

The School of Environmental Studies (SOES)

Academic Year: 2021–2022

Program: Professional Science Master’s with a Concentration in Environmental Informatics

College; School: Interdisciplinary Studies; Environmental Studies

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School of Environmental Studies 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. The 100% online option resulted in a general doubling of enrollment for the past four 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. At the beginning of the Fall 2022 semester, 19 students are projected to be enrolled and a grand total of 28 students have graduated from the program (Table 1).

Table 1. Enrollment and graduation data for the PSM-Environmental Informatics degree program from 2013–2022.

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	4

The PSM-EI program received its first external review during academic year 2019-2020. A self-study report was prepared during Fall 2019 and the external review was conducted during Spring 2020. The self-study report and external review report are appended to this institutional effectiveness report. The self-study report contains additional relevant materials including a curriculum map (Table 5 on page 20) and an alumni survey (Appendix A6 on pages 46-50). The external review report was concise (three pages) and contains valuable recommendations for retaining program quality and suggestions for improvement.

I. Program Goals and Student Learning Outcomes

Program Goal 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.

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

Assessment Tools: Internship report by student; internship supervision evaluation.

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

Assessment Tools: Internship report by student; internship supervisor evaluation.

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

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

Assessment Tools: Internship report by student; internship supervisor evaluation.

Learning Outcome 2.2: Students will communicate effectively in oral and written formats.

Assessment Tools: Internship report by student; internship supervisor evaluation.

II. Assessment Methods

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.

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

III. Rationale for Outcomes and Assessments (Process for Data Analysis)

Internship Written Report by Student: 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.

Internship Supervisor Evaluation: 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 Coordinator and PSM Program Director.

IV. Results

Three students completed internship projects and graduated from the PSM-EI program in 2021-2022. 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 three 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 2021-2022.

Internship Report Title	Industry Sponsor/Host
Runoff estimation of four watersheds in Putnam County, Tennessee	Putnam County 911
Species Distribution Modeling	Tennessee Department of Environment and Conservation, Water Resources Division
Analysis of road-stream crossings in the Elk River watershed of Tennessee-Alabama to address threats to listed and at-risk species	Center for the Management, Utilization and Protection of Water Resources at Tennessee Tech University

Table 3. Summary of industry supervisor evaluations for four PSM-Environmental Informatics students who completed their capstone internships during the 2020-2021 academic year.

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

For all the intern attributes, their supervisors gave them ratings in the top three categories, with the majority of ratings in the “very good” or “excellent” categories. Some attributes relate directly to student learning outcomes. For example, intern “relations with others” depend upon effective written and oral communication, Student Learning Outcome 2.2, and the “quality of work” readily connects with outcomes 1.1 and 1.2. 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’s “understanding of current technology and its potential uses/applications for the [employer] are considered an asset to [the student’s] team”.

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 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,” two supervisors strongly agreed and one agreed. In a similar fashion, all three supervisors described their interns as having very good or excellent initiative and able to proceed well on his/her own (Table 3).

Outcome 2.1 (integrate business management concepts with environmental information): Supervisors commented on how the students used business-related skills to enhance their effectiveness. One supervisor wrote that the intern “integrated well with agency collaborators” and was “cognizant of the needs of resource managers”. Another supervisor wrote that the intern did very well by showing “an ability to explain complex permitting regulations and requirements

in such a way to make it easy for non-governmental agencies/people to understand and comprehend”. 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 three 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 students passed their internship “defenses” and their committees approved their project reports, generally indicating successful communication skills. Supervisors were also 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, all three supervisors strongly agreed; for oral presentations, two strongly agreed and one agreed, which was a similar pattern to that shown in previous years.

V. Modifications and Continuing Improvement: Program Changes Due to Assessments

The PSM-EI program had its first external program review during the 2019-2020 academic year. A self-study report was written (see attached file) 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, thorough, yet concise report (see attached file) 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 in December 2021 to discuss and make recommendations for program changes. The board will meet again in late November or early December 2022.

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 (see attached self-study report). 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. In addition, we modified an existing course, ESS 6520 GIS Project Development and Management, to better meet the technical needs of students and provide more opportunities for online credit. Keeping the same course number, the modified course is titled “ESS 6520 -

Environmental Informatics Python Applications and Machine Learning”. We created a proposal for the TTU Graduate Studies Executive Committee that met in July 2022 to obtain approval to make the course change and curricular changes to better prepare the students for the technical aspects of their careers. The proposal was passed and the changes will go into effect during the upcoming academic year. A copy of the approved proposal is attached to this report.

We also have noticed improvements in supervisor ratings on written communication skills over the past three years. For 2021–2022, all three internship supervisors indicated that they “strongly agree” that their interns produced effective written communications. 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.

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