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| **Assurance of Student Learning Report**  **2021-2022** | |
| Ogden College of Science and Engineering | Department of Earth Environmental and Atmospheric Sciences |
| Undergraduate Certificate in Geographic Information Systems (#174) | |
| Amy Nemon | |

***Is this an online program***?  Yes  No

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| ***Use this page to list learning outcomes, measurements, and summarize results for your program. Detailed information must be completed in the subsequent pages.*** | | | |
| **Student Learning Outcome 1:** Students will be able to organize GIS data and communicate effectively through mapping using accepted principles of cartographic design and spatial reference systems. | | | |
| **Instrument 1** | Direct: Analysis of capstone project in GISC 316 (Fundamentals of GIS). For the capstone project, students must customize a projection for their study area, create a correctly normalized quantitative map of the region that demonstrates an understanding of numerical classification, and develop an attractive map layout that effectively communicates their data set’s theme while adhering to accepted principles of cartographic design. A comprehensive rubric is used to evaluate the capstone project. | | |
| **Based on your results, check whether the program met the goal Student Learning Outcome 1.** | | **Met** | **Not Met** |
| **Student Learning Outcome 2:** Students can demonstrate proficiency in the quantitative and qualitative spatial analysis and critical thinking through written and oral communication. | | | |
| **Instrument 1** | Direct: Applied spatial data synthesis and analysis projects (both written and oral) administered in GISC 317 (Geographic Information Systems). A series of five applied projects is completed in the course. All data analysis and projects completed in the course are from real-world data sets. GISC 317 is the final 300-level GISC course for all certificate students, so examining the artifacts of this course provides the best overall reflection of students’ basic ability to synthesize and analyze data quantitively and spatially. A comprehensive rubric is used to evaluate each of the five projects. | | |
| **Based on your results, check whether the program met the goal Student Learning Outcome 2.** | | **Met** | **Not Met** |
| **Student Learning Outcome 3**: Students will demonstrate proficiency in GIS project planning, design, and implementation, as well as mastery of advanced geoprocessing and modeling techniques. | | | |
| **Instrument 1** | Direct: Analysis of capstone project in GISC 417 (GIS Analysis and Modeling). A comprehensive rubric is used to evaluate the capstone project.  Direct: Analysis of six applied projects in GISC 419 (GIS Programming). A comprehensive rubric is used to evaluate all six projects. | | |
| **Based on your results, check whether the program met the goal Student Learning Outcome 3.** | | **Met** | **Not Met** |

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| **Program Summary** |
| The goals of all three student learning outcomes were met in academic year 2021-2022. As many classes transitioned to in-person and GIS labs re-opened, last year’s shortage of suitable computers for running GIS software was alleviated. The capstone project in GISC 316 in its second year of use as a means to assess learning of GIS fundamentals. The average score of 78.9% for 2021-2022 shows a modest increase over last year’s average of 78.6% and meets the program goal of 70% or better. Course delivery and assignments will continue to be assessed and altered in search of overall improvement of student outcomes. With regard to assessment of spatial analysis and critical thinking skills, the program goal was met with an average score of 84.78% on the five applied projects of GISC 317. With regard to assessment of GIS project planning and design and implementation of advanced geospatial analysis and modeling skills, the program goal was met with an average score of 86.2% on the capstone project of GISC 417. The capstone project combines the skills presented together from the first three certificate courses, to manage, create, analyze, and interpret findings. The project is a true representation of many aspects of geospatial inquiry in which students will be engaging when hired into a GIS position. In 419, students learn to implement custom GIS analytical tools by working on a set of six projects in order to automate spatial analysis processes and geoprocessing workflows with ArcGIS ModelBuilder and Python scripting. The program goal was met with an average score of 91.7% on the six applied projects of GISC 419.  GIS stands for Geographic Information Systems, which is a computerized information system for (1) collecting and editing geospatial data, (2) storing, retrieving, and managing geospatial data, (3) manipulating and analyzing geospatial data, (4) and displaying geospatial data in the form of maps, graphs, charts, and reports. Geospatial data are data tied to geographic locations. Geographic Information Science (GIScience) is the scientific discipline studying the theory, concepts, and effective use of GIS and geospatial technologies (e.g. maps, GPS, satellite, radar, drone, photogrammetry, surveying).  GIScience prepares students to understand geospatial data structures and methods for capturing, modeling, processing, analyzing, and displaying geographic information and spatial patterns. The undergraduate GIS Certificate at WKU consists of four courses: Fundamentals of GIS (GISC 316), GIS (GISC 317), GIS Analysis & Modeling (GISC 417), and GIS Programming (GISC 419). Any undergraduate student who has taken the above four courses with grades “C” or above is awarded with the Certificate. From traditional map makers to current day solution providers, this program is designed to educate and train students with a variety of GIS knowledge and skills, so they can use GIS effectively in their respective fields.  The program combines face-to-face and web courses; and offers an On Demand online format for all courses. |

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| **Student Learning Outcome 1** | | | | | |
| **Student Learning Outcome** | Students will be able to organize GIS data and communicate effectively through mapping using accepted principles of cartographic design and spatial reference systems. | | | | |
| **Measurement Instrument 1** | Direct measures of student learning: Analysis of capstone project in GISC 316 (Fundamentals of GIS). For the capstone project, students must customize a projection for their study area, create a correctly normalized quantitative map of the region that demonstrates an understanding of numerical classification, and develop an attractive map layout that effectively communicates their data set’s theme while adhering to accepted principles of cartographic design. | | | | |
| **Criteria for Student Success** | The overall score on the capstone project will be 70% or higher. | | | | |
| **Program Success Target for this Measurement** | | The goal is for the class average to be 70% or higher on the assessment. | **Percent of Program Achieving Target** | The class average was 78.9%. (n=42) | |
| **Methods** | A comprehensive rubric (see end of this report) is used to evaluate the capstone project. The total score of students across all sections taught Fall 2021 and Spring 2022 was averaged. For n=42 students, the average capstone project score was 78.9% | | | | |
| **Based on your results, highlight whether the program met the goal Student Learning Outcome 1.** | | | | **Met** | **Not Met** |
| **Actions**  The addition of the capstone project in GISC316 was undertaken in the 2020-2021 academic year in response to feedback from more advanced GIS certificate courses that students were not sufficiently mastering projection and cartographic design skills. Based on this year’s results, the redesign of GISC316 seems to have been successful. We will continue to monitor student progress annually and make adjustments in the course and capstone project to further improve student outcomes. | | | | | |
| **Follow-Up** |  | | | | |
| The follow-up will be to ensure that all sections of GIS 316 use the newly developed capstone project. | | | | | |
| **Next Assessment Cycle Plan** | | | | | |
| GISC 316 is taught most semesters, so we will continue to assess this outcome in the next academic year. | | | | | |

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| **Student Learning Outcome 2** | | | | | |
| **Student Learning Outcome** | Students can demonstrate proficiency in the quantitative and qualitative spatial analysis and critical thinking through written and oral communication. | | | | |
| **Measurement Instrument 1** | Direct: Applied spatial data synthesis and analysis projects (both written and oral) administered in GISC 317 (Geographic Information Systems). A series of five applied projects is completed in the course. All data analysis and projects completed in the course are from real-world data sets. GISC 317 is the final 300-level GISC course for all certificate students, so examining the artifacts of this course provides the best overall reflection of students’ basic ability to synthesize and analyze data quantitively and spatially. | | | | |
| **Criteria for Student Success** | Students will have earned a grade of 70% or higher on a series of five applied projects to demonstrate proficiency in quantitative and spatial data analysis, critical thinking, and written communication. (see grading criteria at end of document). | | | | |
| **Program Success Target for this Measurement** | | The goal is for the class average to be 70% or higher on the assessment. | **Percent of Program Achieving Target** | The class average was 84.78%. (n=32) | |
| **Methods** | All sections of GISC 317 during AY22 were included in the data set. A comprehensive rubric was used to evaluate each of the five projects. All project scores were averaged to create the program average. For n=32 students, the program average was 84.78% | | | | |
| **Based on your results, circle or highlight whether the program met the goal Student Learning Outcome 2.** | | | | **Met** | **Not Met** |
| **Actions** | | | | | |
| As the success target for this measurement was met, no follow-up actions are required. Annually, we update all modules in our GISC courses to incorporate any added capabilities of the latest geoscience spatial analysis software and adapt to any changes in GISC technologies and software. Project, assignment, and exam data utilized in our GISC courses are updated to reflect the latest challenges and opportunities present in the geosciences. | | | | | |
| **Follow-Up** | | | | | |
| As this outcome was achieved, we have no intended changes to our program to meet this outcome at this time. We are constantly improving and updating our curriculum, equipment, lab and field research methods and tools, to meet our students’ needs. If deficiencies in any area arise, we are nimble and effective in our responses to our programmatic needs. | | | | | |
| **Next Assessment Cycle Plan** | | | | | |
| GISC 317 is taught every fall and spring. As such, we will assess this outcome again at the conclusion of AY23. | | | | | |

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| **Student Learning Outcome 3** | | | | |
| **Student Learning Outcome** | Students will demonstrate proficiency in GIS project planning, design, and implementation, as well as mastery of advanced geoprocessing and modeling techniques. | | | |
| **Measurement Instrument 1** | Direct measures of student learning (GISC 417): Students in the capstone course, GISC 417 (GIS Analysis & Modeling), were given a final group project for demonstrating skills and knowledge in data visualization and cartography from the core courses, GISC 316 and GISC 317, as well as skills and knowledge from GISC 417. All three courses are required courses in the GIS Certificate program. In addition, students presented their project findings orally.  Direct measures of student learning (GISC 419): Students in this advanced GIS course, GISC 419 (GIS Programming) completed independently 6 applied projects to implement custom GIS analytical tools with ArcGIS ModelBuilder and Python scripting. | | | |
| **Criteria for Student Success** | The overall score on the capstone project will be 70% or higher in GISC 417.  The average scores on the six project will be 70% or higher in GISC 419. | | | |
| **Program Success Target for this Measurement** | | The goal is for the class project average to be 70% or higher on the assessment. | **Percent of Program Achieving Target** | GISC 417: The class average was 86.2%. (n=29)  GISC 419: The class average was 91.7%. (n=24) |
| **Methods** | In GISC 417, all students’ group papers, project data, and maps from GISC 417 in AY22 (Fall 2021) were evaluated. A comprehensive rubric was used to evaluate students’ planning, design, and project implementation. The total project score of all students was averaged. For n=29 students, the average capstone project score was 86.2%.  In GISC 419, all six applied GIS projects in AY22 (Spring 2022) were evaluated. A comprehensive rubric was used for all six projects. The total project score of all students was averaged. For n=24 students, the average capstone project score was 91.7%. | | | |
| **Actions** (Describe the decision-making process and actions for program improvement. The actions should include a timeline.)  The goals for this SLO were met, so no follow-up action is required for both GISC 417 and 419. We have seen a slight increase in the overall percent of student’s passing the GISC 417 final project with a C or higher from 81.8% to 86.2%. We have seen a bigger increase in the overall percent of student’s passing the GISC 419 projects with a C or higher from 83.6% to 91.7%, when compared with 417. 417 was still a hybrid course, while 419 went back to in-person, which may have led the bigger increase in 419. | | | | |
| **Follow-Up** (Provide your timeline for follow-up. If follow-up has occurred, describe how the actions above have resulted in program improvement.)  No follow-up is required. | | | | |
| **Next Assessment Cycle Plan** (Please describe your assessment plan timetable for this outcome)  As these courses are taught annually, we will continue to assess this outcome in the next academic year. It is vital that we analyze the same statistics, for the next academic year, to better understand if the pandemic contributed to these changes. | | | | |

**GISC 316 Capstone Project Rubric**

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| **Project and File Management**   * A complete project has been delivered, including all data and project files, with no broken links, and a written report. No extraneous data is included. | / 5 points |
| **Vector Data Management**   * A custom projection for the study area has been created and appropriately named, and the project uses the custom projection. * Data has been organized logically in a geodatabase using feature classes and feature data sets, and all data has been converted to the custom projection. * The metadata for each feature class has been updated with information on subsetting, clipping and re-projection and new thumbnail images have been created for any altered feature classes. | / 10 points |
| **Map Symbology & Labeling**   * A graduated color map using correct normalization and an appropriate quantitative classification has been created. * Principles of good cartographic design have been followed in selection of colors and placement of labels. | / 15 points |
| **Map Layout**   * The map layout communicates effectively by using principles of cartographic design to place and orient map elements, including a map title, legend, scale bar, and any inset or locator maps used. * The map uses principles of visual hierarchy to emphasize important information. | / 10 points |
| **Report**   * The report is well written from a technical standpoint (e.g. grammar and spelling) and makes a cogent analysis of information presented on the map. | / 10 points |
| **Total:** | **/ 50 points** |

GISC 317 Rubric Example

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| Georeferencing – Criteria:   * The image is accurately georeferenced to the orthophotos * The images were given correct spatial metadata * Include RMS score or table image in write-up | /10pts |
| Feature accuracy - Attribute accuracy – Criteria:   * A polygon feature class was created to hold the polygons multiple were created instead of just one as indicated in the directions. * All data sets reside in the geodatabase * the feature class’s spatial reference was correctly defined * all polygons are present * no extra polygons, gaps, slivers of open areas * Domain Created. Students should follow the same set up as learned in the digitizing practice assignment. A suitable attribute domain for soil type was created in the geodatabase. The geodatabase and subsidiary structures have been set up correctly with a domain * Attribute were created and it reference the attribute domain * All polygons have been given a correct attribute value | /30pts |
| Digitizing quality – Criteria:   * lines are smooth * lines accurately placed relative to areas on photo at edges * adjacent polygons form a smooth boundary | /20pts |
| Symbology – Criteria:   * Each lot type has been given a different color and an appropriate color scheme was selected * Labels do not overlap polygon lines and are well place | /20pts |
| Metadata – Criteria:   * Created the required metadata for the polygon feature class * The metadata contains good and reasonable information | /10pts |
| Project management – Other Criteria:   * all files are present * no broken links in the map project * all names are well chosen and descriptive * All extraneous files (other than the geodatabase, map, & pdf) have been removed * Named layers in the Table of contents (instead of a legend) * Completion is of professional quality. | /10pts |
| Total: | /100pts |

GISC 417 Capstone Project Rubric Example

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| Project planning & design – Criteria:   * Study area determined * Facility type determined * A project proposal with project objectives and steps | /10pts |
| Project data collection – Criteria:   * Sidewalk centerlines collected in the study area with GPS and Collector for ArcGIS * Other required GIS datasets collected in the study area, e.g. facilities, crosswalks, junctions, steps * Project data made available on ArcGIS Online as basic web maps * All project data sets converted in a project geodatabase | /20pts |
| Project data processing – Criteria:   * Sidewalk centerlines planarized * A network dataset built with sidewalk centerlines and walk time cost attribute | /20pts |
| Network analysis – Criteria:   * A service area analysis conducted to general walk time network polygons with proper walk time breaks | /20pts |
| Project map – Criteria:   * A final ArcGIS Online map created | /10pts |
| Project report – Criteria:   * In APA style: page numbers, title page, font and font size, line spacing, justification, and margins * Figures and tables titled and numbered * Project sections: Introduction, Data and Methods, Results, Conclusions * Maps must follow standard principles of cartographic design: layout, legend, map title, scale, etc. | /20pts |
| Total: | /100pts |

GISC 419 Project Rubric Example

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| Data/file management – Criteria:   * Practice good data/file management: subfolders, file/data names * Submission files in a single zipped folder file | /10pts |
| Tool development – Criteria:   * Target geoprocessing workflow identified and tested manually * Custom tool developed with proper tool parameters and properties. * Custom tool tested and debugged without any errors | /60pts |
| Tool documentation and metadata – Criteria:   * Basic naming conventions followed in ArcGIS models or Python scripts * Proper labels added in ArcGIS models * Proper comments added in Python scripts * Tool metadata created | /20pts |
| Project short report – Criteria:   * In APA style: page numbers, title, font and font size, line spacing, justification, and margins * Figures and tables titled and numbered * Report presented in sections * Main lessons learned reported in the conclusion section | /10pts |
| Total: | /100pts |

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| **Program name:** | Certificate in GIS | | |  |  |
| **Department:** | EEAS | | |  |  |
| **College:** | Ogden | | |  |  |
| **Contact person:** | Amy Nemon | | |  |  |
| **Email:** | [amy.nemon@wku.edi](mailto:amy.nemon@wku.edi) | | |  |  |
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| **KEY:** | |  |  |  |  |
| **I = Introduced** | |  |  |  |  |
| **R = Reinforced/Developed** | |  |  |  |  |
| **M = Mastered** | |  |  |  |  |
| **A = Assessed** | |  |  |  |  |
|  |  |  | **Learning Outcomes** |  |  |
|  |  |  | **LO1:** | **LO2:** | **LO3:** |
|  |  |  | Students will be able to organize GIS data and communicate effectively through mapping using accepted principles of cartographic design and spatial reference systems. | Students can demonstrate proficiency in the quantitative and qualitative spatial analysis and critical thinking through written and oral communication. | Students will demonstrate proficiency in GIS project planning, design, and implementation, as well as mastery of advanced geoprocessing and modeling techniques. |
| **Course Subject** | **Number** | **Course Title** |  |  |  |
| GISC | 316 | Fundamentals of GIS | I, R, M, A | I | I |
| GISC | 317 | Geographic Informations Systems | M, A | R, M, A | R |
| GISC | 417 | GIS Analysis & Modeling | M, | M | M, A |
| GISC | 419 | GIS Programming | M | M | M, A |