Institutional Effectiveness
2019-2020

Program: Environmental Informatics PSM

College and Department: College of Interdisciplinary Studies – School of Environmental Studies

Contact: Dr. Hayden Mattingly

Mission: The School of Environmental Studies (SOES) will foster in students the desire to lead purposeful professional lives through the application of scientific principles to environmental issues within the social, political, and economic framework of our society.

Professional Science Master's with a Concentration in Environmental Informatics Program: The PSM-EI program, started in Fall 2013, focuses on analytical and computer-based methods in the study and management of natural resources and the environment. The degree program provides students with a business background and concepts that are applicable across fields as diverse as sociology, public policy analysis, business, sustainable systems, and terrestrial/aquatic ecosystem management. The program provides connections to potential employers through internships and allows professionals the flexibility to earn their degree while working full-time. In 2017–2018 we received approval to offer the program fully online, while retaining the option of completing some or most courses on ground.

Program Goals:

1. Prepare students who possess the mathematical and scientific knowledge to analyze and manage spatially distributed data needed to obtain sustainable solutions for complex, real-world environmental problems.

2. Prepare students who have the business fundamentals, project management and communication skills necessary to become leaders in their chosen fields.

Student Learning Outcomes:

1.1. Students will have the ability to apply GIS and statistical tools to manage spatially distributed environmental data to aid in decision making.

1.2. Students will demonstrate the skills to understand, analyze, and interpret data independently.

2.1. Students will demonstrate the ability to integrate business management concepts with environmental information to manage environmental systems.

2.2. Students will communicate effectively in oral and written formats.

A departmentally developed curriculum map can be found in Appendix 1 that shows the connections between courses and student learning outcomes.

Assessment Methods:

1. *Internship Written Report by Student:* During the internship, students will be working in an industry, utilizing knowledge and concepts learned from the curriculum to produce deliverables, which will be presented in writing and during an oral examination. The oral examination and written report will be evaluated by the graduate student's advisory committee to assess whether the student has mastered program and concentration learning outcomes.

   The student will develop better communication skills and will be encouraged to integrate all aspects of the program's core areas (GIS, statistics, business) by writing an internship project report. The report will be evaluated by the industry employer and the student's graduate advisory committee to ensure that it meets satisfactory standards as judged by the committee.

2. *Internship Supervisor Evaluation:* Internship employers will provide a written evaluation of respective intern's performance in achieving designated deliverables.

   The evaluation of student and program performance will be aided by external industry reports on student activities during the internship. The industry supervisor evaluation will be reviewed by the student's major professor (who is also the instructor for the ESS 6910 internship course) and also by the PSM Program Director.

Results:

The 100% online option resulted in an increase in enrollment the past three academic years (Table 1), with several new students joining the PSM-EI program while working full time for government agencies such as Tennessee Department of Environment and Conservation. As of Fall 2020, 19 students are currently enrolled and a grand total of 21 students have graduated from the program (Table 1).

Table 1. Enrollment and graduation data for the PSM-Environmental Informatics degree program from 2013–2020.

Enrollment data		Graduation data	
Fall semester	Number enrolled	Academic year	Degrees conferred
2013	3	2013–2014	2
2014	5	2014–2015	0
2015	9	2015–2016	3
2016	7	2016–2017	5
2017	8	2017–2018	2
2018	13	2018–2019	4
2019	18	2019–2020	5
2020	19	2020–2021	(to be determined)

Five students completed internship projects and graduated from the PSM-EI program in 2019-2020. The titles of the internship reports are given in Table 2, along with the industry or agency that sponsored/hosted the internship project. Industry supervisor evaluations were received for all five graduating students enrolled in the capstone internship. A summary of the evaluations is provided in Table 3.

Table 2. Titles of internship reports from PSM-Environmental Informatics students who completed internship capstone projects during academic year 2019-2020.

Internship Report Title	Industry Sponsor/Host
Adventures in troubleshooting: Creating a model in ArcMap 10.5 to locate vegetated swales	Tennessee Tech University
The relationship between pilot operating handbook performance charts and aged training aircraft	Hixson Aviation
Aiding in the production of a regional guide to Iceland	Global Treks and Adventures
LiDAR data for assessing the impact of hurricanes and heavy storms	U.S. Fish and Wildlife Service
Brain drain: An analysis of human capital flight in the Cumberland Plateau	City of Cookeville, Tennessee

Table 3. Summary of industry supervisor evaluations for five PSM-Environmental Informatics students who completed their capstone internships during the 2019-2020 academic year.

Intern attribute	Number of ratings per category (out of five students)				
	Excellent	Very good	Average	Below average	Very poor
Attitude	2	3			
Initiative	5				
Maturity and poise	4	1			
Ability to learn	4	1			
Quality of work	4	1			
Quantity of work	3	2			
Dependability	3	2			
Relations with others	3	2			
Judgment	4	1			
Attendance	5				
Punctuality	5				
Overall performance	4	1			

For all the intern attributes, their supervisors gave them ratings in the top two categories. Some of the attributes relate directly to student learning outcomes. In addition, the supervisors provided written comments to lend insight into our progress on student learning outcomes. Examples are provided for each student learning outcome below.

Outcome 1.1 (use GIS and statistical tools to manage spatially distributed environmental data):

The industry supervisor evaluations generally indicated good student mastery of GIS and statistical tools. For example, one evaluation stated that the student was “always striving to learn and help others in the office solve problems with GIS,” and another commented on the student’s excellent workplace skills related to “ad hoc database design/organization as a project progresses.”

Outcome 1.2 (analyze and interpret data independently):

Supervisor evaluations indicated that the students were able to work independently. One question on the evaluation asked the supervisors to rate their level of agreement on a series of statements regarding student performance. For the following statement, "Demonstrate an ability to work independently," all five supervisors strongly agreed. For example, one supervisor stated that the student "works well independently but [is] not afraid to ask questions." Another supervisor commented that the student "excelled at working independently" and "completed her work ahead of time with little aid from us." In the ratings provided in Table 3, all five supervisors described their interns as having excellent initiative and able to proceed well on his/her own. This represents a higher percentage compared to the previous two years, when only four of six supervisors rated student initiative as excellent.

Outcome 2.1 (integrate business management concepts with environmental information):

One student assisted in the production of a tourism guide to Iceland which involved understanding what factors are desirable for tourists, including creating maps of hiking trails and associated distribution of flora and fauna. Another student analyzed why more highly educated citizens might be leaving smaller towns to migrate to larger cities, which entailed understanding the associated impacts on local capacity for economic growth. The supervisor for a third student was impressed with the student's client-relation skills and commented that interactions "with our customers was always positive." The students' advisory committees were glad to see that the students involved business components to the internship projects, which is a required component of the final report and capstone presentation to which all students must adhere.

Outcome 2.2 (effective oral and written communication skills):

The five graduating students defended and presented their internship projects to their graduate advisory committees and other stakeholders, including internship supervisors and other personnel from the internship agencies. The students also completed written internship project reports. All five students passed their internship "defenses" and their committees approved their project reports, generally indicating successful communication skills. Supervisors were asked to rate their level of agreement regarding intern performance on the following two statements, "Produce effective written communications" and "Deliver effective oral presentations". For written communications, four of five supervisors strongly agreed and one agreed, representing an improvement compared to the previous two years when three of six supervisors strongly agreed, one agreed, and two were neutral. For oral presentations, three strongly and two agreed, again representing an improvement compared to previous years when two strongly agreed, two agreed, one was neutral, and one was unknown. This improvement perhaps could partially be attributed to the EVS 7900 elective course which focuses on writing skills.

Modifications for Improvement:

The PSM-EI program had its first external program review during the 2019-2020 academic year. A self-study report was written and submitted to an external reviewer from a similar degree program in North Carolina. The reviewer's site visit in Spring 2020 was converted to a virtual/remote format due to the Covid-19 pandemic. The reviewer produced an excellent and thorough report (See Appendix 2) that was used by PSM-EI program faculty to discuss changes and modifications that could be made for improvements. In addition, our Industrial Advisory Board met during Fall 2020 to discuss and make recommendations for program changes.

Outcome 1.1 and 1.2

Based on PSM-EI Industrial Advisory Board recommendations, the external reviewer report, and faculty involved in teaching courses in the PSM-EI degree program, the following changes were initiated due to program assessments. The external reviewer recommended that we provide more flexibility in the curriculum to allow students to develop technical skills that could boost their ability to analyze spatial data (see Outcomes 1.1 and 1.2 above). A desire for more technical courses was also expressed in the alumni surveys. Following on these suggestions, the advisory board recommended reducing the business course requirements to allow more technical courses to be taken. One course that has the lowest priority for retaining is the accounting course, according to the advisory board and faculty attending the board meeting. Therefore, we will create a proposal for the TTU Graduate Studies Executive Committee during 2021 to request approval to make the curricular changes to better prepare the students for the technical aspects of their careers.

Outcome 2.2 (effective oral and written communication skills)

We also noticed improvements in supervisor ratings on written communication skills this year. The faculty agreed to keep the EVS 7900 Scientific Writing and Grantsmanship course as an elective in the new curriculum, and PSM-EI students are actively enrolling in the class. We will continue to emphasize the importance of written and oral communication skills to the students in the capstone internship course, and by encouraging them in advising sessions to take EVS 7900 if their writing skills are in need of improvement.

Appendices

1. Curriculum Map
2. Self-Study Reviewer's Report

Appendix 1: Curriculum Map

PSM-EI course alignment with student learning outcomes. Courses are listed alphabetically by subject rather than chronologically.

Course	Title	**1.1** GIS and statistical tools to manage environ. data	**1.2** Skills to independently analyze and interpret data	**2.1** Integrate business mgmt. with environ-mental info.	**2.2** Communicate effectively in written and oral formats
ACCT 6010	Accounting Information for Management Decisions			**x**	
BMGT 6200	Organizational Leadership			**x**	**x**
ESS 6510	Programming GIS	**x**			
ESS 6910	Internship	**x**	**x**	**x**	**x**
EVSS 6010	Environmental Social Policy				**x**
GEOG 5410	Remote Sensing	**x**			
GEOG 5650	Environmental Applications of GIS	**x**			
MATH 6070	Applied Linear Statistical Methods I	**x**	**x**		
MATH 6470	Environmental Statistics	**x**	**x**		
MKT 6100	Strategic Marketing			**x**	**x**
Electives		**x**	**x**	**x**	**x**

Appendix 2: Self-Study Reviewer's Report

Tennessee Technical University
Professional Science Masters – Environmental Informatics
External Reviewer Report

April 2020

Introduction

This report provides a summary of the external program evaluation conducted for the Professional Science Masters – Environmental Informatics (PSM-EI) program in the School of Environmental Studies, College of Interdisciplinary Studies at Tennessee Technical University. This review was conducted in accordance with guidelines from the Tennessee Higher Education Commission, following the 32 evaluation criteria across 6 categories as listed in the Program Review Rubric, and is based on discussions with program administrators, faculty, staff, and students between April 6-8, 2020 and a thorough review of the provided program Self-Study Report. The reviewer report has been organized by the six rubric categories and highlights both strengths and recommendations stemming from the external evaluation.

Learning Outcomes

A. Strengths: Learning outcomes are well defined and easily measurable and do an excellent job highlighting the unique aspects of PSM program.

B. Recommendations: None

Curriculum

A. Strengths: Overall the curriculum appears well designed to meet the needs of its students, the college, and the university. There is a diversity of courses with a good combination of professional skills and technical skills. The internship seems robust and prepares students well. The new certificate programs have a lot of promise for helping grow the program and provide students more options.

B. Recommendations:

a. It seems a lot of students are interested in more GIS dedicated courses and more flexibility in the professional skills core. Consider a less prescriptive professional skills core or reducing the number of courses there and adding an additional technical elective.

b. Continue to evaluate online pedagogy and how pedagogical approaches may need to be changed in a hybrid program (on-ground and online students) vs. a fully online model.

c. Consider ways to leverage campus resources to teach students some of these professional skills outside of a credit-bearing situation to free up curriculum space (such as intensive workshops, summer?)

d. Consider more studios and workshops that may help introduce new skills without taking up a lot of faculty resources

e. Consider industry guest lectures in courses

Student Experience

A. Strengths: Students seem to have a very good impression of the program and appreciate the opportunities to work and interact with other students. Given the limited resources, the program has done a great job providing professional development opportunities.

B. Recommendations:

a. Provide students with a more formal orientation into the program and provide a student handbook
b. Provide a consistent mechanism for students to formally and anonymously give feedback on the program (exit survey, etc.)
c. Strongly recommend that as you move towards more fully online, plan ahead for how you can maintain peer networks, faculty interactions inside and outside the classroom, participation in campus events, etc.

Faculty

A. Strengths: There is a diverse group of faculty that are genuinely vested in the success of the program. A small core group provides direct support to students and are well-qualified in their respective fields to support diverse learning objectives.

B. Recommendations:

a. Formalize a faculty group that includes everyone contributing to the program from an admin, teaching, and advising perspective. This group should consistently meet to help foster more collaboration among faculty and between the faculty and students early on in the program so students have a better idea of possible project advising and committee members.
b. Ensure this faculty group receives regular updates on program initiatives, advisory board recommendations, etc. This becomes particularly important as you plan growth to ensure capacity in the interdisciplinary courses.
c. Perhaps develop a seminar program that allows faculty teaching in the program to introduce students to their interests at the start of the program and how EI may play a role in what they do.
d. There is potential for a bottleneck for advising students, solicit faculty willingness early on with a list of clear expectations and benefits of being an advisor

Learning Resources

A. Strengths: There is a consistent recognition of the needs of students and faculty and regular evaluation of these needs. Library and technology resources are robust and appropriate for student assistance.

B. Recommendations:

a. As you have more online students, consider how access to these resources may change and how student needs may change from an on-campus environment. Such as library access, software access, etc.
b. Consider technologies that may be needed to address more virtual students accessing software, video production for lectures, etc.

Support

A. Strengths: The program has been very resilient and productive given modest monetary support. The program has been creative in maintaining fellowship support for students and providing access to professional development opportunities.

B. Recommendations:

a. As the program grows, the current static budget may not be sustainable from an operating perspective. A larger student body may need more direct administrative support

b. Faculty need incentive (overload pay, TA support) to take on more students in courses that may already be full and difficult to get into for PSM students.

c. Consider if the current fellowship support model is going to make sense for a fully online program. Those students may have different support needs and how might those funds be re-appropriated or spread out into more TA support/opportunities for students.

d. Look into industry sponsorships and programmatic grants (particularly for converting to online)

e. Consider term limits for Advisory Board, with consistent rotation of members.

Overall the PSM-EI program at Tennessee Technical University is well-positioned for continued steady growth over the next five years. Department, College, and University support for the program is key to its continued success. Based on the observations from this external review, the program can build off of its current successes to deliver a high-quality, in-demand learning experience for its students in the years to come.

Associate Director of Professional Education | Center for Geospatial Analytics Assistant Teaching Professor | GIST

Director of Graduate Programs | MGIST/GIScert

College of Natural Resources

Jordan Hall 5108 |
Campus Box 7106 North
Carolina State University

2800 Faucette Dr.

Raleigh, NC 27695 USA

esmoney@ncsu.edu | 919-513-0408 | geospatial.ncsu.edu