

**MASSACHUSETTS MARITIME ACADEMY
SCIENCE AND MATHEMATICS DEPARTMENT
EXTERNAL REVIEW 2014**

External Reviewer:

Dr. Kathy Olszewski
Science Department Chair and Professor of Chemistry
State University of New York Maritime College
6 Pennyfield Avenue
Bronx, NY, 10465
718-409-7375
kolszewski@sunymaritime.edu

Site Visit to Massachusetts Maritime Academy:

Date: March 10, 2014

Meetings:

- Captain Brad Lima, Dean and Vice President of Academic Affairs
- All chemistry, physics and mathematics faculty
- Dr. Amanda Woods, Science and Mathematics Department Chair
- Ms. Carla Troupe Laboratory Technician
- Ms. Kate McLaren, Director of Institutional Effectiveness
- Cadets majoring in MSEP, MT, ME, and Energy Systems, including a transfer student and both in and out-of-state students.

Massachusetts Maritime Academy (MMA) is in the midst of a major and rapid expansion. The amount of construction around campus to increase the occupancy of the dorms, the quantity and size of classrooms and also the number of faculty offices is a result of increased enrollment at the Academy. Equally important to the increase in enrollment and building occupancy is the substantial increase in the number and diversity of academic degrees offered and the quality of students attracted to these programs. The Science and Mathematics Department at MMA is doing an excellent job providing a college-level general education in the fields of natural science and mathematics as well as supporting the Academy's major and minor academic programs. Recommendations contained within this report are being made to support the growth the Academy is undergoing.

Assessment

The Departmental Self-Study responses to Standards Four and Five of the NEASC Standards for accreditation were thorough. However, more documentation is likely needed in order to fully comply with what NEASC is asking for in the Assessment of Student Learning section (4.48-4.54).

Learning Outcomes for the Science and Mathematics Department, as well as for all of the courses offered within this department, have been established and are appropriate. Each course syllabus contains the expected Learning Outcomes for the course. MMA hired a Director of Institutional Effectiveness and established a campus-wide assessment committee. Three members of the Science and Mathematics Department serve on this committee. The few course

assessments which were done, were done well. The faculty mapped questions on an exam to the course Learning Outcomes and analyzed how many students met each Learning Outcome.

- Chemistry I – data was collected and analyzed from pre-tests and post-tests given in Fall 2009, Fall 2010 and Fall 2013. Questions on the exams were mapped to the Course Learning Outcomes. In Fall 2009, the gain of understanding of all the Learning Outcomes was determined. A change was made for the purpose of increasing students' understanding of one of the Learning Outcomes and the change in gain of understanding was measured.
- Physics I – a nice analysis was done using the Force Concept Inventory as a pre-test and post-test in Fall 2012 and Fall 2013. However, the analysis was done on only one professor's students and how well students met the Learning Outcomes was only addressed for 9/14 Learning Outcomes. Analysis was not done on the Learning Outcomes which are associated with laboratory activities.
- Physics III – two separate assessments were done by two separate faculty members. Both used questions on the final exams from 2011-2013 which were mapped to Learning Outcomes and students' ability to meet the Learning Outcomes was analyzed.
- Algebra and Trigonometry – a nice analysis of Fall 2010 and Fall 2012 was done using questions on electronic assignments which were mapped to the Course Learning Outcomes. Likewise, how well students did in Calculus I compared with their success in Algebra and Trigonometry, was analyzed. A substantially higher percentage of students met the Learning Outcomes in 2012 when compared with the 2010 data, but no mention was made of changes made which may have produced this result.

The hiring of a Director of Institutional Assessment in 2012, assembling an assessment committee also in 2012, and listing Learning Outcomes for every course show progress towards meeting Standard 4.48. It is admirable that even though the Science and Mathematics department is not a degree-granting department, it still engages in both internal and external reviews every five years (supports Standard 4.52). The Science and Mathematics Department provides a specialized sequence of classes for each major which supports both the student's general education and foundation for his/her upper division classes (supports Standard 4.53). Course evaluations are done by students in all classes taught by non-tenured professors and in some taught by tenured professors (supports Standard 4.54).

Recommendations:

In order to comply with NEASC Standards 4.49 and 4.51, students' ability to meet the Learning Outcomes in all courses offered within the Science and Mathematics Department should be assessed. Questions on final exams or electronic assignments should be mapped to Learning Outcomes and students' ability to meet each Learning Outcome should be analyzed. Ideally, the questions used for assessment should be part of a graded assignment or exam so the students answer them to their best ability. Each course assessment sample should include students from multiple instructor's sections, however, a sample (i.e. every 2nd student alphabetically) could be used and the data could further be broken down by section/instructor. There should be a schedule in place so that courses get assessed on a rotating basis. Changes should be made to courses for the purpose of increasing student learning and the effect of those changes should be noted in the next assessment. The completed course assessments should be housed with the

Program Areas Chairs and they should maintain both the schedule of when courses are due for assessment as well as when they were completed.

As the program and institutional assessment plans at MMA are finalized, Science and Mathematics faculty should work with faculty in the departments housing the majors to determine how their courses support the expected Learning Outcomes at the program level. Faculty should work with the Director of Institutional Effectiveness to determine how their courses support the Massachusetts General Education and MMA Institutional Learning Outcomes.

It is recognized that assessment requires resources and direction provided by the administration as well as extra work from every faculty member. Without buy-in from all parties, the cyclic task of doing course and program assessments, making changes based on the results and re-assessing is difficult to accomplish. Additionally, training and guidance will be needed for faculty who are not comfortable with assessment.

Faculty

All Science and Mathematics Department Faculty have excellent qualifications and track records of accomplishments. All full-time faculty members have a doctorate (except one) and are hired on tenure-track lines. Currently there is only one adjunct instructor needed to assist with changing staffing needs. The administration is supportive of hiring tenure track faculty to support the increase in enrollment. More than half of the faculty members in the Science and Mathematics department have been hired within the last five years; there is a lot of new energy and ideas associated with these new members. The administration rightly considers “teaching effectiveness” as the most important criteria for tenure decisions. The Science and Mathematics faculty appear to be engaged in the success of the college and its students. They participate in faculty governance and student retention via tutoring in the Learning Resource Center and as Athletic Liaisons and Advisors. Students are extremely pleased with the professors they have had in the Science and Mathematics Department. The students who were interviewed unanimously stated that the teachers loved the subjects they were teaching and it showed. Professors are available for extra help and will go out of their way to make themselves available to their students.

The introduction of Program Area Chairs was an excellent idea for the multidisciplinary Science and Mathematics Department. As indicated on the list of Responsibilities of the Program Area Chair, they should take the lead on assessment for their discipline. Although the Program Area Chairs are also tagged with the responsibility of mentoring new hires and adjunct instructors, many/all members of the department are willing to share their syllabi, old exams/quizzes and knowledge with new faculty members. Typically new hires work directly with someone in their field that has taught the class they are scheduled to teach. The department is very open and helpful with new hires. There is a system in place for providing feedback to non-tenured faculty members based on class observations. The Department Chair sits in on one class for all non-tenured faculty each semester until tenure is achieved. Throughout the tenure process other faculty visit classes taught by non-tenured faculty. The Chemistry Faculty have a nice way of slowly introducing new faculty to the courses; new faculty begin with a course load of

exclusively Chemistry I in the Fall followed by exclusively Chemistry II in the Spring and then they are integrated into the remaining chemistry classes in following years.

Faculty in the Science and Mathematics Department have both impressive and diverse backgrounds which should be made use of as the course offerings are expanded.

- Dr. Raymond Lam has a Ph.D. in Inorganic and Materials Chemistry and thus could/should help develop and instruct Materials Science when it is offered beginning in Spring 2015.
- Dr. Lori-Ann Noble has a Ph.D. in biochemistry and thus has an ideal background to develop and instruct an Organic Chemistry course, should one be offered in the future.

Additionally, there are professors with varied backgrounds who could be made use of in other departments, specifically Environmental Protection, Safety, and Emergency Management Department.

- Dr. Jason Hyatt has a Ph.D. in Physical Oceanography and thus has the ideal background to assist with curriculum review and instruction of Oceanography.
- Dr. Matthew Loomis has a Ph.D. in Earth Science and thus has the ideal background to assist with curriculum review and instruction of Earth Science, and Physical Geology among other classes.
- Dr. Lori-Ann Noble has a Ph.D. in biochemistry and thus the necessary background to assist with curriculum review and instruction in biology.

Faculty teaching Science classes are distributed over three departments. Faculty who teach Chemistry and Physics classes are in the Science and Mathematics Department. Faculty who teach Biology, Oceanography, and Geology classes are in the EPSEM Department. Faculty who teach Meteorology are in the Marine Transportations Department. Although the faculty in the Science and Mathematics Department are accepting of this unusual division, uniting the sciences into one department may provide multiple instructors for classes such as oceanography and geology as well as opportunities for qualified instructors to teach different classes. Also having multiple faculty involved in the development, assessment, and teaching of courses is likely to result in more standard and better course offerings. No recommendation is being made other than to be aware of the advantages of uniting science faculty if restructuring is considered in the future.

Support Staff –

Ms. Carla Troupe is working as the Laboratory Technician in both the Science and Mathematics Department and EPSEM Department. Her responsibilities have increased as the number of students, and thus lab sections, have increased. She is very knowledgeable, and energetic as well as interested in the success and safety of the laboratory students.

She is conscientious about proper safety procedures and waste disposal. She insures that all recommended safety equipment is functional and available for student use. There was some concern over the lack of response from the College Safety Officer to members of the Science and Mathematics Department however this situation has improved now that there is an online work request system in place.

Recommendations :

Ms. Troupe's responsibilities in EPSEM appear to be primarily clerical. These responsibilities should be assigned to someone else in that department so she can focus on the numerous responsibilities she has in the Science and Mathematics Department including set-up and break-down of experiments, ordering supplies, and waste disposal. Both the Academy's enrollment and the number of laboratories in the Science and Mathematics Department have increased, thus increasing her workload.

Courses -

The Science and Mathematics Department does not house a major. It exclusively provides the chemistry, mathematics and physics classes needed for the seven majors offered at MMA.

All courses have extensive syllabi including the expected Learning Outcomes, Course Requirements, textbook, contact information and detailed course outline. Some syllabi contain instructions for students with disabilities, but not all. While it is desirable to include information for students with learning disabilities on syllabi, it appears that appropriate accommodations are being provided. The Director of Disability Compliance reports that there are relatively no complaints from cadets or parents.

Appropriate science and math classes were chosen for students in each of the seven majors to both provide the backgrounds for students to achieve the Department Learning Outcomes as well to provide the scientific and mathematical foundation needed for their upper-division coursework.

- Courses are introduced based on changing needs of the other departments as evidenced by the introduction of a Probability and Statistic class in 2014 and Materials Science in 2015. The chemistry faculty also suggested a new full semester Organic Chemistry course for Emergency Management and Marine Safety/Environmental Protection majors.
- The thoroughly thought-out method of providing alternatives and support for students who place into Intermediate Algebra is commendable. The elimination of this remedial class is appropriate for a college seeking to improve the quality of students it admits. Three nicely laid out options are available for students who test into Intermediate Algebra:
 1. Take intermediate Algebra before the start of the freshmen year. This can be done at MMA or elsewhere.
 2. Take an online remedial class through ALEKS.
 3. Take a reduced course-load the first semester and work with a tutor in the Academic Resource Center for at least six hours a week.

The support given by both the administration and faculty is impressive. Although extra tutors were hired specifically to work with students who required mathematics tutoring in the Academic Resource Center, students claim that there were not enough tutors available and the ratio of tutors to students was not sufficient at peak times.

Considering that the percentage of students passing Algebra and Trigonometry who received tutoring (76.4%) was substantially less than the percent of those who passed ALEKS (94.9%) in Fall 2013, consideration should be given to changing option 3 to three hours of tutoring per week plus successful completing of ALEKS with a requirement of a somewhat higher passing rate than the currently required mastery of 119 concepts. The Academy's

Admission Department should emphasize that all students who place into Intermediate Algebra are expected to complete a summer class prior to beginning at MMA so that option 3 is needed only in special situations.

Recommendations:

The listing of Academic Courses should include:

- The number of contact hours per class. This documentation would support the fact that indeed Standard 4.34 is being met and the credit awarded per class/lab appropriately reflects the level and amount of student learning. Some syllabi do include class meeting hours whereas others do not.
- The semesters in which courses are offered, for those courses not offered every semester (i.e. Fall only or Fall odd years only). This would help students who are off-track plan their graduation path. This is especially important for classes like Calculus III and Engineering Mathematics Electives which are offered every other year.

All sections of a given standard freshmen or sophomore math or science class should contain the same content, and be taught at the same level. One method of achieving this is to have a Lead Instructor for each multi-section course and assign him/her with the responsibility of choosing a textbook, establishing a standard syllabi and arranging a common final exam or a set of questions for the final exam which will be common for all versions. Minor modifications may be made by individual instructors but this would ensure a standard course backbone and that each MMA student completing foundation mathematics and science classes have had the same learning experience. While a system similar to that mentioned is utilized in some classes, it is not in others.

The development of non-license majors, the seeking of ABET accreditation and the increased student enrollment imply that the quality of the incoming student to the Academy is increasing. More students may wish to pursue graduate degrees than before and more transfers may be seeking admission to the Academy. For these reasons it may become increasingly important that lower-division science and math classes be comparable in credits and content to those offered elsewhere. The chart below compares the credits in classes at MMA with 2 local community colleges. MMA has articulations with these colleges and has determined the equivalency for their own classes in the articulation agreements. SUNY Maritime College is also mentioned for reference.

Class	MMA Credits	Bristol CC Credits	Cape Cod CC Credits	SUNY Maritime Credits
SM-1131 Chemistry I	3.5	4	4	4
SM-1232 Chemistry II	3.5	4	4	4
SM-1111 Algebra/Trigonometry	3		4	4
SM-1212 Calculus I	3	4		4
SM-2113 Calculus II	3	4		4
SM-6115 Calculus III	3	4		4
SM-212 Engineering Physics I	3.5	4		4*
SM-2224 Engineering Physics II	3.5	4		4*
SM-2127 Survey of Physics	3.5		4	NA

* there is a one credit additional physics lab course. Only Physics I, II and physics lab are required for engineering students.

As the chart alludes to, most colleges/universities offer freshmen and sophomore math, physics and chemistry classes at 4 credits each while MMA does not.

- Students feel that the Academy's focus is on the license students (MT and ME) and that the workload in other majors should be ratcheted up.

The placement method (Accuplacer) used to place students in Algebra and Trigonometry should be investigated. Additionally, the level at which course is being taught and the minimum grade required to pass the class should also be investigated.

- Based on data provided on the "Algebra and Trigonometry Pass Rates Incoming Freshmen Fall 2013", 333 of the entering freshmen (roughly 400) had to take Algebra and Trigonometry. Out of this large percentage, 95% were successful in the class. This extremely high pass rate indicates that the class was too easy for a large percentage of the students placed into this class.
 - Students likewise expressed that it is difficult to place directly into Calculus I but that Algebra and Trigonometry was too easy and therefore they should not have been placed in it.
 - There is concern from faculty that the level of the Algebra and Trigonometry class has been diluted in recent years, specifically this year with the elimination of Intermediate Algebra.
 - Follow-up analysis was done on student success in Calculus I. However, the classes which utilize algebra more than Calculus I are Chemistry and Physics so this may not be the best indicator.

One suggestion is to administer the Accuplacer exam, or an in-house analogous version, at the conclusion of Algebra and Trigonometry as the final exam. Results which do not conform to the pass rate of the class would indicate that either a less difficult placement exam should be used, the level of the class should increase, or the minimum passing grade should increase.

Additional classes to consider:

A track for students wishing to pursue a graduate education would be optimal. This could be accomplished for students pursuing a B.S. in Marine Safety and Environmental Protection and Emergency Management by allowing them to substitute General Chemistry II and a new class, Organic Chemistry, for Organic/Hazardous Materials Chemistry. This substitution would give them two classes required for graduate degrees in biologically or chemically oriented scientific fields. The combination of the two classes would cover the material in the current class more in-depth.

A great decision was made to introduce Materials Science as an elective in 2015. Further discussion with the Engineering Department is recommended to determine if it should be added to the Energy Systems Engineering and Facilities Engineering curricula either in addition to Chemistry II or as a replacement. Materials Science is a standard class in engineering programs.

Students expressed concern over being closed out of sections of science classes which fit into their schedule and are required for their major, most notably Environmental Chemistry and science laboratory classes. When there are sections with low enrollments and the students in those sections are able to take a different section, schedule adjustments should be made to close

low-enrolled sections and open additional sections of closed classes if an additional faculty member cannot be hired.

Technology -

The college requirement that students have laptops and thus the ability for faculty to have them utilize these in lecture courses and labs is wonderful. It appears as though this is being utilized by some, but not all, Science and Mathematics Department faculty. This is evidenced by the utilization of online homework systems in courses, the use of Math CAD in Engineering Physics II, occasional use of clickers in the classroom and the use of Vernier Lab equipment in the physics labs. Both faculty and students report some frustration with the online homework systems. However, the percentage of students completing the homework assignments is high and thus the decision to use this system appears to be a good one. Additionally, the incorporation of a specific graphing calculator in mathematics classes, as evidenced by the syllabi, maximizes the opportunities for calculator instruction and use.

Resources -

Offices - Science and Mathematics faculty share offices. Although they are slightly smaller than what is desirable, the office space is sufficient as long as additional faculty members are not needed. Offices are nicely grouped together to facilitate interaction of faculty.

Laboratories - The Harrington Academic Building contains physics and chemistry laboratories which are old but functional and in reasonable shape. Adding this new spacious multi use lab with pod-style benches was a wonderful solution to scheduling issues.

Classrooms - The size of the classrooms are appropriate for course enrollment. Faculty who wish to simultaneously use the projector and the board often have a restricted amount of board space due to the projector displaying directly on the front board. However, the current set-up is ideal for faculty using exclusively either projected images or the board.

Laboratory Equipment - The administration at MMA has largely funded all requests for replacement and modernized laboratory equipment and thus the laboratories are well-equipped. Faculty state that the laboratory equipment has improved greatly over the past five years.

Recommendations:

Faculty expressed interest in doing demonstrations but are limited by the equipment they can reasonably transport from room to room. Placing a lockable cabinet in one or two classrooms used primarily by science faculty would allow for the temporary storage of demonstration equipment, and having the registrar accept requests for those rooms would facilitate the use of more demonstrations.

Items which should be considered for purchase are:

- Bottle top dispensers such as those sold by Brinkmann. While these dispensers are somewhat costly, they limit the amount of solutions students take and thus reduce the cost of chemicals and amount of waste.
- Mercury analyzer for the Environmental Chemistry Laboratory and centrifuges. While these are in working order, they are outdated.

Summary

The Science and Mathematics Department at Massachusetts Maritime Academy is staffed with qualified and dedicated faculty. The Administration is supportive of their mission and has provided them with the resources necessary to effectively educate the cadets.

Recommendations which should receive the highest level of consideration are:

1. Implement the assessment of Learning Outcomes at the course level. This documentation is likely needed in order to fully comply with what NEASC is asking for in the Assessment of Student Learning section (4.48-4.54).
Science and Mathematics faculty should also work with faculty in the departments housing the majors to determine how their courses support the expected Learning Outcomes at the program level and with the Director of Institutional Effectiveness to determine how their courses support the Massachusetts General Education and MMA Institutional Learning Outcomes.
2. Standardization and addition of some courses to ensure that graduates have the requirements to pursue graduate degrees. Due to the increase in enrollment, the addition of non-license programs, and the rise in quality of students, it is likely this will become increasingly desirable.