REVIEW OF THE M.C.E AND M.S.C.E. IN CHEMISTRY

Classification of Instruction Programs (CIP) Code: 13.1323
Chemistry Teacher Education

OVERVIEW

The **M.C.E and M.S.C.E. in Chemistry** program at Illinois State University is housed in the Department of Chemistry within the College of Arts and Sciences. The department also offers the following degrees: B.S. in Chemistry, B.S. in Biochemistry, M.S. in Chemistry. This is the first full program review for the M.S.C.E. and M.C.E. program.

The Master of Chemistry Education (M.C.E.) is a professional degree designed to improve the content and pedagogical knowledge of teachers of chemistry who do not possess a bachelor's degree in Chemistry. The Master of Chemistry Education program can be completed entirely online or as a blended program (partially online and partially on-campus).

The Master of Science in Chemistry Education (M.S.C.E.) is a professional degree designed to improve the content and pedagogical knowledge of teachers of chemistry who already possess a bachelor's degree in Chemistry. The Master of Science in Chemistry Education program can be completed entirely online or as a blended program (partially online and partially on-campus).

Both degrees, established in 2010, were designed to take current secondary chemistry teachers and to "improve both their content knowledge and pedagogical skills so that they can improve the chemistry knowledge of their students." The online nature of the programs attracts a diverse pool of teacher-students from across the US, teaching in rural, suburban, and urban areas and with varying access to resources.

Enrollment by Plan of Study, Fall Census Day, 2012-2019
M.C.E and M.S.C.E. in Chemistry, Illinois State University
First Majors Only

	2012	2013	2014	2015	2016	2017	2018	2019
M.C.E.	0	1	0	2	2	13	14	19
M.S.C.E.	1	1	2	8	6	14	16	19

Degrees Conferred by Plan of Study, Graduating Fiscal Year 2012-2019
M.C.E and M.S.C.E. in Chemistry, Illinois State University
First Majors Only

	2012	2013	2014	2015	2016	2017	2018	2019
M.C.E.	14	1	1	0	3	0	3	3
M.S.C.E.	9	0	0	0	0	1	6	5

Table notes:
Graduating Fiscal Year consists of summer, fall, and spring terms, in that order. For example, Graduating Fiscal Year 2018 consists of the following terms: summer 2017, fall 2017, and spring 2018.

EXECUTIVE SUMMARY
PROGRAM REVIEW SELF-STUDY REPORT

Program goals
The Master's in Science in Chemistry Education (M.S.C.E.) and the Master's in Chemistry Education (M.C.E.) are professional degrees designed to improve the content and pedagogical knowledge of chemistry teachers.

Students learning outcomes

Graduates of the program will have both the theoretical and practical knowledge and skills necessary to:

- learn and interpret current chemistry knowledge appropriate for the secondary school classroom.
- be conversant in the historical, philosophical, organizational, and current research issues in chemistry and science education.
- develop and improve their teaching practice for the continual education, growth, and understanding of all chemistry students.
- take leadership roles facilitating the success of other science/chemistry teachers.
- develop a series of action research projects aimed at identifying strengths and weaknesses in classroom instruction and process of continual improvement.
- assess, evaluate, and improve chemistry education in secondary schools.

Program curriculum (2018-2019)

The Master of Science in Chemistry Education (M.S.C.E.) is a professional degree designed to improve the content and pedagogical knowledge of teachers of chemistry who already possess a bachelor's degree in Chemistry. The 33-credit hour degree requires coursework in three areas: Chemistry Content (12 credit hours), Chemistry Education, and Foundational Science Education (15 credit hours). It also requires a continuing and capstone classroom project (6 credit hours). By the time of final degree awarding, a candidate must have completed three years of full-time teaching.

The Master of Chemistry Education (M.C.E.) is a professional degree designed to improve the content and pedagogical knowledge of teachers of chemistry who do not possess a bachelor's degree in Chemistry. The degree requires 33 credit hours of coursework in three areas: Chemistry Content (12 credit hours), Chemistry Education, and Foundational Science Education (15 credit hours). It also requires a continuing and capstone project (6 credit hours). By the time of final degree awarding, a candidate must have completed three years of full-time teaching.

Program delivery

The program is delivered primarily through fully online instruction.

Department faculty (Fall 2019)

21 tenure track faculty members (11 Professors, 4 Associate Professors, and 6 Assistant Professors)
6 non-tenure track faculty members (5 full-time, 1 part-time, totaling 5.30 FTE)
Undergraduate student to faculty ratio: 7 to 1
Undergraduate student to tenure-line faculty ratio: 8 to 1

Core faculty for the M.C.E and M.S.C.E includes six tenure track faculty members who teach courses within the program.

Specialized accreditation

There is no specialized accreditation, recognition, or other external approval available for the M.C.E. and M.S.C.E. degrees. However, the B.S. is accredited by the American Chemical Society.

Changes in the academic discipline, field, societal need, and program demand

This is the first program review for these degrees. There have been changes in the external factors even during the lifetime of the programs. One significant change in the professional landscape for teachers, who are the students in the M.S.C.E. and M.C.E. program, is the requirement and stricter enforcement of the requirements to teach Advanced Placement (AP) and Dual Credit courses. In many states and at many secondary institutions, to teach these courses teachers must have a Master's in the discipline or a Master's and 18 hours of graduate course work in the discipline. The M.S.C.E. and M.C.E. program often meets the needs for teachers who want to teach these courses in their schools. In addition, there continues to be more research which underscores the importance of content specific teaching knowledge (pedagogical content knowledge or specialized content knowledge) for effective instruction and improved student learning. The M.S.C.E. and M.C.E. provide teachers with this improved knowledge.

Responses to previous program review recommendations

This is the first program review for the M.S.C.E. and M.C.E. programs. The third-year program review indicated the need to increase program enrollment. While the programs fell below the IBHE-established metrics for enrollment. and graduation from 2014-2016, the enrollment has increased substantially since 2016 and is no longer below the metrics in any year. The main action taken to address enrollment issues was assignment of dedicated effort by the Director of Chemistry Education in the Department of Chemistry, which included hiring a tenure-track faculty member, Dr. Sarah Boesdorfer, to take on that role, then taking direction of the M.S.C.E. and M.C.E. programs to increase the communication with current students. Increased levels of communication and support by a faculty member with current visiting and interested students along with the students currently enrolled in the program has allowed students to successfully enroll and complete the program.

Major findings

Overall, the M.S.C.E. and M.C.E. programs have been able to help in meeting the needs of a population of in-service teachers seeking to get professional development in chemistry education. Program faculty offer courses that help students improve their teaching and advance their careers. The online nature of the courses makes it possible to for the students to incorporate classes into their busy schedules and take the courses from wherever they are in the world. The Full Cost Recovery (FCR) nature of these courses makes them incredibly valuable sources of revenue for the Department and Provost, which helps to support other on-campus programs.

Despite the success and benefits of these programs to the department, the programs continue to struggle in gaining a foothold within the traditional hallows of the academic building. Online education in a laboratory-based discipline remains a challenge. For many of the department faculty, teaching online courses falls outside of their comfort zone. This has led to fewer course offerings than they would like and reliance on external faculty, not familiar with the culture of Illinois State University and sometimes not as invested in the institutional reputation. The online chemistry sub-discipline content course offerings must expand, though, if the program is to thrive.

The program also relies on a single instructor for action research capstone project supervision, with some dependence on The School of Teaching and Learning. For the programs to continue to grow, this will have to change. The program will need more faculty for that portion of the program, either internally or as extra supervisors. As with all graduate courses, the content of the courses also needs to be revisited to incorporate the current literature – such a change is more of a challenge in an online course where the courses often must be completely designed and deployed early in the semester to allow the asynchronous learning students have enjoyed so far. Alignment of the courses with Next Generation Science Standards (NGSS) will also be valuable for many enrolled in-service teachers.

Financially, these programs are different from the department's traditional M.S. program (and most science graduate programs) in that students pay to be in these programs (instead of being paid to be in the programs in exchange for teaching/research). These programs are self-sufficient, then, financially, but there is a burden on the students in the program to pay tuition and fees. Certainly, some receive assistance from their employer, but an option to be able to better support tuition waiver requests or provide scholarships for these teachers is an opportunity for improvement.

Initiatives and plans

With the growing number of students, the program needs to continue to increase course offerings, specifically in the chemistry sub-disciplinary content category. More offerings will help provide more choice and flexibility to students in the program and reduce course sizes. Professional development for faculty in online instruction would allow more to feel comfortable participating. Creation of a scholarship for the students in this program would also be a possibility in the current Redbirds Rising campaign or a future campaign, which would align well with the history of the institution. Each of these represents concrete action items that could be envisioned for the next program review cycle.

PROGRAM REVIEW OUTCOME AND RECOMMENDATIONS FROM THE ACADEMIC PLANNING COMMITTEE

Review Outcome: The Academic Planning Committee, as a result of this review process, finds the M.C.E., M.S.C.E. in Chemical Education to be in Good Standing.

The Academic Planning Committee thanks the program for a comprehensive and critical self-study report that included stakeholder input over a period of three semesters. The M.C.E., M.S.C.E. in Chemical Education program was designed to provide opportunities for full-time chemistry teachers to improve both their content knowledge and pedagogical skills so that they can improve the chemistry knowledge of their students. The two degrees differ in the level of preparation of the incoming students/chemistry teachers and in their requirements across the coursework areas of chemistry content, chemistry education, and science education. The M.C.E. degree was designed for chemistry teachers who do not possess a bachelor's degree in chemistry, whereas the M.S.C.E. degree was designed for chemistry teachers who possess a bachelor's degree in chemistry. The curriculum is delivered by faculty members who collaborate to provide foundational courses, specialized courses, and field experiences, as well as supervise action research projects that serve as students' culminating experiences. The committee commends the program faculty for offering one of the only programs in the country to provide graduate-level, online education specifically focused on chemistry education and serves as an aspirational program for other institutions.

The committee congratulates the faculty and staff on the growth of their program enrollment during the period of review. We note that the program is currently working at capacity and further growth may be dependent on increased departmental faculty involvement. The committee supports faculty efforts to explore further expansion of program enrollment during the next program review cycle. We commend the development and use of the recruitment strategies identified in the self-study report that the program has begun using. The committee encourages the program to continue refining and implementing their plan for student recruitment, including in the plan strategies for increasing enrollment by students from racial and ethnic groups traditionally underrepresented in the program and discipline.

The committee commends the program faculty on the development and implementation of their plan for the assessment of student learning outcomes. The degree to which those processes are embedded in the program is particularly noteworthy. The student learning outcomes assessment plan provides for collecting and evaluating student assignments with rubrics, gathering student and alumni feedback through surveys, and using all of this information for curricular and program review. The self-study report provides ample evidence that evaluation and assessment findings continue to be used by faculty to determine and implement program modifications.

The committee commends faculty members of the Department of Chemistry for their contributions to the M.C.E., M.S.C.E. in Chemical Education program. All tenure track faculty members in the Department of Chemistry either are graduate faculty members or, at the time of the self-study report, had applied for graduate faculty membership. Accordingly, all tenure track faculty members teach graduate courses, supervise and advise graduate students, and serve on thesis committees. Faculty members are active researchers who publish in international, peer-reviewed journals, often with students as co-authors.

Recommendations.

The Academic Planning Committee thanks faculty and staff of the M.C.E., M.S.C.E. in Chemical Education program for the opportunity to provide input regarding advanced chemistry educator preparation at Illinois State University through consideration of the submitted self-study report. The following committee recommendations to be addressed within the next regularly scheduled review cycle are provided in a spirit of collaboration with

Chemical Education faculty and staff. In the next program review self-study report, tentatively due October 1, 2027, the committee asks the program to describe actions taken and results achieved for each recommendation.

Continue to monitor enrollment trends and refine the plan for recruitment and enrollment growth. The self-study report states that enrolling female students and students who self-identify as persons of color continues to be a challenge for postsecondary chemistry programs across the nation, including the program at Illinois State. In light of the Illinois State Board of Education's (ISBE) concerns related to statewide teacher shortages, the committee encourages faculty to continue to actively evaluate the program's recruitment plans to ensure that Illinois State University is meeting the needs of both the program and the State. The committee encourages the program to continue to develop and implement a plan for student recruitment, including in the plan strategies for recruiting for diversity across multiple dimensions (including, but not limited to, gender and race/ethnicity) and to maintain a climate of inclusion for all students.

Increase coordination with Milner Library. The self-study report notes the challenges faced by program and library faculty to maintain access to journals and databases most needed for teaching and research in the department. We recommend working with the department's subject liaison librarian to examine and evaluate Milner Library's journals and monograph collection related to chemistry education to aid in both the selection and deselection processes of these sources. We also recommend working with your subject librarian to develop tiered information fluency learning outcomes for the program, align those outcomes to the curriculum, and integrate those outcomes into the student learning outcomes assessment plan for the program. The committee further encourages program and library faculty to continue investigating alternative library resource funding strategies and resource delivery options, including, but not limited to, enhancing resource sharing across universities in the state, expanding per-use subscription services such as *Get It Now*, incorporating funding for library resources in research grant proposals, and seeking contributions to library funds by external entities (e.g., corporate partners).

Continue to refine a plan for alumni tracking and engagement. The committee encourages the program faculty to continue to refine their plan for tracking program alumni and use the system to enhance alumni networking. These activities may become even more important in the years ahead as the program's alumni become more diverse. The program could benefit from increased involvement of its alumni in providing input regarding the program. To help further develop alumni relations, the committee recommends that the department investigate establishing an alumni advisory board. Such a board could provide input regarding curriculum design and student learning outcomes assessment, help students establish networks in the discipline and compete for jobs, guide the program and department with solicitation of external funding to support equipment and library resource purchases, and assist the department with student recruitment, retention, and success efforts.

Continue to focus on diversity, inclusion, and equity. As indicated in the self-study report, the committee encourages the program to pursue its goals related to further developing a diverse, inclusive, and equitable environment that effectively supports students, faculty, and staff from diverse backgrounds.

Continue implementing and refining the student learning outcomes assessment plan. The committee encourages faculty to continue its implementation of the student learning outcomes assessment plan for the program during the next program review cycle, to continue to utilize information gathered through plan implementation to make program revisions as necessary, and to document how that has been done. The committee encourages faculty to periodically evaluate the effectiveness of the plan in assessing student learning to identify any modifications to the plan faculty may deem necessary.