

Assessment Report for Academic Year 2022-2023

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Program: Masters of Science in Environmental Management (MSEM) Program: Graduate Degree

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MSEM Mission Statement

The Environmental Management Program will educate graduate students to provide management solutions to environmental problems using innovative, interdisciplinary approaches in an environmentally just manner.

There have been no changes to the Mission Statement since the last report.

The MSEM Advisory Committee is currently drafting a revised mission statement that they will bring to the department for discussion.

PLOs

1. Demonstrate an interdisciplinary approach in analysis of environmental issues and management strategies.
2. Utilize both theory and applied knowledge to evaluate and recommend management strategies for environmental issues.
3. Choose and apply appropriate tools, techniques, and (or) technologies to analyze environmental issues.
4. Skillfully communicate environmental management issues through written reports, oral, and visual presentations.

There have been no changes to the PLOs since the last report.

The MSEM Advisory Committee is currently drafting revised PLOs to reflect the current program, clarify language, and improve assessability. They will bring these revisions to the department for discussion.

Curricular Map

The curricular map for the MSEM Program shows the extent to which the current learning outcomes are covered in each course (Table 1). The focus of this year's assessment used the Masters Project course (ENVM 698) presentation files to evaluate PLO1 (highlighted in yellow

in Table 1). We also wanted to gather a baseline assessment of how much students focused on environmental justice in their Master's Project research. There are a few reasons for examining environmental justice: 1) it is an important part of the University's Mission, 2) the department may want to consider adding environmental justice to the program PLOs, so having a baseline prior to that departmental discussion would be useful for informing that discussion, and 3) if adopted as a PLO (or not) this assessment provides a baseline to examine future progress on including environmental justice in the MSEM program.

Table 1. Curricular Map for MSEM Program. I = Introduced, D = Developed, M = Mastered.

Learning outcomes/Course	Demonstrate an interdisciplinary approach in analysis of environmental issues and management strategies	Utilize both theory and applied knowledge to evaluate and recommend management strategies for environmental issues.	Choose and apply appropriate tools, techniques, and (or) technologies to analyze environmental issues.	Skillfully communicate environmental management issues through written reports, oral, and visual presentations.
Aquatic Pollution	M	M	I	M
Climate Change Mit.	D-M	D-M	D	D
Data Analysis	M	M	M	M
Ecology	I	I,D	I	I
Energy Auditing	NA	NA	D	D
Env.Eng. I + II	N/A	N/A	D	D
Environmental Chemistry	N/A	I/D	I	D
Env Economics	N/A	I	D	N/A
Environmental Health	M	D	I	D
Environmental Policy	D-M	D	I	D
Env Toxicology	M	D	D	D
Field Survey Management	I	I	D	M
GO Remediation	D	D	D	D
Hazardous Waste Mgt.	I	I	D	I
Marine Resources	D	M	I	M
Master's Project ENVM 698	M	M	M	M
Natural Resource Ec.	N/A	D	D	N/A
Quantitative Methods	N/A	N/A	D	I
Research Methods	M	D	M	D
Risk Management	D	D	D	D
Risk Assessment	M	D	D	N/A
Risk Management* AK	M	M	D	M
Stream + Riparian Eco.	D	D	D	D
Sustainability Leadership	D	D	D	D
Sustainability: The Future	D	D	D	D
Sustainable Building	D	D	D	D
Sustainable Design	M	M	D	M
Urban Resilience	D-M	D-M	D	D
Water in Env Management	I	I	D	D

Water Treatment	D	D	D	D
Wildlife Conservation	I, D	D	D	D

There have been no changes to the Curricular Map since the last report.

Assessment Schedule

The most recent Academic Program Review for the ENVS Department and the MSEM Program was in spring 2018. Table 2 shows a list of past assessments and plans for future MSEM assessments.

Table 2. Assessment schedule for MSEM Program since 2015-2016 Academic Year.

Academic year	PLOs reviewed
2015-2016	PLO 4: using Master's Project Presentations
2016-2017	PLO 2: using Master's Projects
2017-2018	Skipped this report, with permission, due to lack of a consistent GPD
2018-2019	PLO 3: using 3 introductory required courses
2019-2020	PLO 4: using Master's Project presentations
2020-2021	PLO 3: using Research Methods
2021-2022	Broad Program Assessment
2022-2023	PLO 1: using Master's Project presentation slides
2023-2024	PLO 2 (management strategies) proposed
2024-2025	PLO 4 proposed

Methodology

This year we assessed PLO 1 (*Demonstrate an interdisciplinary approach in analysis of environmental issues and management strategies*) using the visual presentation files from five sections of ENVM 698 Masters Project that were taught in Fall 2022 and Spring 2023. We also used the presentation files to assess the students' focus on environmental justice in their research. The Master's Project is the capstone of the program, where students develop and conduct individual applied research projects that lead to environmental management recommendations.

We reviewed the final presentation slides for all 34 students from five sections of Masters Project in the 2022-2023 academic year. Each student was evaluated by two faculty with the students distributed evenly between the faculty (April, n=24; Stephanie, n=23; Tom, n=23). Assessments for PLO1 were based on the rubric in Table 3 that incorporates three criteria covering different aspects of PLO 1. Table 4 shows the rubric for assessing student focus on environmental justice. We calibrated our reviews with an initial collaborative review of two proposals by all three faculty. We discussed our initial assessments of these two proposals, and clarified scoring as well as details in the rubric to calibrate and simplify scoring of the 34 proposals. We next each reviewed another two students independently and compared our results to ensure that we were reasonably consistent. After these efforts to ensure consistency, all of the students were reviewed.

Two methods are used to evaluate the reviewers' data: 1) nonparametric comparisons based on rank (Kruskall-Wallis Test), and 2) graphical comparisons to visually understand the results. These methods are used due to the data being ordinal (hence statistical methods for metric data, such as mean, standard deviation, ANOVA, etc., are not appropriate for analyzing these data).

Table 3. Rubric for PLO 1 using the final presentation slides from Masters Project.

Criteria	Exceptional (3)	Proficient (2)	Approaching Proficient (1)	Below Proficient (0)
number of disciplines	More than one discipline, significant contributions from two or more disciplines, clear use two or more disciplines in synergy	More than one discipline, contributions from two or more disciplines	more than one discipline, but dominated by just one (only touches on one or more others)	only one discipline can be found
integration of disciplines	Effective integration of information, data, and methods from two or more disciplines	Adequate integration of information, data, and/or methods from two or more disciplines	some integration of information, data, and or methods from two or more disciplines, but primarily multiple disciplines treated separately	only one discipline can be found
utilizes research methods (analysis) from multiple disciplines	Effective use of methods from multiple disciplines	Adequate use of methods from multiple disciplines	Some use of methods from different disciplines, but lacking depth, detail, or effective use of the methods	only one discipline can be found

Table 4. Rubric for assessing focus on environmental justice using the final presentation slides from Masters Project.

Outcomes	Exceptional (3)	Proficient (2)	Approaching Proficient (1)	Below Proficient (0)
Emphasis on environmental justice	There is a clear emphasis on EJ that is shown to underpin the entire research project	EJ is part of the project rationale, but doesn't connect with all parts of the project	EJ is shown to be an aspect of the research, but not an important one	There is no clear/obvious mention of EJ
Analysis of environmental justice	Exceptional use of analytical methods to assess EJ directly or to assess a topic that is then directly related to EJ (e.g., use Environmental Justice Indices)	Adequate use of methods that were applied directly to EJ issues	Some methods used, but their applicability to EJ or their implementation is weak	There is no clear/obvious mention of EJ
Environmental justice is a clear motivation for the research	Students make clear an emphasis/rationale for the research is environmental justice	Students demonstrate a clear concern for environmental justice in their research, but there is a lack of focus on EJ	Students mention EJ, but it isn't much more than that mention	There is no clear/obvious mention of EJ

Limitations and Constraints that Need to be Evaluated

As with any study, there are important limitations that need to be considered and examined. The first issue is the use of the slides from the students' presentations. Slide styles can vary from large amounts of text (where students may not verbally state much more than the text on the slide) to small amounts of text (where students verbally provide details). The slide styles are not mandated universally in the program; rather, slide styles largely depend upon the students and project instructor for a section. For the Master's Project presentation, either style can work. However, for this assessment, the evaluations come from only looking at the slides, so slides with less text will be less likely to provide the detail that would result in higher scores in evaluations. Similarly, the content structure can also vary between instructor sections, which can impact evaluations. Specifically, some instructors may expect students to provide more slides on methodology and some may emphasize recommendations/results slides. Since this assessment of PLO 1 focuses more on disciplinary methods, the slide show structure can impact evaluations. For both of these reasons, it will be useful to compare results between Masters Project sections to examine how important these potential limitations may be.

A constraint of this study is that the evaluations were done by only three faculty, whereas in past MSEM assessments, four or five faculty conducted the assessment. With fewer faculty, there could

be greater impact from a single faculty member’s evaluations on the overall results. Therefore, it is important to compare results between the different faculty to examine potential differences that could impact the results.

Results

The first part of the Results section examines the potential impacts from differing results between different Masters Project sections and between different faculty reviewers. Once an understanding of those impacts is gained, an evaluation of PLO 1 and environmental justice is made.

Effect of reviewer

The scores for each criterion were compared between the faculty reviewers using the Kruskal-Wallis test (Table 5). Using a significance level, α , of 0.05, Table 5 shows that there is no statistically significant result for any of the criteria that would indicate a difference in results between the reviewers for any indicator for either PLO1 or the Environmental Justice assessment. The criteria with lowest p-values (utilizes analysis methods from multiple disciplines, and emphasizes environmental justice) suggest that further clarification on those criteria could help reviewers improve consistency. Based on this test, variations in reviewer scoring are not significant and don’t affect the overall results of this assessment.

Table 5. Comparison of faculty reviewer results for each criterion using Kruskal-Wallis test.

<i>PLO 1</i>	p-value
number of disciplines	0.460
integration of disciplines	0.408
utilizes research methods (analysis) from multiple disciplines	0.140
<i>Environmental justice</i>	p-value
Emphasis on environmental justice	0.210
Analysis of environmental justice	0.718
Environmental justice is a clear motivation for the research	0.888

Evaluation of potential reviewer bias

One of the reviewers, Stephanie Siehr, was also an instructor for one of the Masters project sections. Therefore, it is possible that there may be some unconscious bias due to this reviewer being exposed not only to the student PowerPoint files, but also to a semester of working with her section’s students on their research. To evaluate the possibility of this bias occurring, results from her section were compared between the reviewers to see if Stephanie’s assessments of those presentation files are statistically significantly different from the other reviewers.

Table 6. Evaluation of potential reviewer bias. Comparison of faculty reviewer results for each criterion using Kruskal-Wallis test for only Stephanie Siehr’s section.

<i>PLO 1</i>	p-value
number of disciplines	0.734
integration of disciplines	0.567
utilizes research methods (analysis) from multiple	0.119

disciplines	
<i>Environmental justice</i>	p-value
Emphasis on environmental justice	0.406
Analysis of environmental justice	0.732
Environmental justice is a clear motivation for the research	0.748

Effect of Masters Project section instructor

The possibility that the Masters Project section instructor could impact the evaluations is important to evaluate. Similar to the analysis for potential effects of the reviewer, nonparametric methods are used to evaluate the possibility that the student’s instructor has an impact on the scores.

The scores for each criterion were compared between the faculty reviewers using the Kruskal-Wallis test (Table 7). Using a significance level, α , of 0.05, Table 7 shows that there is no statistically significant result for any PLO1 criteria. However, there is no necessity of using a statistical significance level of 0.05, and if a slightly larger significance level were used, there would be a significant difference for PLO1 indicator #1 (number of disciplines).

To help understand the potential differences between instructors for PLO1-number of disciplines, a comparison between instructors is shown in Figure 1. Figure 1 shows that Professor Siehr’s section has more “3” scores than the other sections. These differences could be due to the nature of the projects and the instructor that students chose to fit those topics. This difference also suggests that greater specificity of the criterion – and assessment of other artifacts, such as the live or recorded presentation, or the full research report – could bring greater depth and consistency to the assessment.

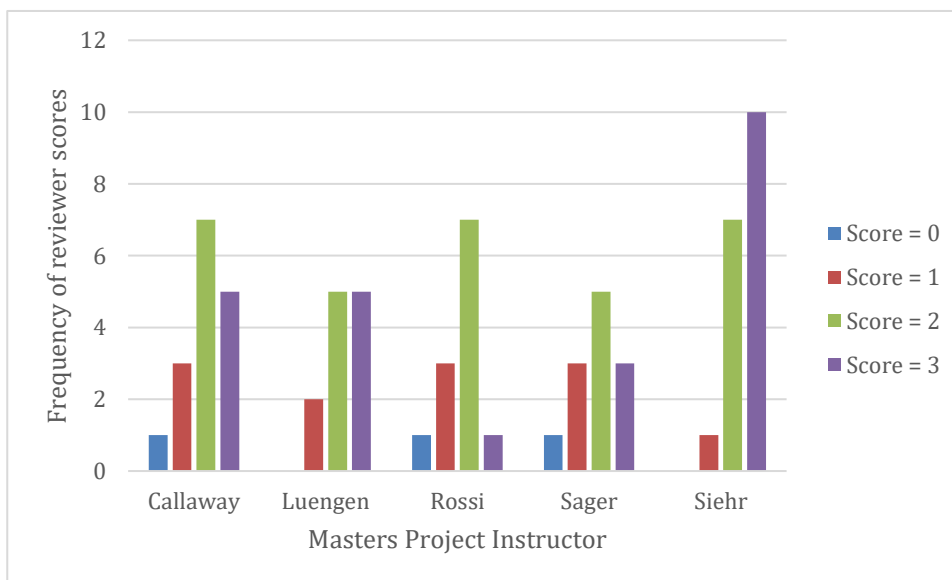
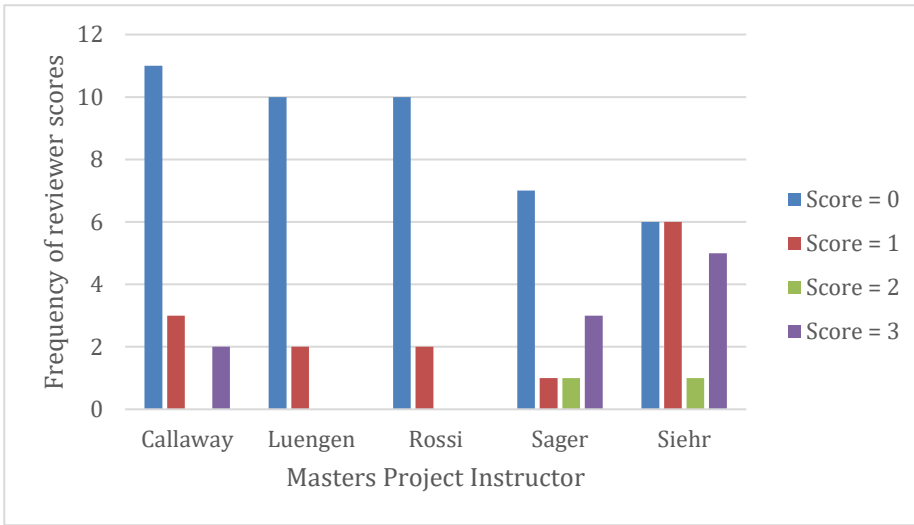
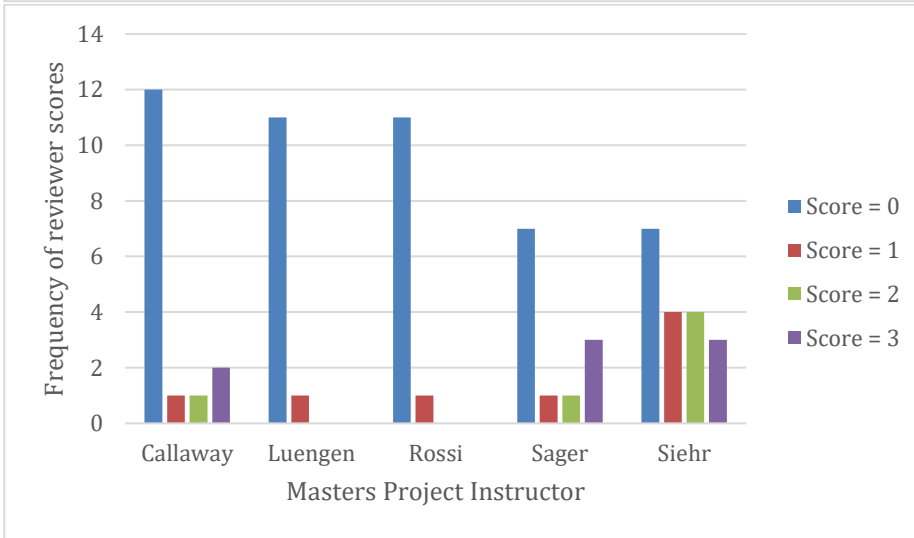


Figure 1. Comparison of scores by instructor for PLO1 criterion – number of disciplines.

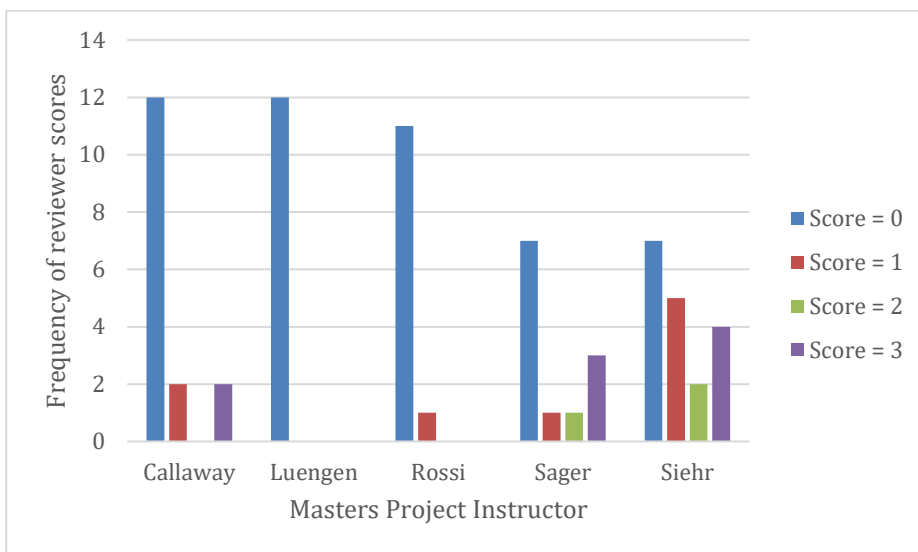
For the assessment of environmental justice in the slides, all three criteria showed a statistically significant difference based on the Masters Project instructor (Table 7). Figure 2a-c provides a visual comparison of each environmental justice criteria for the different instructors.



a)



b)



c)

Figure 2a-c. Comparison of scores by instructor for Environmental justice criteria: a) Emphasis on environmental justice, b) Analysis of environmental justice, and c) Environmental justice is a clear motivation for the research.

For each of the environmental justice criteria, Professor Siehr’s section appears to have higher scores than the other sections, especially when compared to Professor Luengen’s and Professor Rossi’s sections. These differences could be due to two different reasons: 1) different instructors explain different expectations of including environmental justice in the projects, and/or showing that in the slides, or 2) the student choice or assignment of instructor creates differential topic choices between instructors.

Table 7. Comparison of instructor results for each criterion using Kruskal-Wallis test.

<i>PLO 1</i>	p-value
number of disciplines	0.051
integration of disciplines	0.467
utilizes research methods (analysis) from multiple disciplines	0.487
<i>Environmental justice</i>	p-value
Emphasis on environmental justice	0.014
Analysis of environmental justice	0.007
Environmental justice is a clear motivation for the research	0.002

Mastery of the learning outcome, PLO1

The assessment of student performance for PLO1 is made by examining all of the reviewers’ scores for all five Masters project sections in Fall 2022 and Spring 2023. Results of the assessment of PLO1 are shown in Figure 3. For all criteria, a score of 2 (Proficient) is the most common, and a score of 3 (Exceptional) is the next most common. For criterion 1 (Number of Disciplines), 79.4% received a score of 2 or 3; 70.6% received a score of 2 or 3 for criterion 2 (Integration of Disciplines); and 69.1% received a score of 2 or 3 for criterion 3 (Utilizes Research Methods from Multiple Disciplines). For criterion 1 (Number of Disciplines), 16.2%

received a score of 1 (Approaching Proficient); 22.1% received a score of 1 (Approaching Proficient) for criterion 2 (Integration of Disciplines); and 23.5% received a score of 1 (Approaching Proficient) for criterion 3 (Utilizes Research Methods from Multiple Disciplines). For criteria 1 (Number of Disciplines), only 4.4% received a score of 0 (Below Proficient); and only 7.4% received a score of 0 (Below Proficient) for the other two criteria (Integration of Disciplines, and Utilizes Research Methods from Multiple Disciplines).

While it is concerning to have any scores of 0 and 1, it is important to recognize the limitations of this study, which likely result in lower scores for interdisciplinary work than actually existed for students' work on their projects. The reason is that this study did NOT assess the oral presentations in their entirety; this assessment only assessed the slides used on the presentations. Therefore, the additional verbal explanations could have given more evidence of interdisciplinary work, which would have resulted in higher scores (but not lower scores). Also, the presentations are necessarily short, and so the students may not have time to fully demonstrate their interdisciplinary work in the projects. A fuller assessment of both the presentations and written reports could result in higher scores (but not lower scores). Finally, the Masters Project does not necessarily require an interdisciplinary approach to result in excellent research and results. Students who do not follow an interdisciplinary approach on their Masters projects are likely to have gained interdisciplinary skills and abilities through their other program coursework, due to the design of the curriculum.

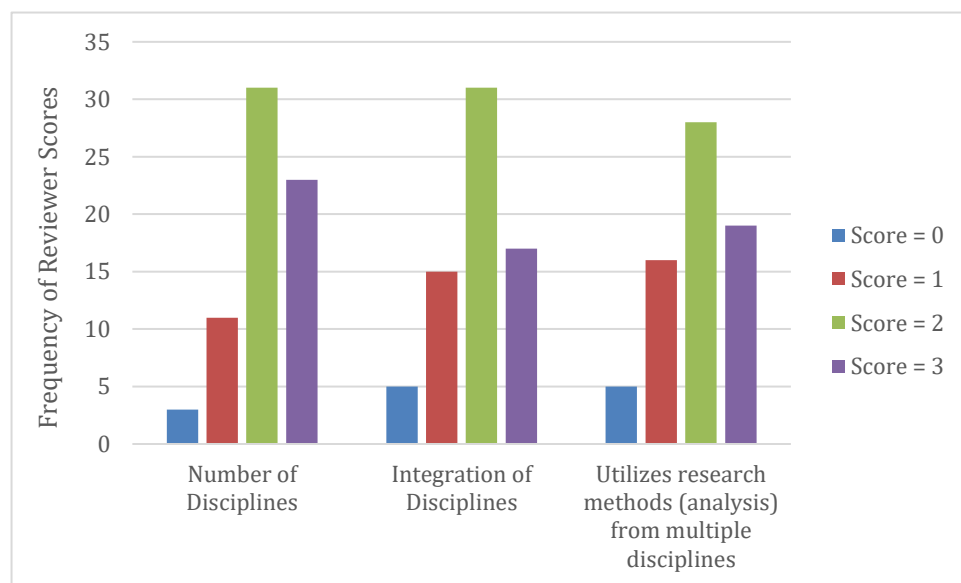


Figure 3. Score distributions for the three PLO1 criteria.

Assessment of Environmental justice in Masters Project

The assessment of how environmental justice is included in the Master's Projects was done to gain a baseline understanding of student research interests, faculty guidance, and course design. Presentation slides from all five Masters project sections in Fall 2022 and Spring 2023 were

used. Results of the assessment are shown in Figure 4. These results show clearly that almost all students were given a score of zero (Below Proficient). These results do not directly relate to existing program PLOs, but there is some thought that environmental justice could one day be brought into the PLOs. If that were to happen, and if it were expected to be seen in all Masters Projects, then changes would need to be made to the Masters Project.

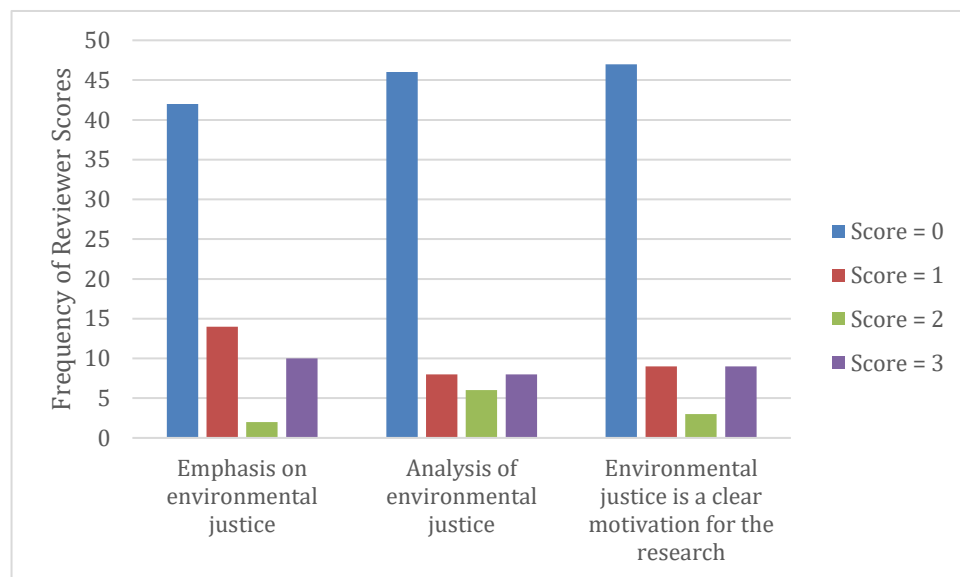


Figure 4. Score distributions for the three Environmental justice criteria.

Comparison with previous assessment

We have not previously assessed PLO1. This first effort at assessing PLO1 provides some useful insight to help inform and improve future assessments of PLO1. A challenge for assessing PLO1 is that it is truly a program outcome, and therefore is difficult to assess samples from one part of one class in the program. Instead, interdisciplinary environmental skills and knowledge, can come from the entirety of a student’s program education (all courses). Future efforts to assess PLO1 could be improved by using other types of data that look at a broader sweep through program materials. One source of information that could be used in future would be looking at and scoring student course choices that fulfill the graduation requirements (do the courses come from multiple disciplines?). Another approach would be to gather assignments that lend themselves towards interdisciplinary work from several different courses.

Discussion of Results and Plans for Improvement

Even though PLO1 is not an explicit requirement for the Master’s Project, students still demonstrated a string degree of interdisciplinary approaches in their research. 79.4% of students were Proficient or Excellent in including more than one discipline in their research, 70.6% of students were Proficient or Excellent in demonstrating an integration of multiple disciplines, 69.1% were Proficient or Excellent in using research methods from multiple disciplines. We were also interested in understanding the degree of environmental justice included in their

Master's Projects, despite environmental justice not being a MSEM PLO or a required part of the Master's Project. Even so, the assessment demonstrated that there was an interest in incorporating environmental justice as a part of some students' research.

Improvements to our understanding of PLO1 for MSEM in future assessments could be made by:

- Evaluating student course choices during their entire MSEM education
- Using PLO1 assessment sheets for professors attending student final presentations
- Asking Master's Project instructors to provide answers to questions regarding interdisciplinary work in the projects that they are grading

Since students are not explicitly asked to use multiple disciplines in their Master's Project, this scoring is as much feedback for Research Methods and Master's Project course design, as it is a reflection of student performance. In addition, PLO1 is about the whole curriculum, what courses and advising we offer, as well as particular courses. PLO1 is valuable for professional development and our program, which is confirmed by alumni and employers and other professionals. Therefore, it is important to continue to maintain and advance this aspect of the MSEM curriculum.

To increase the use of interdisciplinary research, Research Methods and Master's Project could explicitly highlight the use of mixed research methods and multiple disciplines in the courses. Examples could be provided to students in the course materials and exercises could be used to help students develop these skills. These results should lead to discussion among the faculty regarding whether the MSEM program should explicitly require multi-disciplinary analysis in the Master's Project, or whether the focus for assessing PLO1 should be on student course choices across the curriculum.

This report will be shared with the Environmental Science Department faculty, and the results will be discussed at an upcoming Department faculty meeting. The goals of the discussion are to use the assessment results to collectively evaluate ways to improve student performance on PLO1 in the future. Some possible improvements might come from modifying our assessment rubric using input from the entire department. Other improvements could come from improved source materials to evaluate PLO1 (assessment design) and more explicit preparation for interdisciplinary research in our Research Methods course (curriculum).