## Student Learning Outcomes Assessment

**Department: Geosciences BS Geology all tracks**

<table>
<thead>
<tr>
<th>Year</th>
<th>Objective</th>
<th>Direct Measure (DM)</th>
<th>DM Results</th>
<th>Indirect Measure (IM)</th>
<th>IM Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring &amp; Fall</td>
<td>Objective 4: To become technologically proficient by using basic computer software.</td>
<td>Direct Measure data were not compiled this year due to complexities brought forth by the COVID19 crisis. However, programmatic changes in the past few years that address improving student technological proficiency are highlighted here. Geology field camp participation. Student rankings were not pursued this year because of the COVID19 crisis. Field camp directors are pressed as it is to either cancel 2019 field courses or design alternative virtual field experiences.</td>
<td>DM data were not tabulated this cycle (*). Instead, a summary of recent programmatic changes that address improving student technological proficiency is provided. Focused and purposeful programmatic changes implemented in the last few years (implemented 2018 fall) to bolster student technological proficiency include: a) requiring GEOG 305 and 413 (Cartography and GIS) for all Geology majors, b) broadening capstone experiences to include internships and/or research, avenues typically rich with opportunity to use technology, c) creating new courses such as GEOS410 (Geophysics) that are technology intensive, d) embedding many technology based activities and experiences in already existing courses, such as in GEOS 541 and 545 (Geomorphology and Hydrogeology), e) faculty and students routinely using course management systems, in our case D2L, f) commonly requiring students to present research, where they design talks and posters to display their results, and g) encouraging students to augment their technological competencies by minoring in GIS. These changes were implemented following recommendations from the American Geosciences Institute and the Future of Undergraduate Geoscience Education and by perceived need by current Geology faculty. Six Geology students attended geology field camp in 2019. Again, inquiries for student rankings were not sent to host institutions (**). Three students attended Indiana University (IU), historically a prestigious and competitive field camp. Two others attended Lehigh University, with one student being hand selected to continue his field education by participating in the highly selective GSA Bighorn Basin Field Research</td>
<td>Student exit survey (*) and Alumni survey (^^) results and comments.</td>
<td>Cumulative results from both Student Exit and Alumni surveys (!) contain responses to aspects of technological proficiency. One question on each survey specifically addresses this objective. Responses are from a composite of all Geosciences graduates and alumni, and not specifically those with a Geology degree. Student Exit survey results addressed the following question: How well do you feel your required courses have prepared you in terms of knowledge of relevant technology? Responses of 4 (more than adequate) and 5 (very well) totaled 90.9%. Alumni survey results addressed the following question: How well were you prepared in terms of knowledge of relevant technology? Responses of 4 (more than adequate) and 5 (very well) totaled 46.4%. If responses of 3 (adequately) are included, then the result increases to 76.6%. Included on the Alumni survey are two other pertinent questions: a) What is the most valuable course taken while a student at EU?, and b) Which course should be added to the curriculum? In terms of most valuable courses, ~20% responded by selecting GIS or a course with a significant technological component. In terms of added courses, ~29% identified courses in GIS or with substantial technology use (@).</td>
</tr>
</tbody>
</table>
One student attended the South Dakota School of Mines field program. All students successfully completed their field courses.

**Impressions**

This is our first attempt to assess student technological proficiency specifically. We have insufficient and/or incomplete ways to measure student success and collect data with respect to developing technology competencies. Thus, gauging success is restricted by limited data, with several actions done across the curriculum but not well measured.

Students, from early stages to late, and across the curriculum, are exposed to and use various computer applications to develop their technological skills, competencies, and proficiency. Please see Geology Software Inventory below. With that said, development of more robust and better instruments to specifically measure student success and acquire meaningful data with respect to technological proficiency is necessary.

Recently implemented programmatic changes were strategically, purposefully put in place to bolster student use with computers and thus proficiency with technology. We based these changes on anecdotal information from alumni, perceived student educational gaps through faculty understanding of post-graduate needs, and undergraduate education guidelines set forth by national-level workforce studies.

Student performance at field camp is (at least) to an acceptable level, equivalent to “A” and “B” level work (#). This performance is an indication of high program quality and adequate to excellent student performance, competitive at a national level.

One question on both Student Exit and Alumni surveys specifically addresses aspects of this objective.

Overall, graduating students as well as alumni indicate that their educational experience at least adequately developed their technology skills. Satisfaction with technology skills development dropped for alumni, indicating a probable reality check upon entering the workforce or graduate school. This drop suggests that we need to address more completely and broadly proficiency in technology and computational geology in our curriculum to align with real-world needs. Alumni indicated that technology-based courses were valuable to them and that more are needed. However, perhaps only specific, targeted revisions, additions, etc., may be necessary. With current faculty restrictions, modifications will be limited.

**Limitations and Strengths**

Small number of Geology faculty (4 full-time, tenured faculty, with 1 currently serving as Dept. Chair, and 1 regular part-time faculty) to cover wide breadth and depth of competency and skill development in the discipline. We are few in number but highly skilled, experienced geoscience educators. Faculty expertise and training are somewhat aligned with accomplishing this objective. We would no doubt benefit from more professional development in the realm of technology and its integration into the curriculum!

**Proposed Action Item: Assessment Tool**

1. To develop Direct Measures to better assess student technological proficiency. Geology students use a wide variety of computer technologies and through anecdotal evidence gain competencies, but our instruments to measure their competencies and acquire relevant data are insufficient and/or incomplete. This, coupled with the COVID19 crisis, limited our ability to assess properly this objective. Recent programmatic changes were done based on student needs perceived by faculty and recommendations by external agents. We need to evaluate how well these changes have served our students.

2. To create and embed more focused questions specific to this objective into both Student Exit and Alumni surveys. These surveys are invaluable to us, with alumni especially indicating (dis)connections between student technological proficiency and post-graduate, applicable realities. Their recommendations provide meaningful feedback on workforce expectations of graduating Geology students.

3. To separate responses for different majors within Geosciences. We are still working on how to do this!
### Proposed Action Item: Program Content and Course Assessment Practices

1. Continue to test-drive our new BS Geology programs and remedy potential issues that may appear. These programs came onboard in the 2018 fall.

2. Consider developing new course offerings and/or student activities that contain substantial components related to developing greater technology competencies and skills and improving their technological proficiency. Possibilities include Surface Hydrology, Quantitative / Computational Geology, and embedding more virtual / remote field experiences and computer applications into existing courses.

### Action Items Implemented

- Continued successful implementation of new BS Geology curricula (Traditional Geology track and Environmental Geology track), which now has 1) fundamental required and elective specialty course offerings better suited for each of the BS Geology tracks, 2) options for high-impact capstone research course and/or internship experience in addition to traditional Geology Field Camp, and 3) math requirements better aligned with prospective post-graduate plans.

### Objective to be Assessed Next Year

Next year, we will assess **Objective 3: To develop written and oral communication skills.**

---

### Notes:

- (*) These measures are usually assessed in selected upper level geology courses. Data are typically gathered every time the course is offered, with every Geology major being assessed. The criterion used to measure performance is a scoring scale (proficiency ≥ 70%). No data were collected during this cycle because concrete, rigorous Direct Measures were not in place and insufficient / incomplete data were acquired. The COVID19 crisis directed our attention elsewhere.

- (**) This measure is assessed by examining GEOS 581 – Geology Field Camp course grade and/or, when available, performance ranking with respect to other field camp attendees. Data are typically gathered on all Geology majors who attend field camp and collected every summer. Data was requested during this cycle to lessen the workload on field camp directors during the COVID19 crisis.

- (#) For perspective, consider: a) a majority of students attending field camp are typically from the host institution, which favors those students and not those from EU; and b) EU students merely need to pass for the credits to transfer, which provides little incentive to excel. Yet, they typically do excel. Host institutions for 2019 field camps were Indiana University – Bloomington (3 students), Lehigh University (2 students), and South Dakota SM&T (1 student). Also, to complicate interpretation of results, overall student performance at field camp is based on a variety of factors beyond academic preparation. These include individual student strengths and weaknesses of Geology knowledge and skills, variables linked to the affective domain of the student, and competitive level of other students attending a particular camp.

- (^) Instructions to access Exit surveys online are distributed in selected upper level Geology courses to all Geology majors who file intent to graduate. Surveys are submitted electronically near the conclusion of fall and spring semesters and a scoring scale is used to assess performance. Note that this is a recently implemented procedure where students file electronic surveys rather than hand in paper copies of surveys. Student Exit and Alumni surveys are now available electronically, with little effect however on improving low response rates. Response rates must be increased. Also, electronic survey results currently do not distinguish between different majors within Geosciences. They should.

- (^^) Data are collected every year and gathered via traditional and electronic mailing, where instructions to access Alumni surveys online are (e)mailed to all Geology majors on 5-year and 10-year graduation anniversaries. A scoring scale is used to assess performance. Note that this is a recently implemented procedure where alumni submit electronic surveys rather than send in paper copies of surveys.

- (!) Although the surveys are available electronically and submitted online, response rates are still frustratingly low. Additional efforts are needed to bolster those response rates.

- (@) Courses suggested by alumni for addition include: required internship, more / advanced GIS, various geophysics courses, more / advanced hydrology, specific programming courses (Python, etc.), photogrammetry, and more geospatial techniques.
Geology Software Inventory – May 2020
Alphabetical listing of software used by Geology students (courses in which software is used):

- AqteSolv: data processing, modeling (GEOS 545)
- ArcGis: mapping, modeling (GEOS 410, 541, 545; GEOG 305)
- Desire 2 Learn (D2L): course management system (all)
- Excel: data manipulation, statistics, and visualization (GEOS 410, 505, 521, 541, 545; GEOG 305)
- GeoBlocks 3D: 3D geologic visualization (GEOS 531)
- Geographic information systems (GIS) suite of software: framework for gathering, managing, and analyzing spatial and information data (GEOG 413)
- Google Earth: mapping, topographic / landform analysis (GEOS 101, 410, 505, 521, 541, 545; GEOG 305)
- GPRViewer: data processing (GEOS 410)
- MohrPlotter: graphical data plotter (GEOS 531)
- PA DCNR Map Viewer: Pennsylvania geology (GEOS 101, 112)
- Pathfinder Office (GPR software): mapping, surveying (GEOS 410)
- PowerPoint: posters, presentations (GEOS 112, 375, 410, 505, 521, 523, 525, 541, 545; GEOG 305)
- RadExplorer: data processing (GEOS 410)
- Seisimager: data processing (GEOS 410)
- SoilExplorer: mapping, geography of soils (GEOS 505)
- SoilWeb (Purdue): mapping, geography of soils (GEOS 505)
- Tectonic Motions in the Western United States: GPS data, plate-motion map (GEOS 531)
- USGS Earthquakes: mapping, earthquake geography (GEOS 101)
- Virtual Dating: isotopic dating techniques, calculations (GEOS 101, 112)
- Virtual Earthquake: modeling, calculations (GEOS 101)
- Visible Geology: data processing, visualization (GEOS 531)
- Water Erosion Prediction Program (WEPP – USDA): modeling (GEOS 505)
- WebSoil Survey (NRCS): mapping, data extraction (GEOS 505)
- Word: word processing (GEOS 101, 112, 375, 410, 505, 513, 521, 523, 525, 531, 541, 545; GEOG 305)
- World Wide Web: online information acquisition (all)
<table>
<thead>
<tr>
<th>Year</th>
<th>Objective</th>
<th>Direct Measure (DM)</th>
<th>DM Results</th>
<th>Indirect Measure (IM)</th>
<th>IM Results</th>
</tr>
</thead>
</table>
| 2020 | Objective 2. Core knowledge of geospatial and natural science techniques and technologies. | Competencies assessed in  
A. GEOG4 13 GIS (N=2 students)  
2b – specific assignment question (max 10 points)  
B. GEOG425 Geog. of Water Resources (N=10 students)  
2c – specific question from written assignment (max 15 points).  
C. GEOG525 Forest Geography (N=9 students).  
2a. 3 tests questions (max 7 points)  
D. GEOG 545 Environmental Planning (N = 12 students).  
2c Two assignments. First written assignment involving map interpretation. Second paper about storm water runoff mitigation.  
E. GEOG 395 Internship (N = 3 students)  
2b. based on supervisor evaluation | A.2b. All students achieved an A  
B.2c. 8 of 10 students achieved C or better outcome (7 of 10, B or better).  
C.2a. 2 of 9 students achieved C or better  
D.2c  
- 12 of 12 achieved C or better on first (11 of 12, B or better)  
- 12 of 12 achieved C or better on second (8 of 12, B or better)  
E.2b 3 of 3 achieved positive rating (1 Good, 1 very good, 1 excellent) |
Impression | Some have very small sample sizes.
--- | ---
Limitations | Students may be sophomores, juniors, or seniors.

**Proposed Action Item:** Further work in combining assessment for the Environmental Studies and GIS majors. This will allow for larger sample sizes and more meaningful interpretation of the results.

**Proposed Action Item:** Add more GIS content into non-techniques courses. This will improve students' knowledge of GIS, and will allow progress in the previous action item of integrating the GIS and environmental studies assessments.

**Action Items Implemented**
- Developed a new course, Field Natural History (GEOG 302). This new course will be taught in the field and will give students a hand-on experience in field technology. This was developed due to alumni surveys which indicated students wanted more hands-on learning opportunities. It was an action item in a previous SLOA report.

**Objective to be Assessed Next Year**
- Objective 3 – intellectual and practical skills necessary to succeed as a professional.

The order of competencies under learning objectives 1 & 2 for the Environmental Studies program was modified to parallel similar learning objectives for the B.A. Geographic Information Science (GIS) major program. Both the Environmental Studies and GIS programs are based on a geography foundation, since both are traditional realms of study within the discipline of geography.

**Revised Learning Objectives and General Competencies for the B.A. Environmental Studies Program:**

1. Core knowledge of human and physical systems and the natural world.
   a. Understand fundamental geographical concepts, including scale, region, location, place, distance, distribution, pattern, and process.
   b. Master key terms and concepts associated with environmental geography.
   c. Describe spatial patterns of human and physical systems and the natural world.
   d. Understand the nature and history of human impacts to the environment.

2. Core knowledge of geospatial and natural science technologies and techniques.
   a. Demonstrate skill in the use of natural science technologies and techniques common to the environmental sciences.
   b. Demonstrate skill in the use of GIS (Geographic Information Systems) techniques and technology.
   c. Master spatial analytic processes and decision-making, including map interpretation and use.

3. Acquire and hone intellectual and practical skills necessary to succeed as an environmental professional.
   a. Demonstrate information literacy.
   b. Develop excellent oral and written communication.
   c. Demonstrate quantitative literacy and data management proficiency.
   d. Demonstrate spatial literacy.

4. Develop capacity for integration and synthesis with respect to environmental and geographical opportunities and problems.
a. Develop analytical and critical thinking skills.
b. Propose solutions for complex environmental problems by integrating core knowledge (objectives 1 & 2) and intellectual/practical skills (objective 3).
c. Participate effectively as a team member and a team leader.

5. Acquire the foundation and skills necessary to promote lifelong learning and engaged citizenship.
   a. Demonstrate civic knowledge and engagement – local and global.
   b. Appreciate how culture and experience influence people’s perceptions of places and regions.
   c. Recognize that personal and social responsibility are associated with understanding environmental issues.
   d. Develop ethical reasoning and action.
## Program: Geographic Information Science (GIS)

<table>
<thead>
<tr>
<th>Year</th>
<th>Objective</th>
<th>Direct Measure (DM)</th>
<th>DM Results</th>
<th>Indirect Measure (IM)</th>
<th>IM Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>Objective 2. Core knowledge of Geospatial technologies and techniques, and the study of spatial phenomena</td>
<td>Competencies assessed in&lt;br&gt;A. GEOG 305 Basic Cartography (N = 3)&lt;br&gt;2b – specific assignment question</td>
<td>A.2b. 3 of 3 students achieved A outcome</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. GEOG 413 GIS (N = 1 student)&lt;br&gt;2a – specific exam question from exam (max 5 points)&lt;br&gt;2b – specific assignment question (max 10 points)&lt;br&gt;2c – specific assignment questions (max 5 points)</td>
<td>B.2a. all students achieved an A outcome.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. GEOG 414 Remote Sensing (N = 1)&lt;br&gt;2d – specific assignment question</td>
<td>2b. all students achieved A outcome.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>D. GEOG 420 GIS Applications in Business and Planning (N = 16)&lt;br&gt;1a – assignment (max 100 points)</td>
<td>2c. all students achieved A outcome</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C.2d all students achieved an A outcome.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D2a. all students achieved C or better (12 of 16, B or better). Note: this includes GIS and Environmental studies majors)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Impression

This small sample size makes it difficult to interpret the results.

### Limitations

Sample size is very small. GIS (Geographic Information Science) is a new major program that we anticipate will grow with time. Splitting the former geography major into two distinct programs (GIS and Environmental Studies) has reduced sample sizes for student learning outcome assessment.
| Proposed Action Item: Assessment Tool | Further work in combining assessment for the Environmental Studies and GIS majors. This will allow for larger sample sizes and more meaningful interpretation of the results. |
| Proposed Action Item: Program Content and Course Assessment Practices | Add more GIS content into non-techniques courses. This will improve students' knowledge of GIS, and will allow progress in the previous action item of integrating the GIS and environmental studies assessments. |
| Action Items Implemented | Revised a number of courses – Cartography (GEOG 305), GIS Applications in Business and Planning (GEOG 420). |
| Objective to be Assessed Next Year | Objective 3 – intellectual and practical skills necessary to succeed as a professional. |