and consolidation within the chemistry industry. Offering of more specialized MS degrees, as well as certificate programs, are also on the rise.

(2) student demand

International student demand remains high, as the number of applicants has always exceeded the number of GAs available. Unfortunately, for the past 4 years not all GA positions were eventually filled, as accepted students either did not get a visa appointment in time or were not granted a visa after the interview. While Sri Lankans / Indians remain the largest and most consistent contingent (50%), recently Africans have become an important source (14% total, but 57% of the students in the last 2 years). Our Dept has had occasional female students from the Kingdom of Saudi Arabia, who come with financial support of their government; 2 students did this in this review period, but only 1 stayed to completion.

Domestic student demand remains low, and they made up only 25% of the total student population. This is in part due to the fact that BS matriculates can go directly into a PhD program (without needing a MS degree first), as well as the leveling off in the distinction between BS and MS chemistry in industry after the first few years. Most of the domestic students enter the program since they either wish to pursue teaching at a community college, to seek a degree beyond the BS but not willing to commit to the time and demand of a PhD program, to continue their participation on the research project they were working on as an undergraduate, or simply because they didn't have other concrete plans.

(3) societal needs

With the increased number of HS graduates first going to a community college, the need for chemistry instructors remains high and therefore this is one prominent need for MS graduates. Additionally the US training received through the program is essential for international students to eventually accomplish their desire to complete a PhD degree and/or become employed in the US in chemistry. Finally, given the highly competitive nature of securing an industry job in chemistry, the MS degree confers an edge over those applicants with only a BS degree.

(4) institutional context for offering the degree

The thesis-based MS degree is crucial to the Department, College, and University mission to continue excellence in research and graduate education as it 1 of only 32 degree programs. The chemistry department has always been one of the strongest units on campus with regard to research levels and external grants. While undergraduates do contribute here, in a large number, their courseload and extracurricular activities (athletics, RSOs, and employment) prevent them from doing more than 8 hours of research a week. Thesis MS students can devote more time, as are expected to have at least 1 full summer focusing on research. Securing external grants is essential for the department to sustain these efforts, and often it is the MS students who make more of the significant contributions. MS students also help to maintain continuity and provide maturity, role model, and assistance to the undergraduates working in research groups. MS students with GAs also assist in department efforts in supervising lab students (with supervision themselves), that is cost effective (since double sections of gen chem labs can be offered with only 1 faculty instructor instead of requiring 2 sections with 2 instructors) and allowing for a greater student experience (as a GA can help students in organic lab do one set of analysis while the faculty member leads the students individually through using instrumentation like GC/MS or NMR). The use of GAs to grade lab reports and lecture exams/quizzes, and posting grades, for 1000-level allows faculty to devote more time to their teaching, research, and service efforts. These GA experiences greatly contribute to our MS student's success in PhD programs, where they will do the same.

(5) other elements appropriate to the discipline in question

Increased focus and egregious failures have led to an increased urgency and incorporation of discussion of and training in ethical behavior in chemistry, which has been added as a learning objective in our program. Additionally an increase in online education, and degrees, has occurred. A significant internal change was the merging of the College of Sciences (11 departments) with the College of Arts and Humanities (9 departments) to give a new College of Liberal Arts and Sciences. While the new structure meant there was only 1 dean for the College, 2 associate deans were kept, one for each of the previous colleges. Overall this change has not significantly impacted the operation of or delivery of the curriculum of the Dept

b. Description of major findings and recommendations, including evidence of learning outcomes and identification of opportunities for program improvement

Of the 36 MS students, 22% presented at a national conference (with another 25% being listed as an author on a presentation) and nearly 80% presented at a least 1 EIU event. These numbers would be even higher if the covid pandemic had affected travel and conferences. 41% of the students were listed as an author on a peer-reviewed paper, with the average number of publications being 1.5 per student. It should also be noted that the influx of new faculty has energized the research output, with the 3 faculty hired since 2019 accounting for 8 (22%) of the MS students, as well as the department now having faculty in all 5 subdisciplines to mentor students.

Of the 29 matriculates, 14 went on to a PhD program (with only 1 not finishing) and 11 went into the chemistry industry (the remaining 5 are unknown). EIU MS students were accepted into prestigious chemistry PhD programs, such as the University of Illinois, Indiana, Arizona, Cincinnati, Nebraska, Syracuse, Kentucky and Iowa State. Those employed included 2 as instructors (at Lakeland and EIU), 2 who went overseas (back to their home countries), and the rest to industry, some of which are well-known (Millipore Sigma, AbbVie, EMD Electronics).

The assessment data for most learning objectives were very high, with 100% achievement in the areas of learning fundamental principles, utilizing chemical information and database sources, and written and oral communication [with seminar averages of 2.4 or higher (out of 3, where 3 = exceeds expectation, 2 = acceptable, and 1 = needs improvement)]. The only assessment data points that are not as positive were certain course benchmarks related to individual students ability to critically analyze chemical problems and experimental data – only 53% met the goal in CHM 5420 Modern Organic and under 50% in CHM 5210 Bonding and Reactivity. This will be monitored going forward to see if this is a persistent problem. (Given the size of our program, we currently offer each core course once every 4 semesters, meaning these courses have only been taught twice under the review period).

An accelerated (5yr) BS/MS, and accompanying BA/MS, program was also established, both due a trend of having EIU matriculates enter our MS program, as well as an effort to increase recruitment and enrollment of chemistry majors at EIU. The program started off well, with 2 students immediately switching to the program, but unfortunately neither completed their MS degree. (One became pregnant and withdrew from the university, while the second had completed the coursework and research but had difficulties finishing their thesis). Since then, no other students have pursued this option, though 7 graduating majors did subsequently immediately enter the traditional MS program. Reasons for the low participation include that some of these students were transfer students, who would have had to declare their intentions after only their first semester at EIU and were just more focused on degree-completion, while other students did not have clear career plans in their junior year but then in their last semester decided upon further education / continuation of research in their undergraduate research group.

Currently for FA24 the department is at 8 tenure/tenure-track faculty (including the chair), with at least 1 faculty member in each of the classical 5 chemistry subdisciplines. This compares to 12 tenure/tenure-track faculty in 2016, where retirements were in part due to the state adjustment of the retirement benefits, restrictions due to the state budget crisis, and faculty wishing to be at different types of institutions. Budget issues have prevented direct 1:1 replacement for each loss.

Unfortunately one of the new faculty hired left after 2 years (we were not the right fit for him), but a replacement has been hired. There are still enough faculty to deliver the curriculum, but further reductions would make it very difficult to continue doing so.

Since 2021, the design and planning for a New Science Building, which will house the Dept of Biological Sciences in addition to the Dept of Chemistry and Biochemistry, has been underway. This is reaching final stages, with anticipated construction beginning in 2026 and completed June 2028. The building will be 3 stories, with chemistry occupying the complete 3rd floor as well as shared labs/classrooms on the other 2 floors. This building will provide modern lab spaces for both teaching and research labs, with individual research labs being maintained. Additionally external grants and start-up packages have allowed for acquisition of additional instrumentation, such as a rotating disk electrode and potentiostats, ACTstation computer servers, a kinetics UV-VIS spectrometer, and a fluorescence spectrometer with lifetime measurements capability. Additionally a research lab has been converted into a BSL-2 cell culture lab space, and another room now houses a new epifluorescence microscope for cellular imaging studies.

c. Description of actions since last review:

Institutional pressure to increase the overall enrollment in the program led first to the development of a non-thesis MS degree, in part based on the popularity of other non-science MS degrees at EIU. A hurdle to this development is the requirement of the students to take 4 more lecture courses to meet the required credit hours, against the difficulty in our department offering these courses. This was accomplished by identifying graduate or upper-level (above course number 4750) undergraduate courses in other majors that relate to the degree. Since approval of the program, 2 students have begun the program – one was an EIU BA chemistry major who wanted to pursue a MS but not do research, while the second was accepted as a MS Dietetics and saw the opportunity to graduate with two degrees. More recently additional pressure is being applied to develop a fully online non-thesis MS program.

Another area of change is modification of the assessment measures, and data collected, for the degree. To assess how well the students learned the material, the benchmark was changed from the entrance exams (which really was measuring their previous knowledge) to monitoring student grades in the core graduate courses. Additionally an ethics learning objective was established, which in implementation has the students earn the CITI responsible conduct of research certificate. Development and administering of an optional exit survey for MS students (that parallels those used for BS students) has been accomplished and will be useful in identifying success and failures from the student perspective. Moving of some faculty assessment forms to an online format, and departmental buy-in / collective pressure to complete the forms, has led to higher rates of completion and thus fuller data sets. The idea of readministering the entrance exams to students near the end of their degree had been proposed, and while this has merit, it was eventually abandoned due to difficulty in administering as students are trying to complete degree requirements.

To try and address the international visa issue, time was spent trying to identify European institutions that might be fertile recruiting grounds, and subsequently there was some reach-out to them. So far this has not yielded any recruits. Discussions with the Office of International Students, as well as the Graduate School, about the timelines were also conducted.

d. Description of actions to be taken as a result of this review, including instructional resources and practices, and curricular changes

As mentioned earlier, development of an online-only nonthesis MS program is underway, which aims to for a 12-month completion timeline. As this program will share core courses with the thesis-based MS program, it also will lead to some revision of that program, as well as some increased opportunities (as part of the program, 2 credit elective courses will be offered in the summer that thesis-based students could enroll in). Additionally the department has been asked to design the program so that undergraduates with degrees in other areas could participate, which is also leading to some revision of the BS program.

Monitoring of student achievement of benchmarks in the core courses will be followed, as well as analysis of exit survey comments and trends.

Comments from the College Dean:

The M.S. in Chemistry remains a successful program at EIU though it is currently undergoing revision to address some current challenges which are outlined below. Departmental faculty have been recognized for their work with MS students: over half of the faculty have received an award for research mentorship. Faculty were awarded a total of 15 external grants for over $1.6 million during the review period. MS students work on many of these grants and GAs also assist departmental teaching and research efforts through supervising undergraduate students as laboratory assistants. In addition, 78% of students in the program presented their research at least once and over 60% were listed as an author on a peer-reviewed article. It's worth emphasizing that over 90% of students who matriculate into the program graduate with their MS degree. However, one key challenge faced by the program is the difficulty in filling all graduate assistantship positions along with a decline in applications among domestic students. Over the last four years, many accepted international students were unsuccessful in obtaining a visa to study in the U.S. This has resulted in declining student enrollment from a high of ten students in 2021 to five in 2025. Note: six MS in Biology students were mentored by Chemistry faculty though they are not included in the official program numbers. In an effort to address the challenge in declining student numbers, the department is in the process of developing an online only non-thesis MS program. The department also established an accelerated track for BS students interested in pursuing an MS in Chemistry at EIU. The department has been active in preparing for an eventual move into a new science building alongside the Department of Biological Sciences. It is anticipated the new building will be ready for the move in 2028.

We recommend a decision of **Program in Good Standing**

VPAA Decision:

- (●) Program in good standing
- ( ) Program flagged for priority review
- ( ) Program enrollment suspended

VPAA Explanation:

40.0501 M.S. in Chemistry

The summary above indicates progress in the M.S. in Chemistry program, which is one of only 32 such master's programs in the country. The unique preparation offered by the master's program gives students an edge over the bachelor's in chemistry students as they compete for spots in doctoral programs. The program is adapting to a more interdisciplinary field of chemistry, one that is integral to many professions in technology and health. Faculty continue to win major grant funding and to provide invaluable research and teaching opportunities for master's students. The program's highly competitive graduate assistantships are not always filled because of the large percentage (80%) of international awardees who are unable to obtain their visas for study in the U.S. The program has made recruitment efforts, assessment improvements, and curricular changes like the ongoing development of a non-thesis, fully online degree. More regular and required entrance and exit surveys may be implemented for clearly capturing students' improvement in learning over the course of their study.