Geoscience Career Master's Preparation Survey Report

Heather R. Houlton

American Geosciences Institute
Workforce Program

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About the Geoscience Career Master's Preparation Survey (Geo Career MaPS)

Traditionally in the geosciences, the Master's degree is the degree for employment and most likely to promote career growth within the profession. Current workforce supply-and-demand trends indicate a net deficit of 135,000 geoscientists in the next 10 years. The discipline is facing a harsh reality where closing the long-term workforce supply gap will only be possible by producing well-trained geoscientists with the appropriate competencies and skills-portfolios that meet the scope and depth of employers' requirements.

Limited data exist regarding non-Ph.D. preparatory Master's degree programs, particularly considering academic and career preparation, students' career paths and advising and mentoring practices. Understanding how programs are preparing Master's students for employment, how prepared students feel to enter the workforce and the alignment of graduates' skills with workplace requirements is imperative for remaining competitive in a global geoscience market. Society increasingly relies on the work of geoscientists for energy, fresh water, natural resources, and safety from natural hazards and thus preparing high quality geoscientists to meet today's demand is vital.

The American Geosciences Institute (AGI) and the Association of American Geographers (AAG) assessed the preparation of Master's students and compared their preparation to what non-academic professionals indicated as the most important skills for geoscience occupations. The study was funded by the National Science Foundation, grant #1202707.

There are four main areas of inquiry:

1. What are the motivations and career goals of Master's students who pursue graduate study in geology and geography? What factors influence and inform these decisions?

2. What entry-level positions are most commonly taken by graduates of Master's programs in geology and geography?

3. How satisfied are faculty and students with the curriculum, advising, and professional development opportunities provided by Master's programs?

4. What types of geoscience, geographic, and general competencies are taught and developed in Master's programs? How prepared were current non-academic professionals in their field of employment when entering the workforce from their Master's degree programs? What are the skills and competencies required of new hires in geology and geography employing industries, and how important are these to employment?

The Institutional Review Board (IRB) of the University of Colorado, Boulder provided approval for executing this research through the Association of American Geographers' Enhancing Departments and Graduate Education (EDGE) Program.

This report disseminates information regarding these lines of inquiry about Master's degree programs, students' career decisions, their preparation and influences, and non-academic employers' preparation and current positions.

Research Methods

Participants

The study aimed to recruit 20 geology, 20 geography and 10 hybrid departments to participate in the survey, all of which offered a Master's degree that does not intend on preparing students to pursue a Ph.D. We defined a "hybrid" department as a program that contains a mixture of geology and geography courses or one that has combined geology and geography programs into one department. Our targeted departments only included those which do not confer doctoral degrees and those which do not intend on preparing students to pursue doctoral degrees upon graduation. These specific requirements made identification of these programs difficult, and limited the number of total departments from which we could sample. Thus, this report does not aim to make generalizations about all Master's degree programs. It does intend, however, to catalyze community discussion about the emerging trends being observed.

The initial list of faculty members within geology departments was generated from AGI's Directory of Geoscience Departments. The query also included faculty in some geography departments that are found within AGI's database. To identify faculty in more geography departments, AAG provided a list from their database. Both databases included some hybrid departments.

The following table describes the number of departments who participated in the study. Not all departments had both students and faculty participate (e.g. Faculty from 25 different Geology departments participated in the survey. However, students from only 18 different Geology departments participated).

Geology Departments	Geography Departments	Hybrid Departments
Faculty = 25	Faculty = 33	Faculty =10
Students = 18	Students = 25	Students = 9

Data Collection

The Geo Career MaPS instrumentation was developed and expanded upon from AAG's Geography and Career Planning Survey for students and faculty from the Enhancing Departments and Graduate Education (EDGE) program. The EDGE Survey contained questions regarding satisfaction of programs, student career decisions, and preparation of non-technical and technical geography competencies. To appropriately measure the competencies taught and learned within geology and hybrid departments, AGI and AAG collaborated with the National Association of State Boards of Geology (ASBOG). ASBOG is the organization responsible for developing and grading the Fundamentals of Geology and Practicing Geology examinations used for state licensure. Incorporating the competencies covered within the ASBOG exams ensured Geo Career MaPS was well aligned with industry standards.

The survey tool, LimeSurvey, was used for the study. Questions were designed as a 5-point Likert scale. The first choice on the scale always read "Not Applicable/I don't know." The scale read from left to right, which corresponded with negative to positive responses (i.e. when inquiring about preparation the scale read: "Not Applicable/I don't know, Not Prepared, Somewhat Prepared, Adequately Prepared, Extensively Prepared").

A small pilot test was sent to a select few faculty and students to refine the survey instrumentation. Input from participants allowed AGI staff to clarify questions and make slight modifications to the instrument.

To recruit individuals to participate in the research, AGI and AAG crafted a hardcopy letter that explained the study, impetus for the research, and an invitation to participate. This informational letter was physically mailed to the department head or chair's office for dissemination to faculty and administrators within each program. After receipt of the letter, department heads and chairs, administrators, counselors, and faculty received a series of 3 emails (the initial email about the study calling for participation with survey link and 2 follow-up reminder emails) between October 2013 and December 2013. Data collection continued in the spring semester 2014 and throughout the summer via direct contact with faculty, social media alumni groups, and dissemination of the survey to selected AGI member societies.

Data Analysis

Once data collection was completed, we imported the data into Microsoft Excel for quality control and analysis. Subsequent data analysis was performed using JMP, a statistical software package. In all of the faculty and student surveys, there were a series of qualifying questions to ensure we accurately collected data from the appropriate sample population:

- Faculty at 4-Year institutions in geology, geography, or hybrid departments that confer Master's degrees, but not doctoral degrees. Additionally, faculty who actively advise Master's students had an additional set of questions inquiring about advising practices.

- Students who are currently enrolled within a 4-Year institution in a Master's degree program which does not confer doctoral degrees, who are seeking to exit with a Master's degree.

- Non-academic professionals who graduated with their highest degree as a Master's. These professionals may or may not have come out of non-Ph.D. granting departments.

For those individuals who did not fit the above criteria, their data were not included in the analysis. This also included social/human geographers.

More than 350 participants qualified using the above criteria. This includes faculty and students in geology, geography, and hybrid programs, as well as non-academic professionals in geology and geography disciplines. We estimate from AGI's Directory of Geoscience Departments and through AAG's database that there was an average of 2,200 Master's students enrolled annually in non-Ph.D. preparatory programs between 2000 and 2013. Additionally, there were approximately 800 active faculty members within these programs in 2013. Thus, we estimate that approximately 3% of students and 14% of faculty completed our survey. Unfortunately, estimating the total number of professionals in the geoscience workforce based on the qualifying criteria is highly complex, so we were unable to determine a percentage of participation. However, from the faculty and student participation rates, we believe to have captured a representative dataset for this study.

Analyses measuring statistical differences between faculty, students, and non-academic professionals were completed for each of the questions for each type of department, as well as between different department types. For the statistical analyses, the "Not Applicable/I don't know" option was discarded because it is not measurable on the ordinal scale from "Not Prepared" to "Very Prepared", cited above. The Wilcoxon/Kruskal Wallis Tests (Rank Sums) were used: a 2-Sample Test with Normal Approximation and a 1-way Test, ChiSquare Approximation. For a full report of the statistical analyses, please visit www.americangeosciences.org/workforce/geo-career-maps.

Image submitted by Teresa Ubide to AGI's 2014 Life in the Field contest.

Acknowledgements

There are several organizations and individuals that were integral in the success of this project. First, I would like to express my sincere appreciation to the National Science Foundation for supporting the research. I would also like to thank my co-PI Michael Solem and my colleague Leila Gonzales for conceptualizing the project and demonstrating its utility to NSF. The members of my research team deserve equal gratitude: Joy Adams, Jamie Ricci, and Candice Luebbering. Thank you so much for all your hard work over the years helping develop the survey instrumentation, with data collection and with all the data analysis, interpretation, and dissemination! I would also like to thank AAG's Enhancing Departments and Graduate Education (EDGE) program and the National Association of State Boards of Geology (ASBOG) for contributing their expertise regarding geography and geology competencies, and for giving us the opportunity to present at your events. I would be remiss if I didn't thank all those who participated in the research. This study would have never happened without you! Thank you for taking the time to thoughtfully complete our survey. Finally, I would like to thank Brenna Tobler, Nicole Schmidgall, and Kathleen Cantner for their creativity and design work.

Contents

Section 1 — Demographics of Geoscience Career Master's Preparation Survey Participants

Since 2005, female enrollment at four-year institutions has hovered around 57%, which is comparable to the percentage of female students enrolled at two-year institutions (Wilson, 2014). Specifically in the geosciences, female enrollments for Bachelor's, Master's, and Doctoral candidates hovered around 40%, 40-45%, and 40-45% respectively, between 2010 and 2012 (Wilson, 2014). During this timeframe, it appears that there was a decline in female enrollments; however, the actual number of female students in geoscience departments was increasing. The apparent downward trends for female enrollments were due to a large increase in male enrollments.

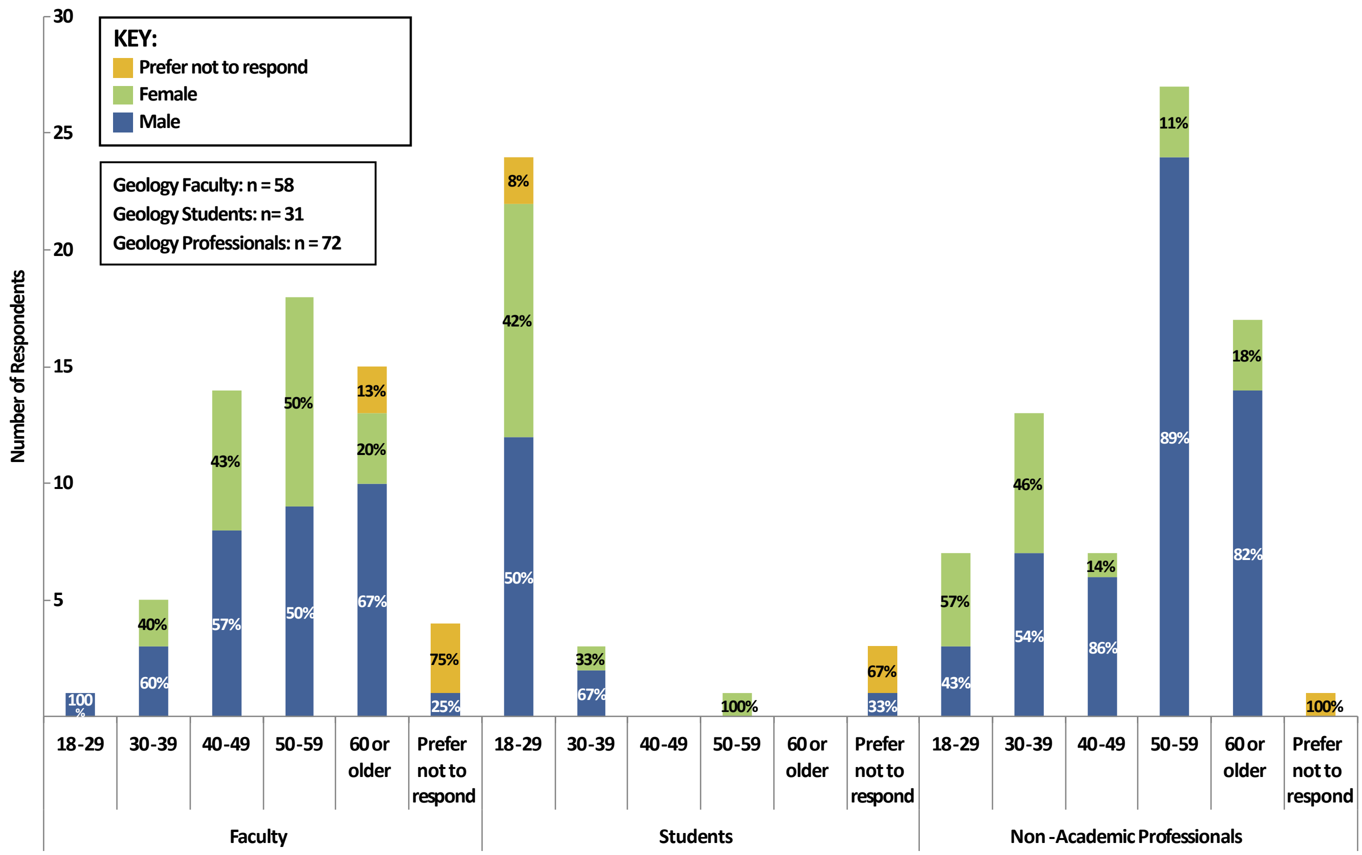
The demographics of science, technology, engineering, and mathematics (STEM) communities do not reflect the general ethnic and racial diversity in today's U.S. population. Geoscientists of diverse ethnic or racial backgrounds comprise approximately 6-8% of the total U.S. geoscience workforce. However, this includes multiracial data, which increases the percentages because some individuals that had traditionally not been counted are now considered underrepresented minorities. This participation rate of underrepresented geoscientists is lower than the participation rate of other STEM disciplines (Wilson, 2014).

The gender and demographic data presented in this report align with these overall trends, despite our small sample sizes. Additionally, multiracial data were not double counted, thus the percentages are not inflated due to individuals with dual or mixed racial/ethnic backgrounds.

Image submitted by Benjamin Surpless to AGI's 2014 Life in the Field contest.

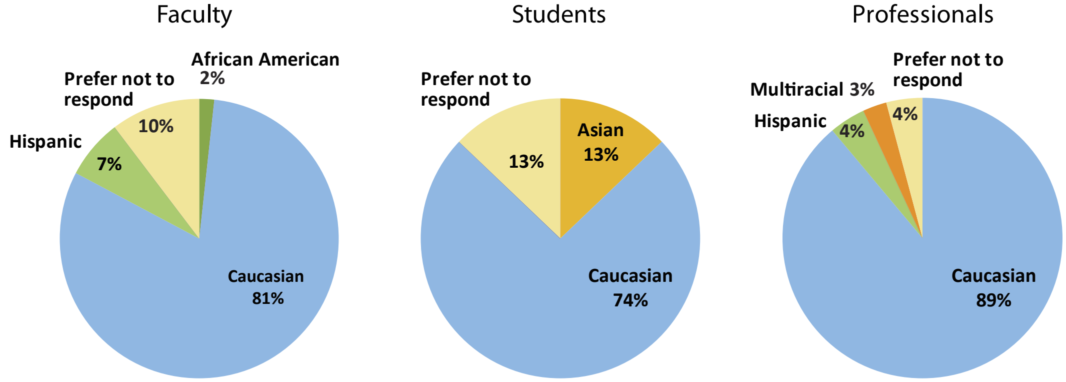
GEOLOGY

Figure 1.1: Age and Gender of Geology Respondents



In Geology, our survey participants' age and gender trends mirror those in the broader geoscience community. The majority of faculty participants are males 40 years of age or older, though of those between the ages of 50 and 59, half are men and half are women. Our student respondents are primarily 29 years of age or younger, with the majority being male. These male-dominant trends in academia reflect those in the private sector; an overwhelming proportion of geology participants 30 years of age and older is male: 86% of participating private sector geologists ages 40-49 are male and 89% of those ages 50-59 are male.

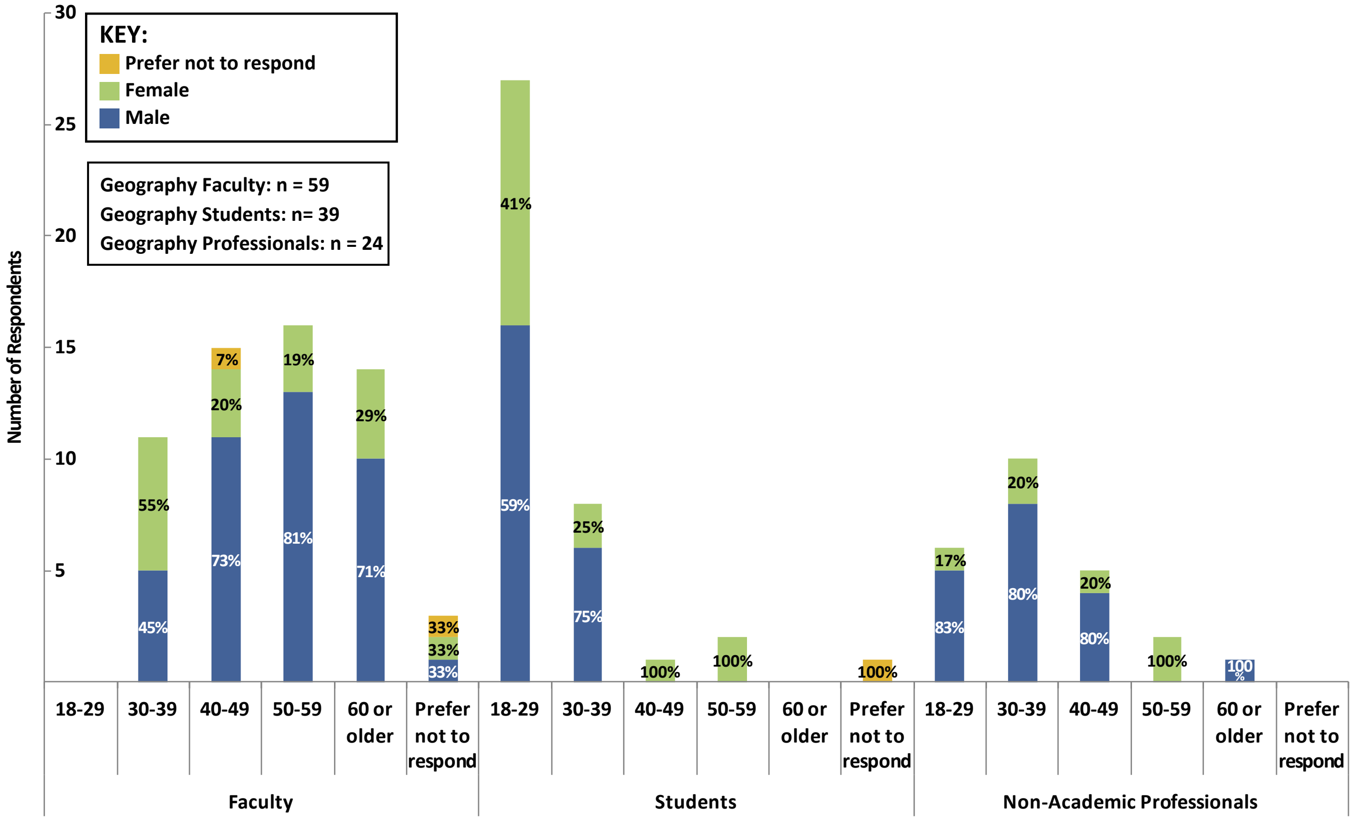
Figure 1.2: Race and Ethnicity Demographics for Geology Respondents



The majority of geology faculty are Caucasian, with fewer than 10% being from underrepresented groups. Students who responded to the survey are primarily Caucasian; there were no traditionally underrepresented geoscience students who participated in our survey. Lastly, 7% of our non-academic professionals are from underrepresented groups, and an overwhelming 89% are Caucasian.

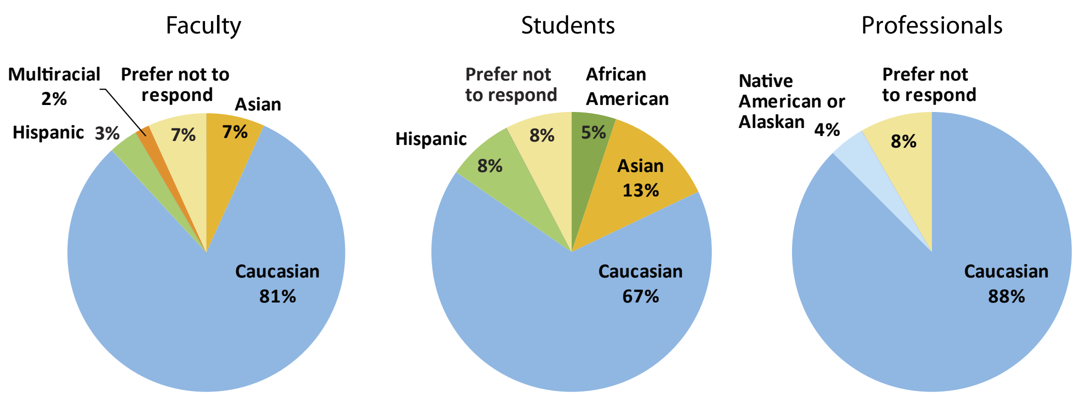
GEOGRAPHY

Figure 1.3: Age and Gender of Geography Respondents



Geography survey participants' age and gender trends mirror those of our geology respondents, as well as those of the broader geoscience population. Faculty respondents who are 40 years of age and older tend to be male, and 81% of those between the ages of 50 and 59 are male. Students are primarily under the age of 30; however, a larger group of the responding students ages 30–39 is studying geography than geology. Most of these older students are male (75%). Non-academic participants tended to be male (over 80%), and younger than 40 years of age.

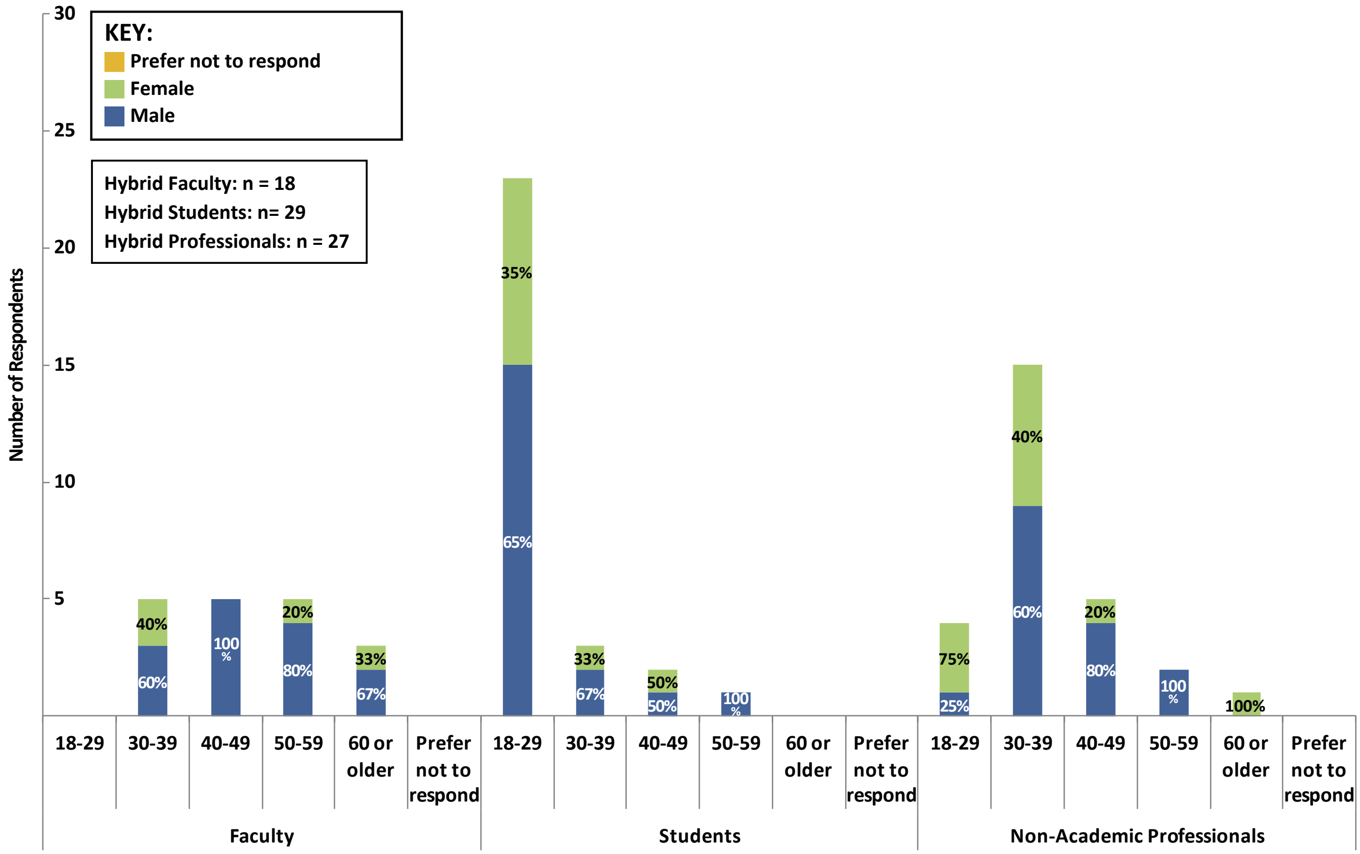
Figure 1.4: Race and Ethnicity Demographics for Geography Respondents



Similar to geology faculty, the majority of our geography faculty participants are Caucasian, with 5% from underrepresented groups. Geography students are a little more diverse, with 67% Caucasian and 13% from underrepresented groups. However, only 4% of our non-academic respondents are from underrepresented groups, with the majority of individuals being Caucasian.

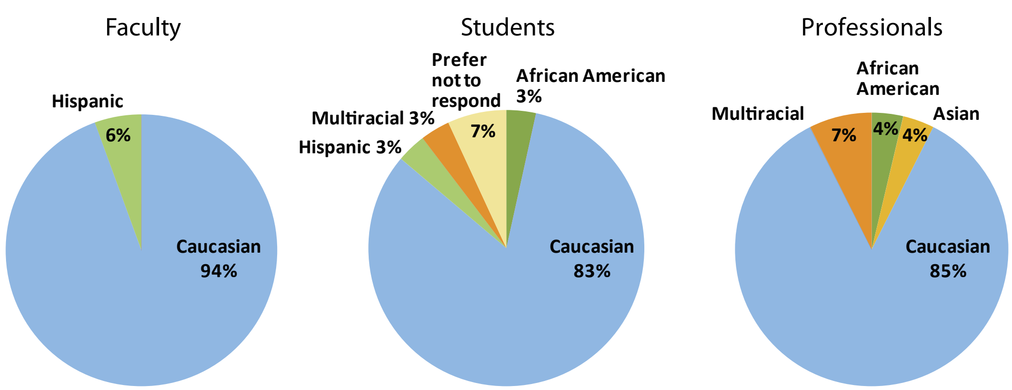
HYBRID

Figure 1.5: Age and Gender of Hybrid Respondents



Faculty and student respondents in hybrid geology-geography departments are predominantly male, similar to the trends observed in geology and geography Master's degree programs. The majority of students are under 30 years of age, yet similar to geography, there are several students over the age of 30. Non-academic professionals are mostly under 50 years of age, and representation is more gender-balanced then for their academic counterparts.

Figure 1.6: Race and Ethnicity Demographics for Hybrid Respondents



Most of our hybrid respondents are Caucasian (94% of faculty, 83% of students, and 85% of professionals). Student and professional participants are more diverse than faculty participants, with 9% and 11% from underrepresented groups, respectively.

Understanding students' reasons for choosing a Master's program and how the program has influenced their career goals are important for assessing programs' abilities to prepare graduates to transition into meaningful geoscience careers. Additionally, data about financial support available to students are also reported. This section aims to paint a broad picture of the Master's degree programs sampled in the study. These data are not meant to provide generalizations about all Master's programs, but rather illuminate emerging trends within our small sample.

Decisions to Enroll

The first set of graphs explains students' reasons for enrolling in their Master's degree programs. The graphs compare students within geology, geography, and hybrid departments. Specifically, the survey asked students, "How important were the following factors in your decision to enroll in your current graduate program?" Students indicated how important 23 different items were regarding their decisions to enroll in their Master's programs.

Geology: n= 31 responses
Geography: n = 39 responses
Hybrid: n = 28 responses

KEY:
- Very Important
- Important
- Somewhat Important
- Not Important
- Not Applicable/ I don't know

Figure 2.1: Students' Decisions to Enroll in a Graduate Program, part 1

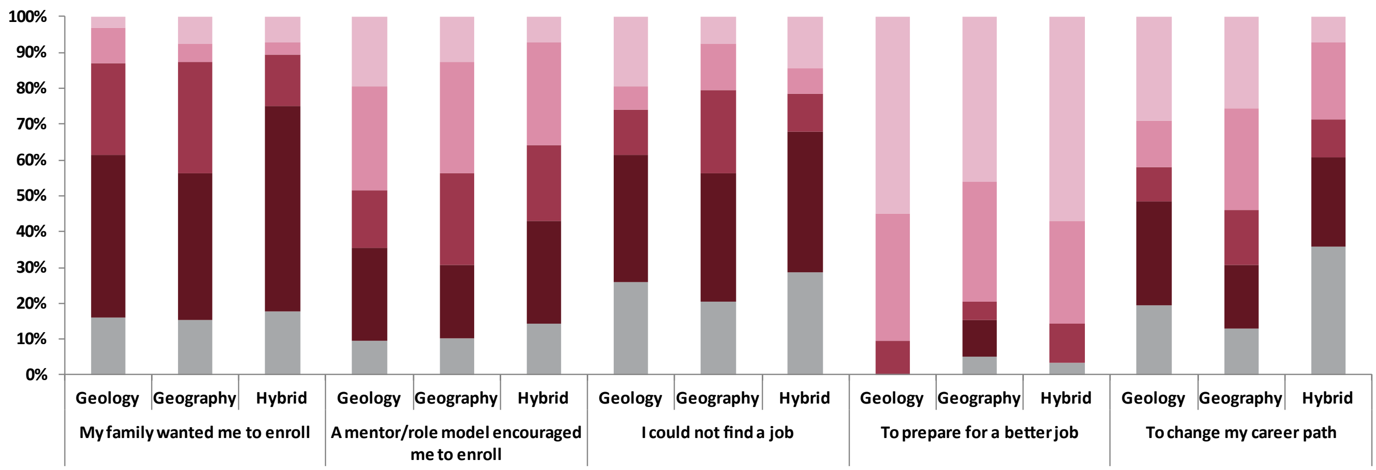


Figure 2.2: Students' Decisions to Enroll in a Graduate Program, part 2

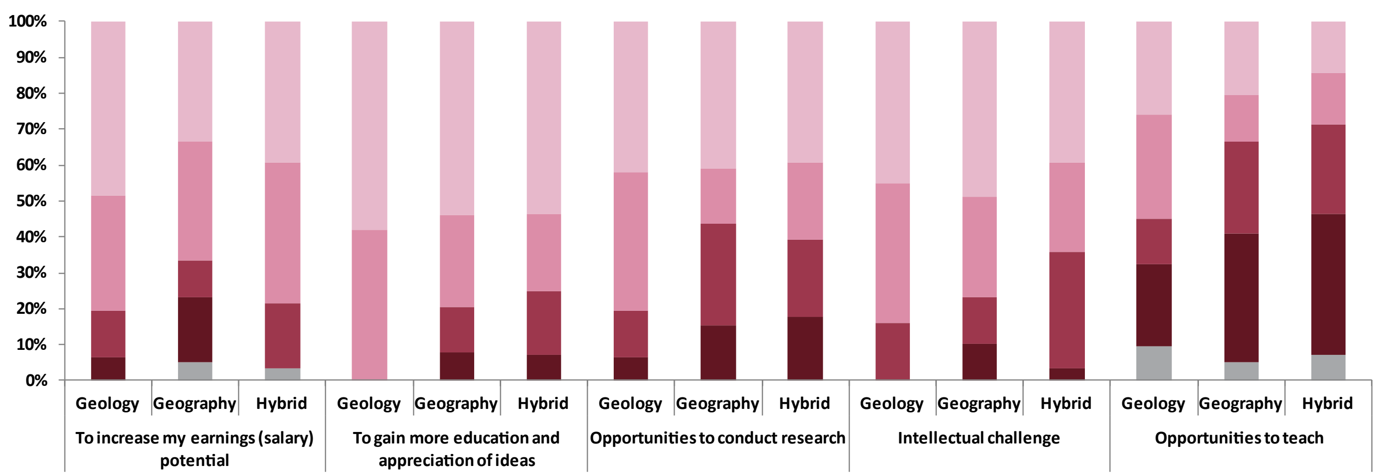


Figure 2.3: Students' Decisions to Enroll in a Graduate Program, part 3

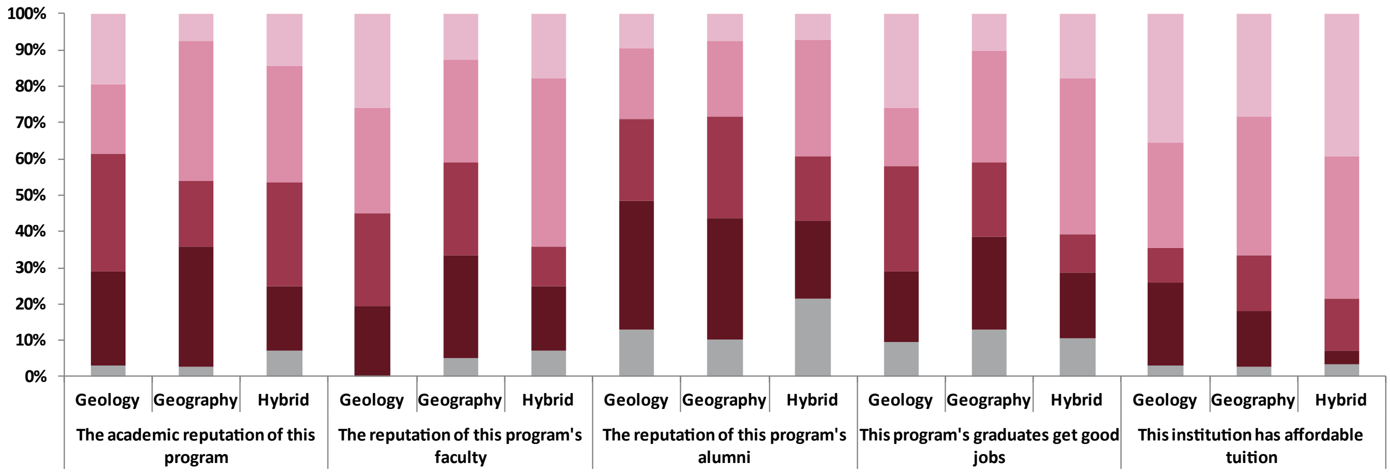


Figure 2.4: Students' Decisions to Enroll in a Graduate Program, part 4

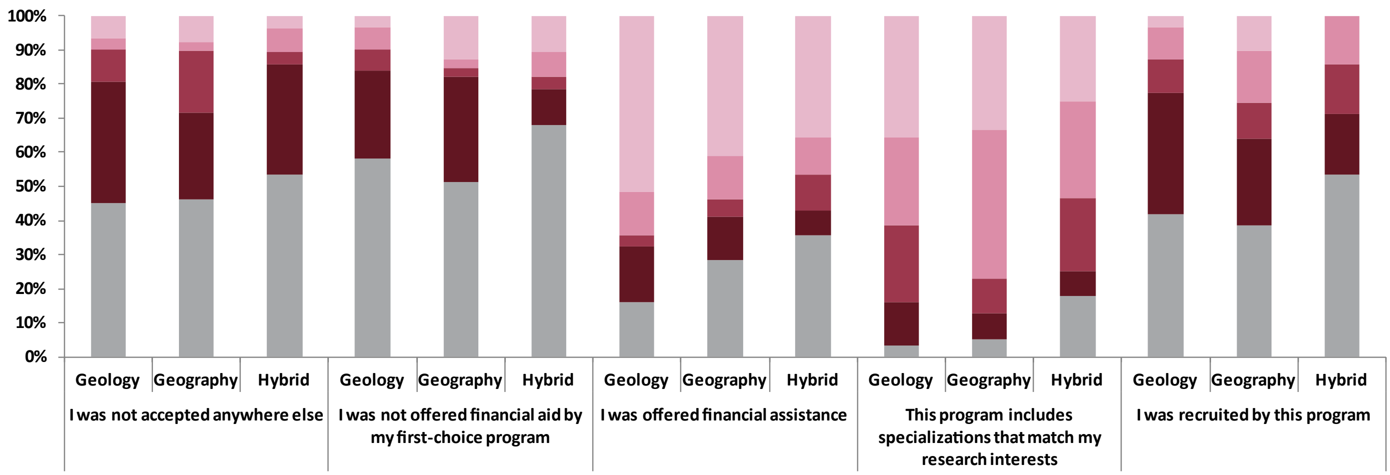
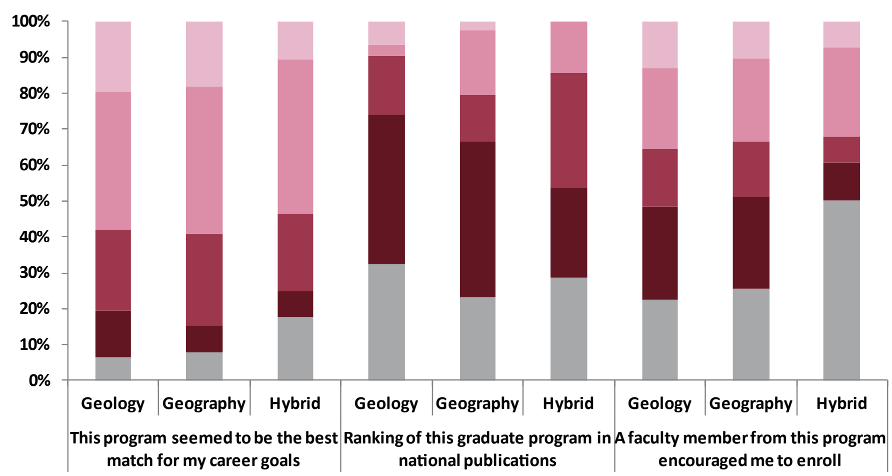


Figure 2.5: Students' Decisions to Enroll in a Graduate Program, part 5



Influences

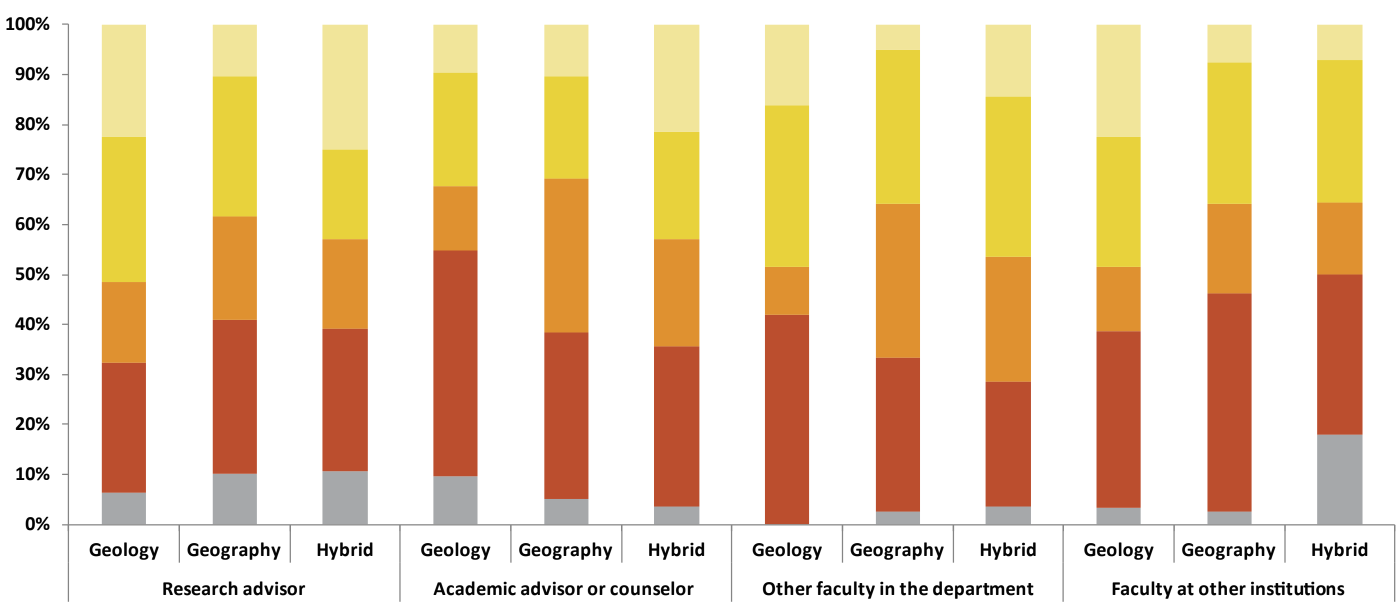
This set of graphs shows what factors, internal and external to their degree programs, were most and least influential to students for pursuing their career goals. The survey asked students, "To what extent has each of the following individuals, resources, or experiences influenced your #1 career goal?"

First, data were collected specifically to understand students' number one career goals; the survey specifically inquired, "In a sentence or two, please describe your current #1 career goal." Students' answers ranged from short-term goals such as simply completing the degree or obtaining a permanent position of employment, to goals which were more sentimental (e.g., find a job that I love and get to travel). Those students who had more practical career goals cited specific occupations within the academic, government, or private sectors. Looking specifically across geology programs, students' most common career goals included working in the private sector within education, environmental consulting, and energy exploration with many aspiring towards management positions within a company. In geography departments, Master's students are looking to pursue teaching and education careers, work in the Geographic Information System (GIS) field, in preservation and conservation, meteorology, or in industry in general. Students who are enrolled in hybrid geology-geography programs have more variability in their career goals. Their goals ranged from pursuing careers in GIS, environmental, conservation, or water resource challenges to careers in geochemistry, economic geology, education and museums, or energy exploration.

KEY:
- Very Influential
- Influential
- Somewhat Influential
- Not Influential
- Not Applicable/ I don't know

Geology: n= 31 responses
Geography: n = 39 responses
Hybrid: n = 28 responses

Figure 2.6: Influences on Students' Career Goals, part 1



KEY:
- Very Influential
- Influential
- Somewhat Influential
- Not Influential
- Not Applicable/ I don't know

Figure 2.7: Influences on Students' Career Goals, part 2

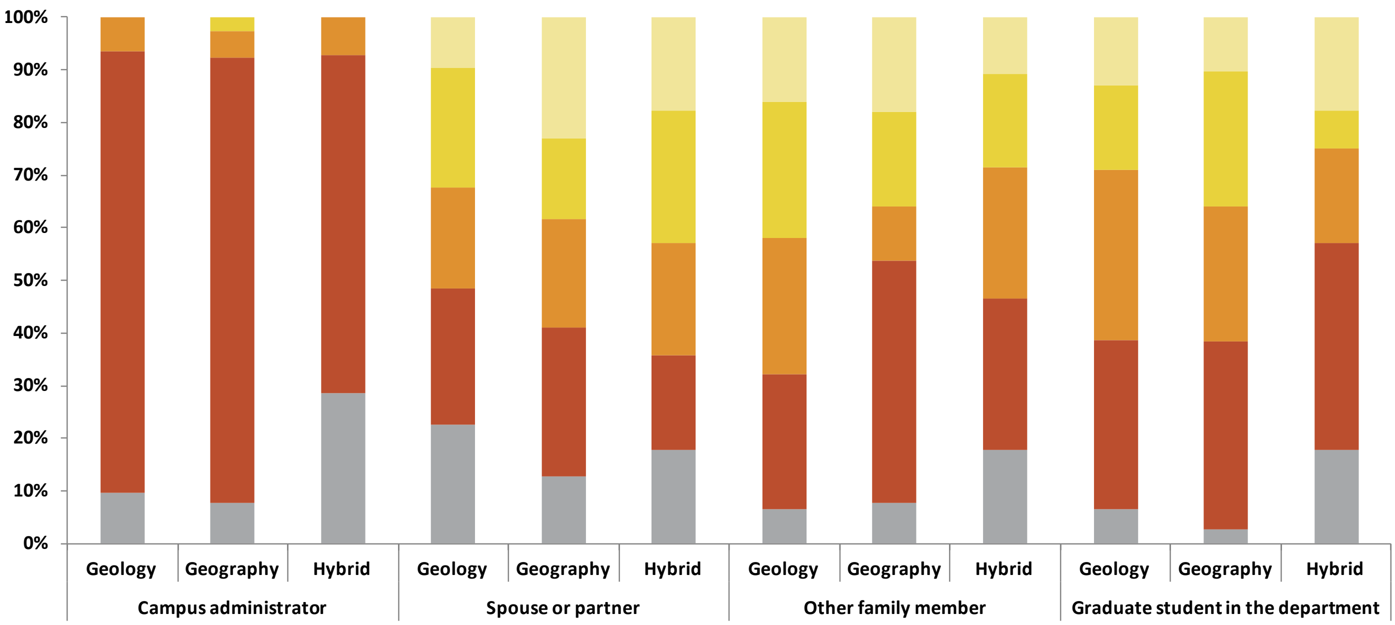
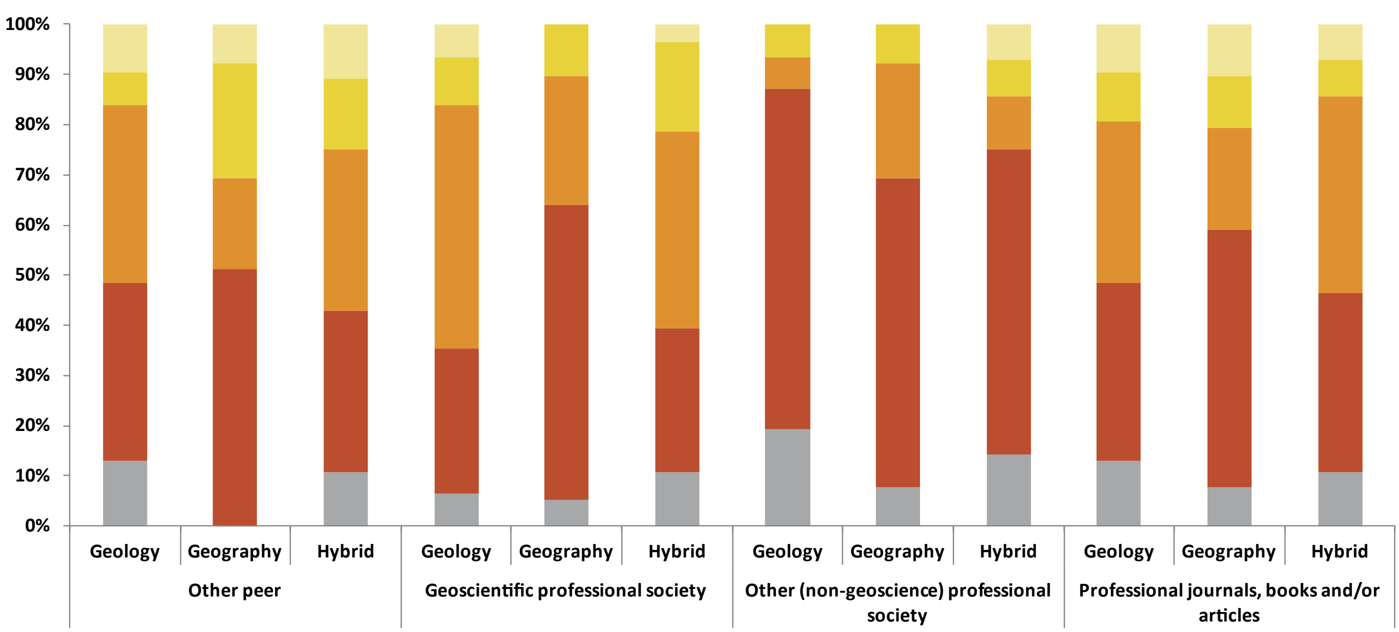


Figure 2.8: Influences on Students' Career Goals, part 3



KEY:
- Very Influential
- Influential
- Somewhat Influential
- Not Influential
- Not Applicable/ I don't know

Figure 2.9: Influences on Students' Career Goals, part 4

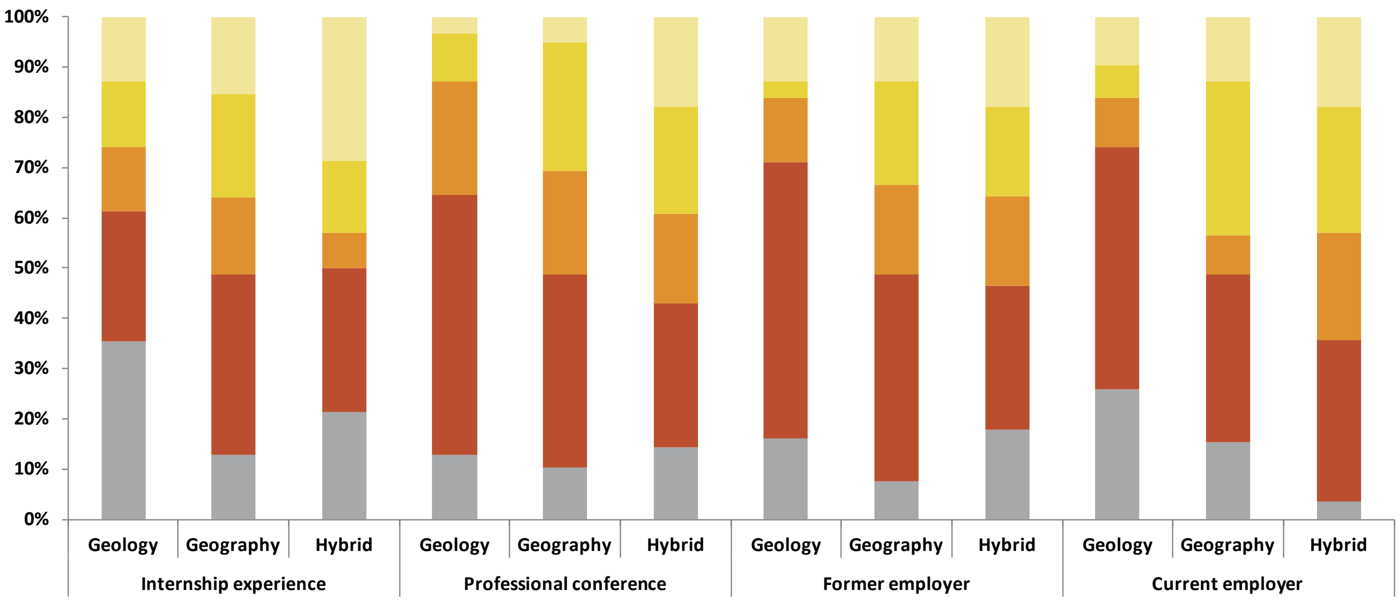
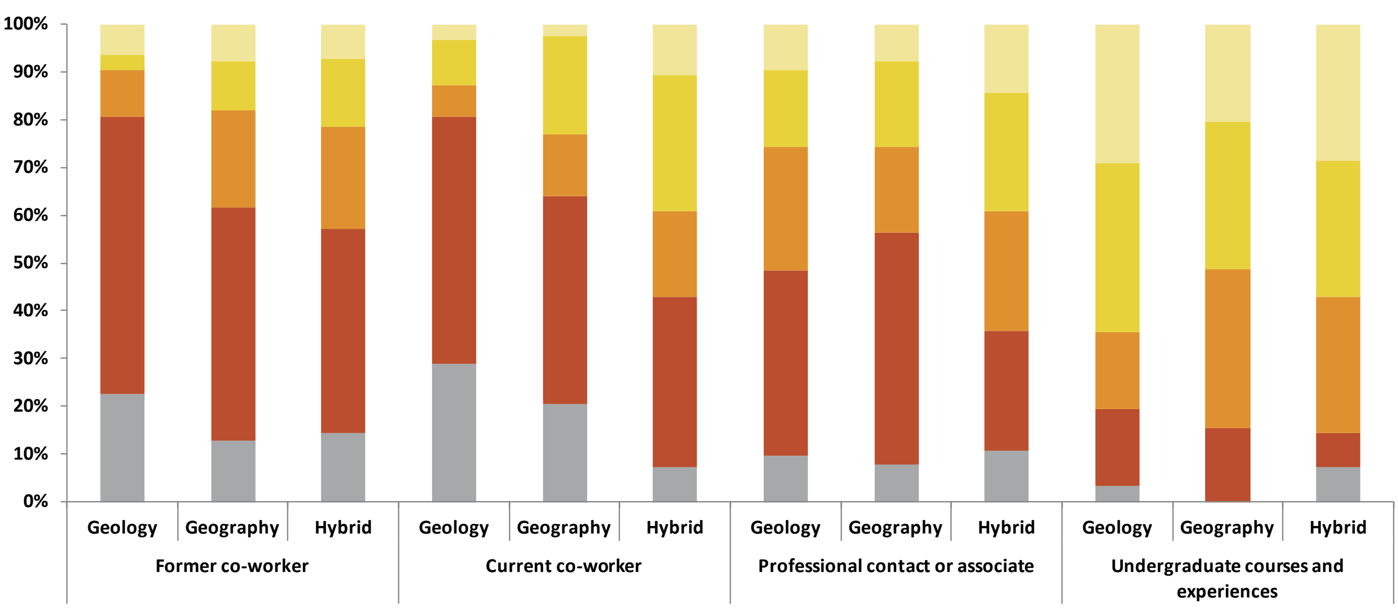


Figure 2.10: Influences on Students' Career Goals, part 5



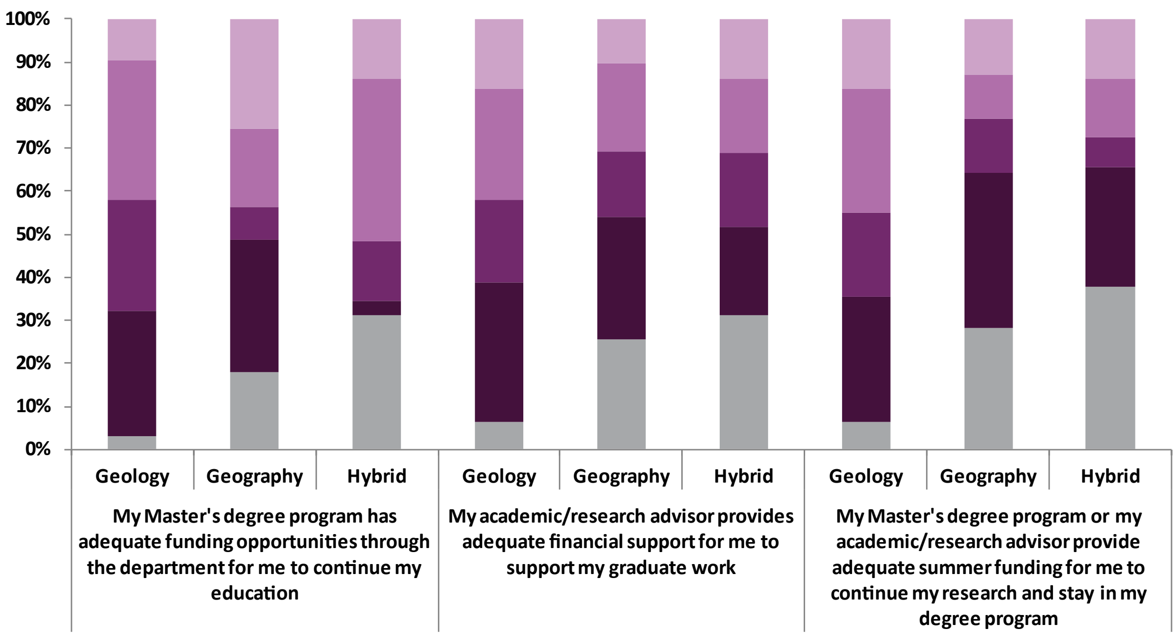
Financial Support

This graph shows students' responses to questions regarding funding opportunities and financial support in geology, geography, and hybrid programs. The survey question stated, "Indicate your agreement with the following statements about financial support."

KEY:
- Strongly Agree
- Agree
- Somewhat Agree
- Do Not Agree
- Not Applicable/ I don't know

Geology: n= 31 responses
Geography: n = 39 responses
Hybrid: n = 29 responses

Figure 2.11: Students' Financial Support in Master's Degree Programs



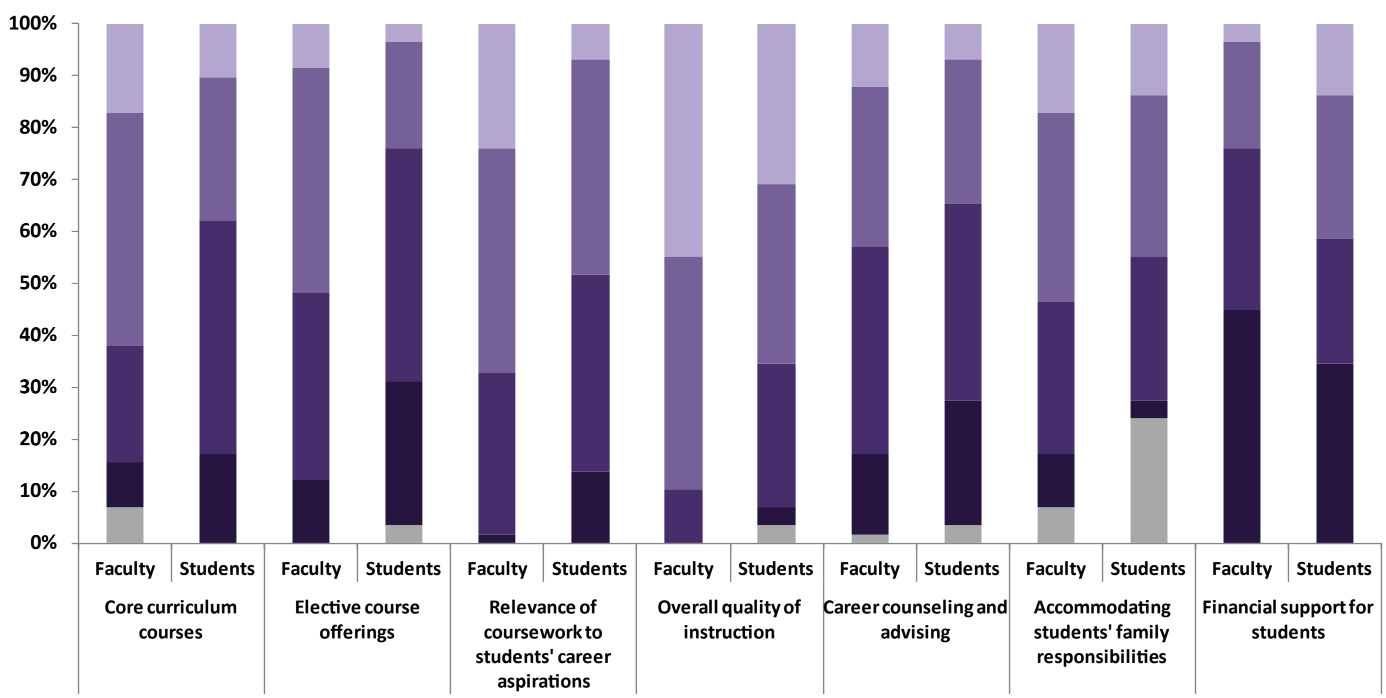
Section 3 — Faculty and Students' Satisfaction with Departments

Faculty and students were asked to rate the level of satisfaction they have with their Master's degree programs. The survey asked faculty, "Rate your level of satisfaction with the following aspects of your department's Master's degree program." Similarly, students responded to, "How satisfied are you with the following aspects of your Master's degree program?" The survey listed 22 items for faculty and students to rate. Below are nine graphs rating faculty and students' satisfaction with their Master's programs in geology, geography, and hybrid departments.

KEY:
- Very Satisfied
- Satisfied
- Somewhat Satisfied
- Not Satisfied
- Not Applicable/ I don't know

Geology Faculty: n = 58
Geology Students: n= 31

Figure 3.1: Satisfaction with Geology Departments, part 1



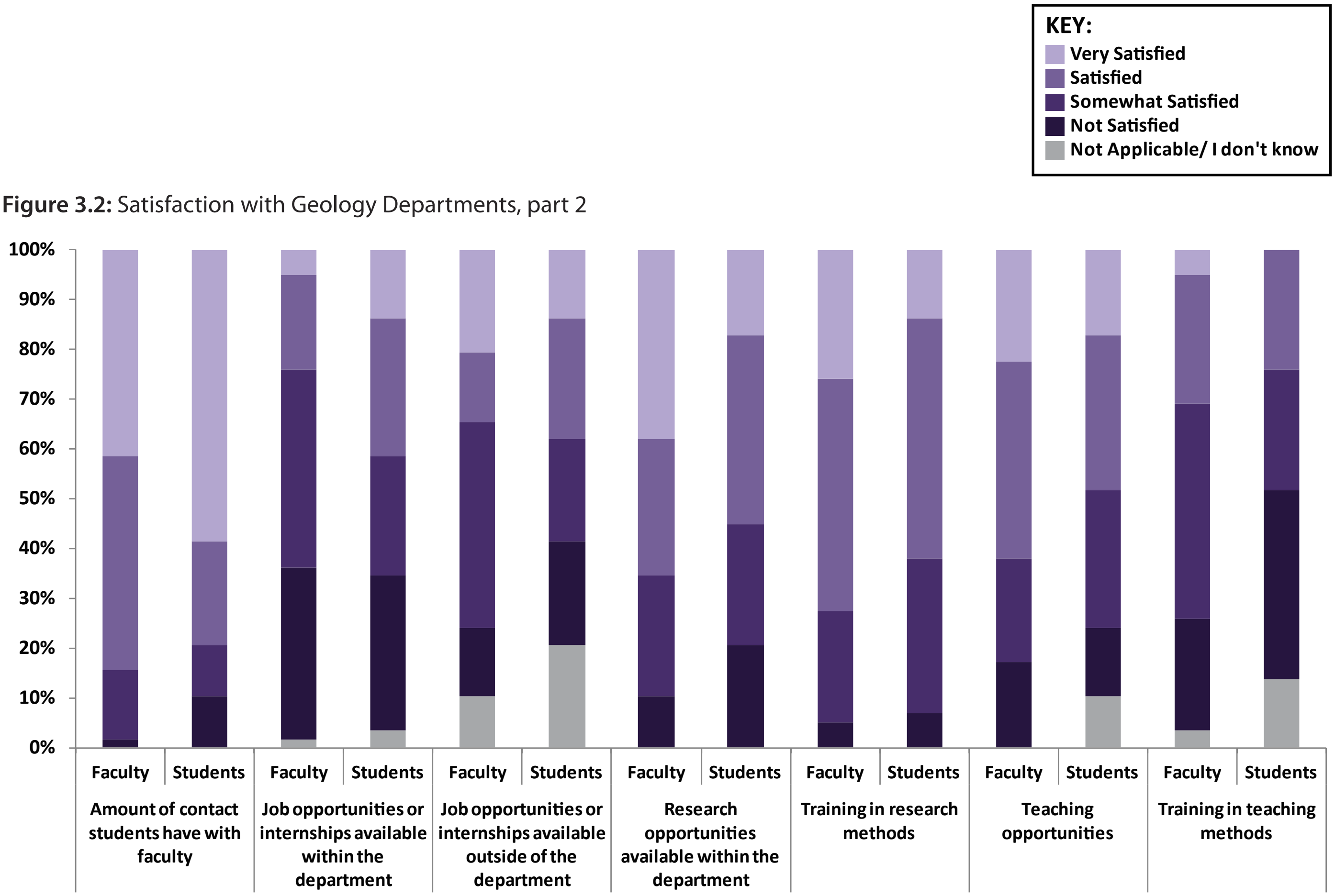


Figure 3.2: Satisfaction with Geology Departments, part 2

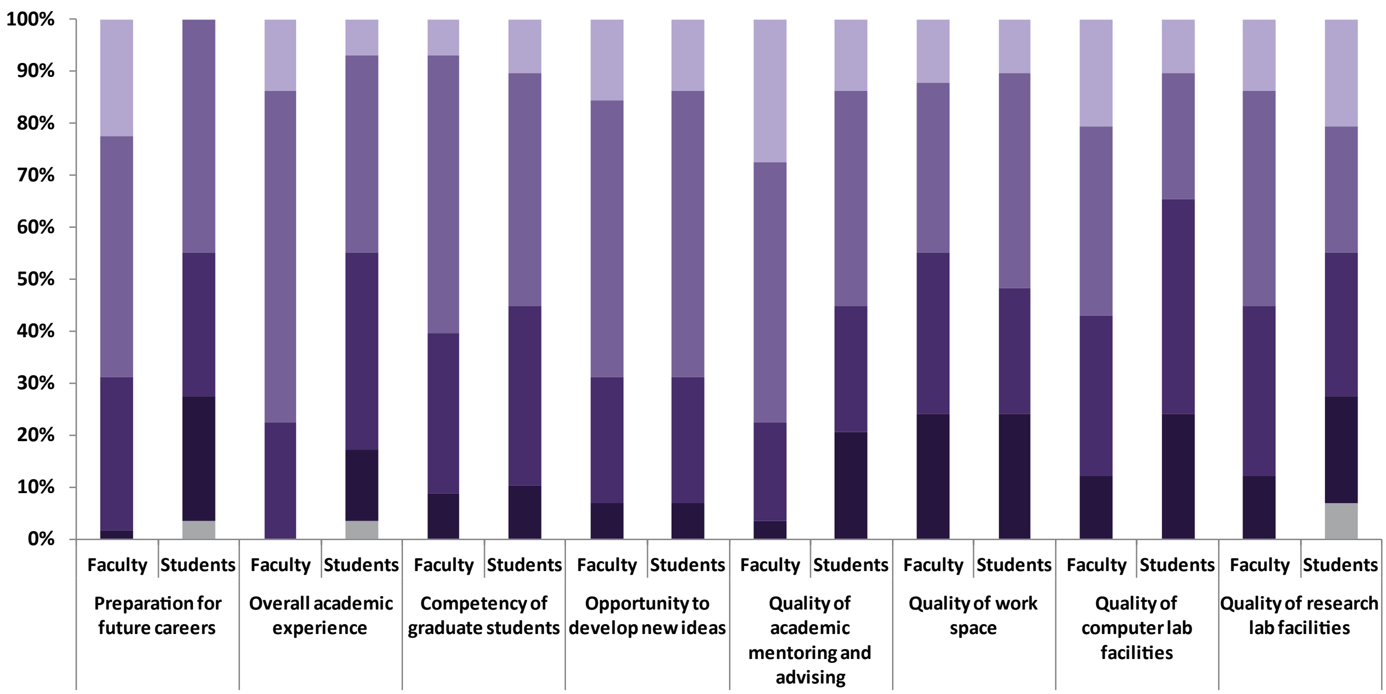


Figure 3.3: Satisfaction with Geology Departments, part 3

GEOGRAPHY

Figure 3.4: Satisfaction with Geography Departments, part 1

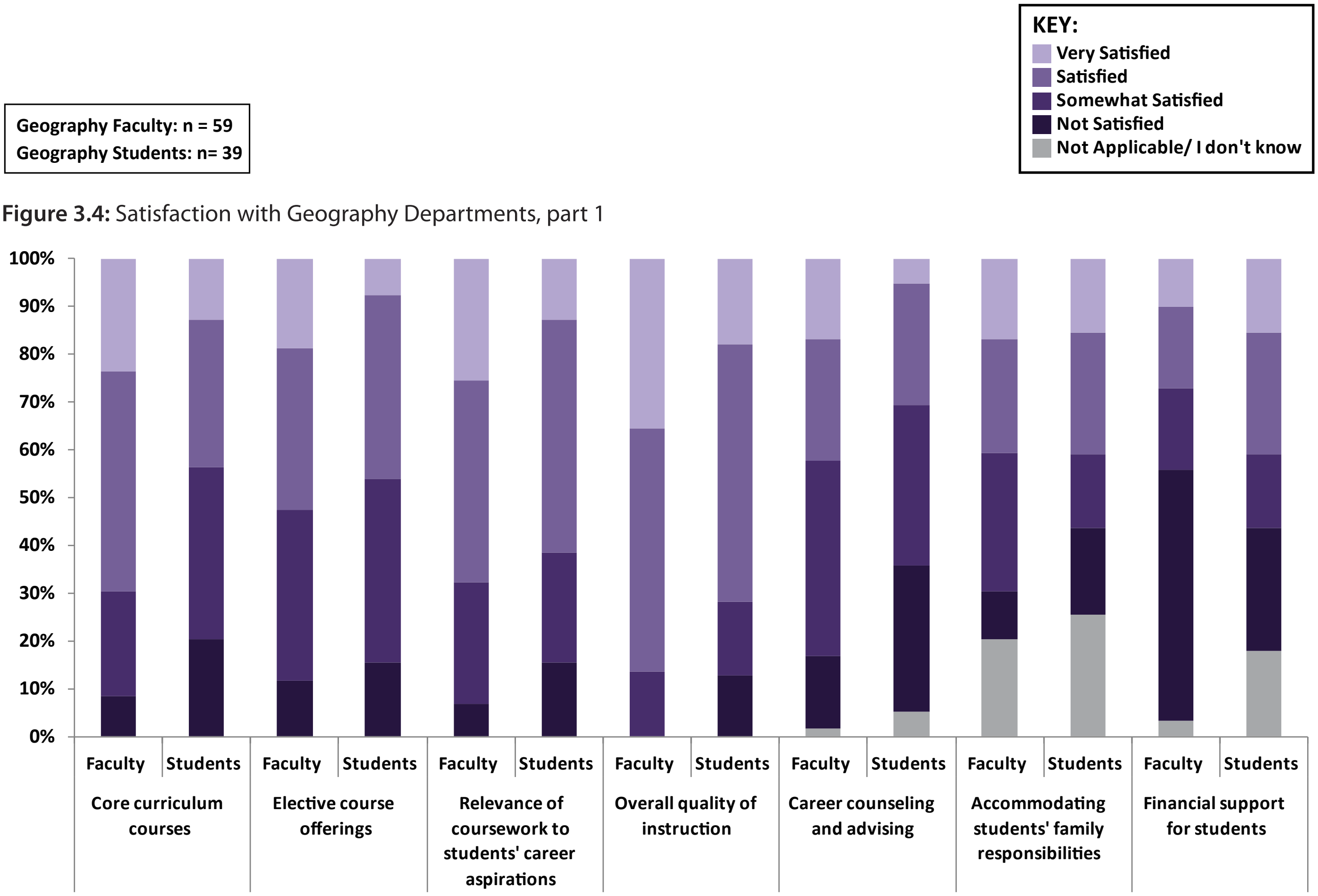


Image submitted by Ulyana Nadia Horodyskyj to AGI's 2014 Life in the Field contest.

Figure 3.5: Satisfaction with Geography Departments, part 2

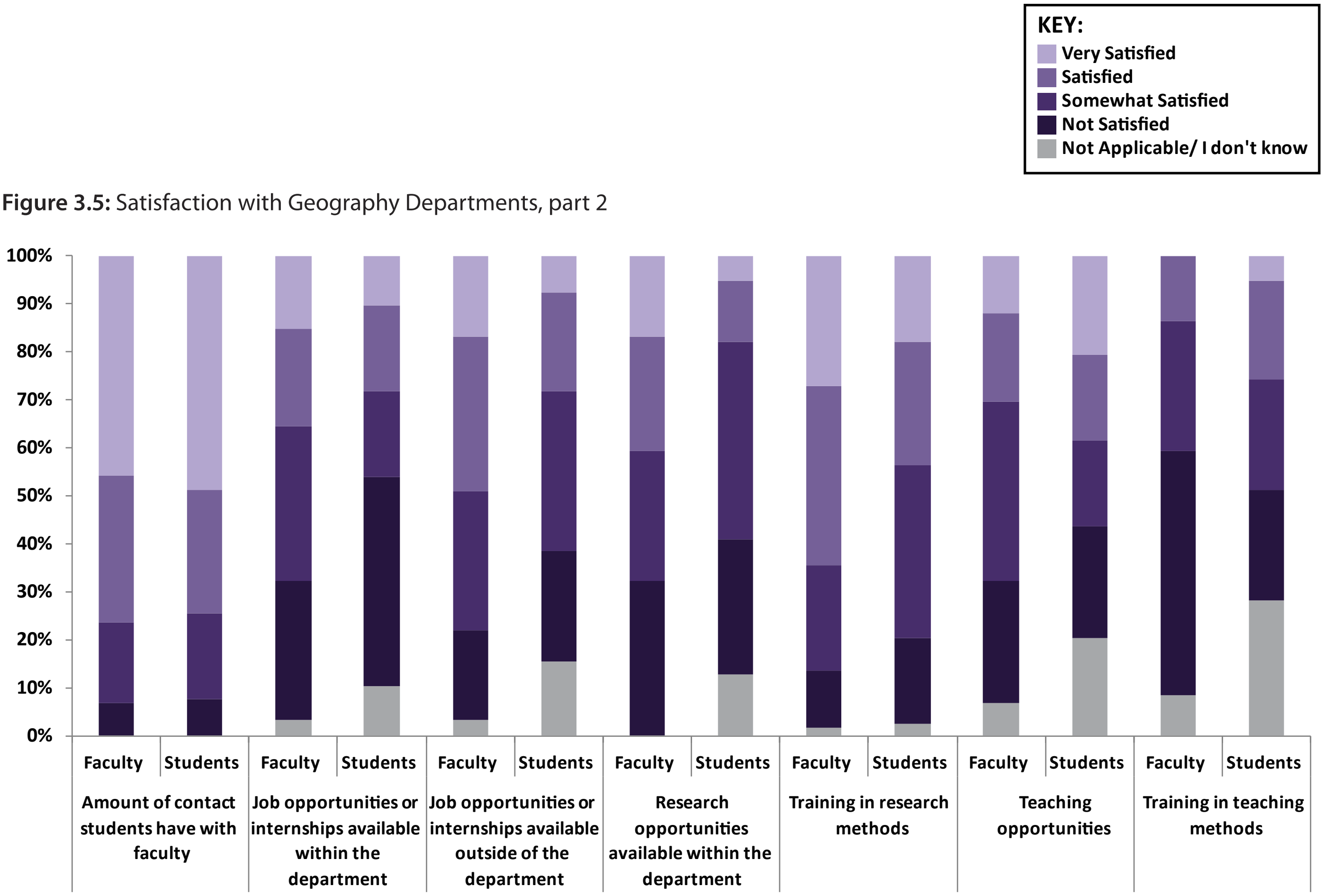
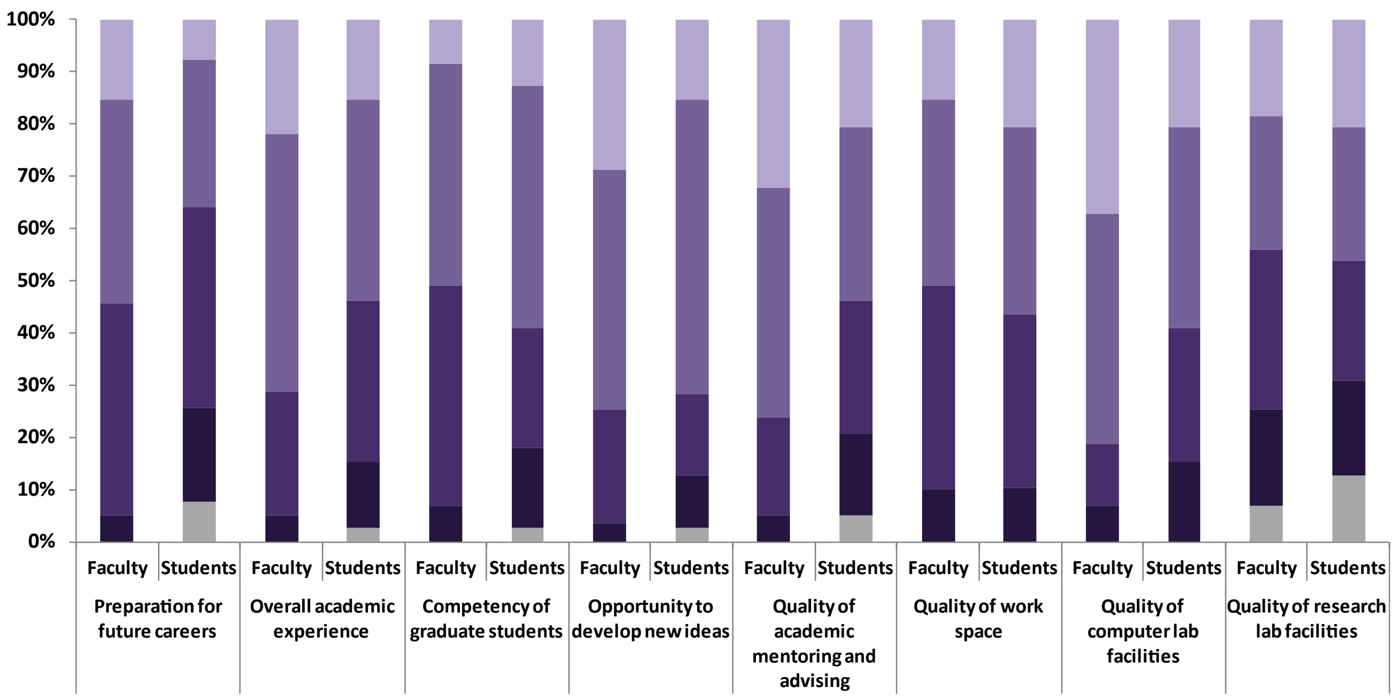


Figure 3.6: Satisfaction with Geography Departments, part 3



HYBRID

Hybrid Faculty: n = 18
Hybrid Students: n= 29

Figure 3.7: Satisfaction with Hybrid Departments, part 1

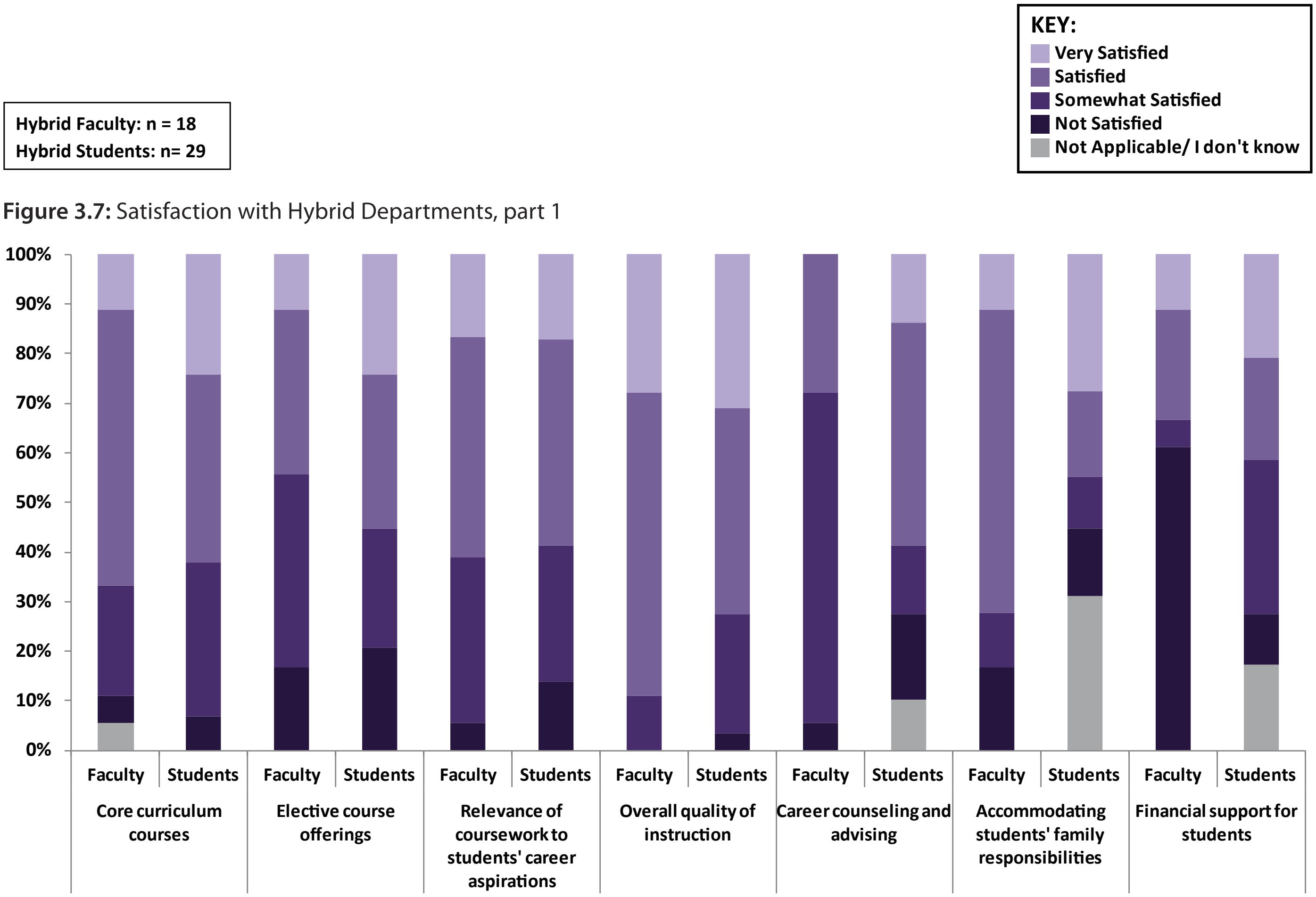


Image submitted by Reed Maxwell to AGI's 2014 Life in the Field contest.

KEY:
- Very Satisfied
- Satisfied
- Somewhat Satisfied
- Not Satisfied
- Not Applicable/ I don't know

Figure 3.8: Satisfaction with Hybrid Departments, part 2

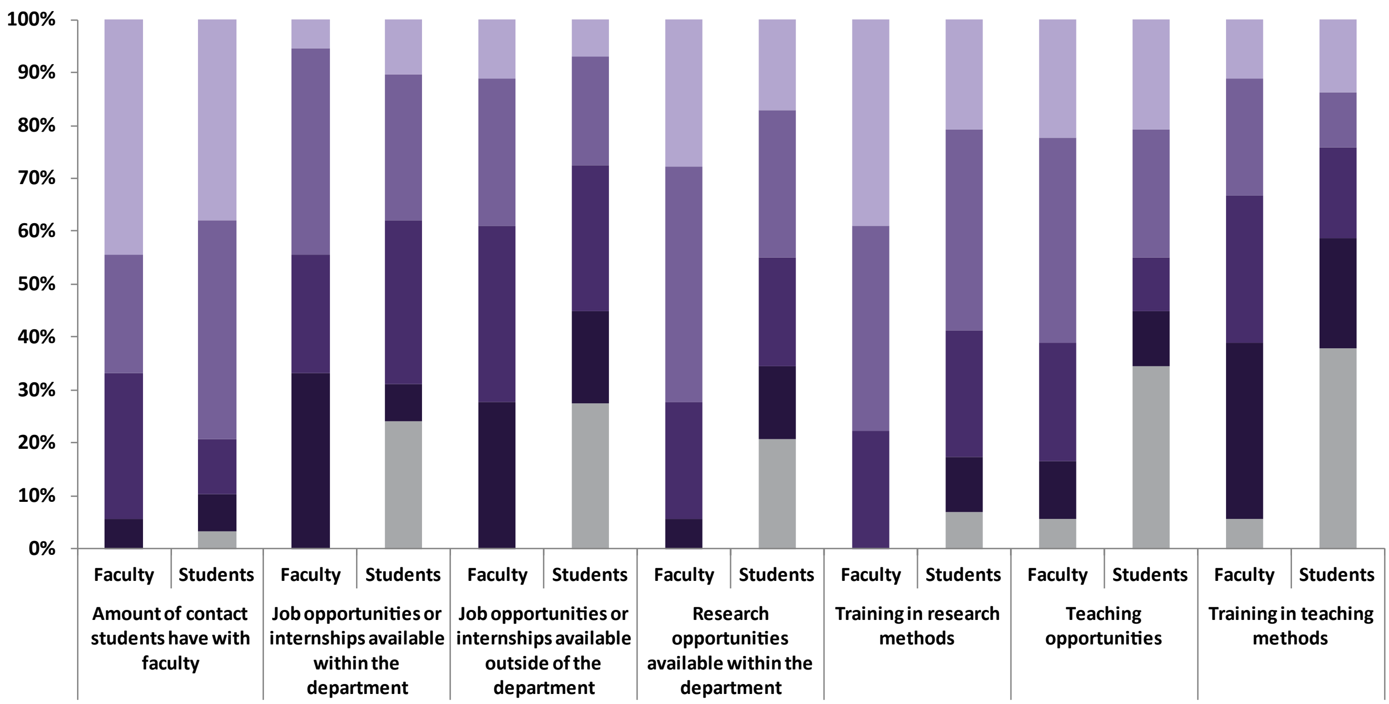
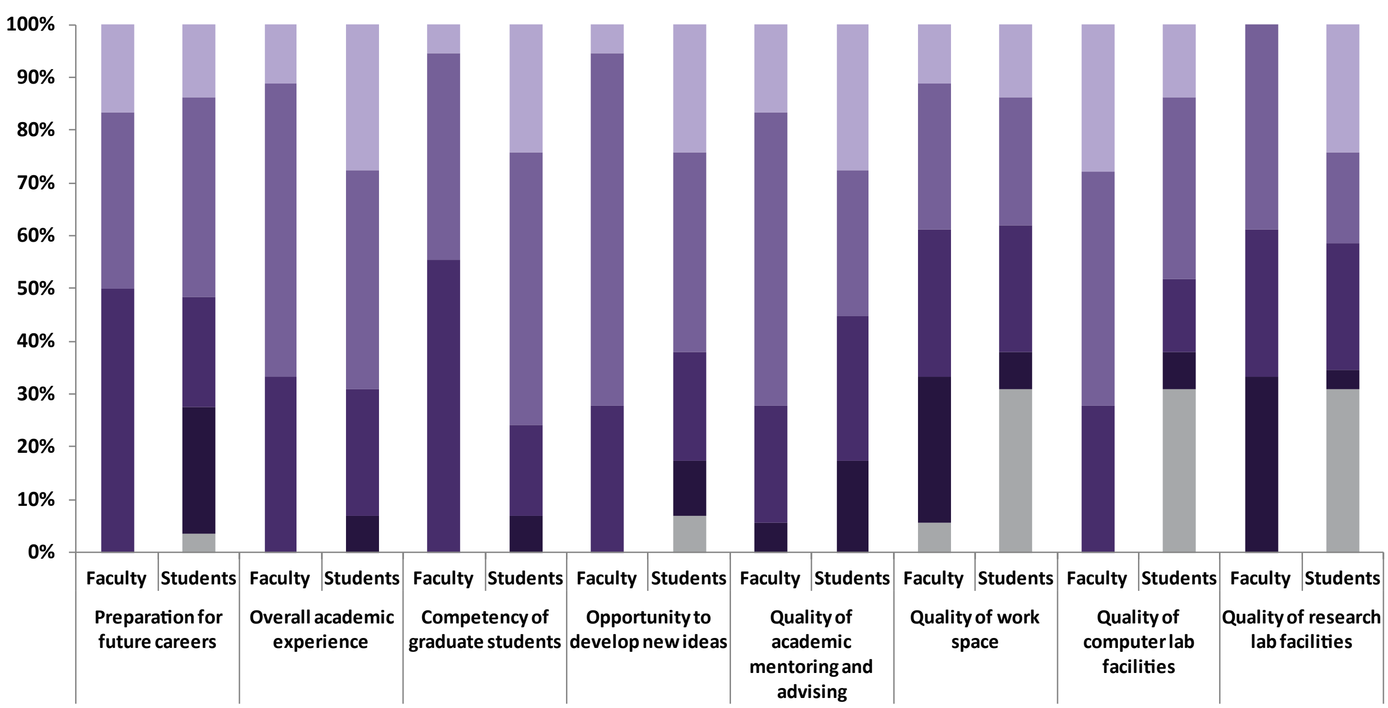


Figure 3.9: Satisfaction with Hybrid Departments, part 3



Section 4 — Types of Positions Taken by Students

Similar to understanding students' experiences and reasons for choosing a Master's degree program, the types of careers students pursue after graduating from their programs is reflective of those Master's programs and how well they prepare students to enter the workforce. We present data regarding the types of positions that current students intend on pursuing and present data on what positions faculty say their graduates have accepted post-graduation. We compare the intended and secured positions to the types of positions currently held by non-academic professionals. It is important to note that the highest degree received by these non-academic professional participants is the Master's degree. This analysis helps identify potential deviations between intent and outcomes of graduates or potential shifts in the nature of the job market.

Faculty were asked about the types of positions their students have accepted post-graduation from their Master's degree programs, "How often do your Master's advisees secure each of these types of positions post-graduation?" Students were asked about the types of positions they want to pursue once they graduate, "How likely are you to consider the following career choices after completing your graduate program?"

We compare these data to pie charts that report the types of positions that non-academic professionals secured after completing their Master's degree. Note that some respondents cited more than one type of position they secured after graduation. Non-academic professionals from geography and hybrid programs who indicated "other" include being employed during their Master's program, and being employed as a Research Associate at a university after graduation.

Additionally, we compare the results to what non-academic professionals indicated as the types of positions they currently hold in their careers. Non-academic professionals were asked, "Which of the following positions did you secure after graduating from your Master's degree program?" and "Which of the following best describes your current position?"

Image submitted by Robyn Haney of Global Geophysical Services to AGI's 2014 Life in the Field contest.

GEOLOGY

KEY:
- Very Often/Likely
- Often/Likely
- Somewhat Often/Likely
- Not Often/Likely
- Not Applicable/ I don't know

Geology Faculty: n = 58
Geology Students: n= 31
Geology Professionals: n = 72

Figure 4.1: Geology Students' Accepted/Desired Positions

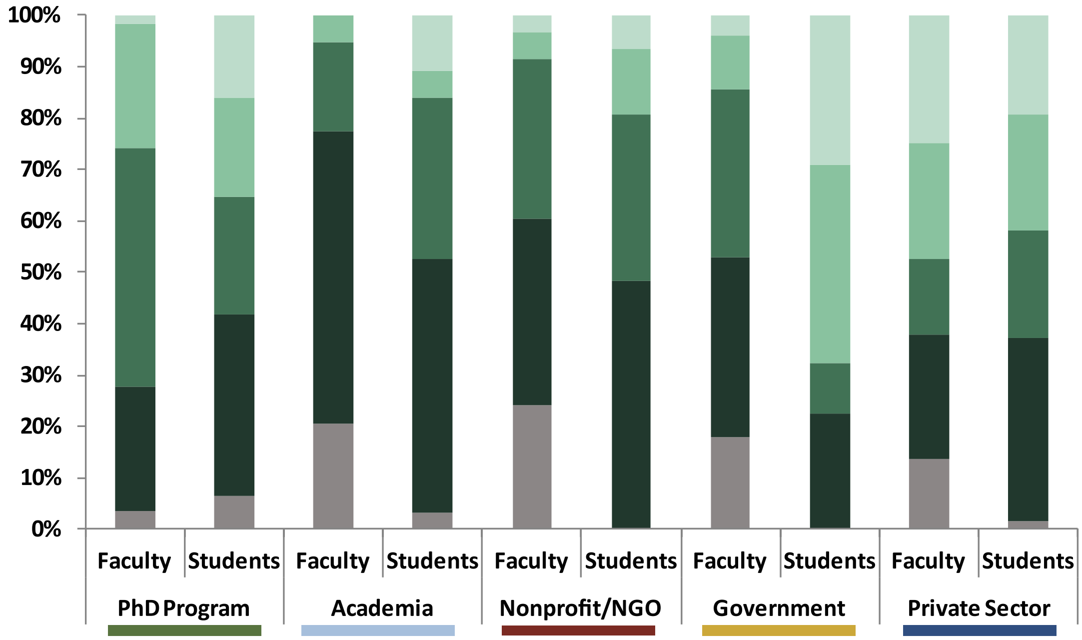
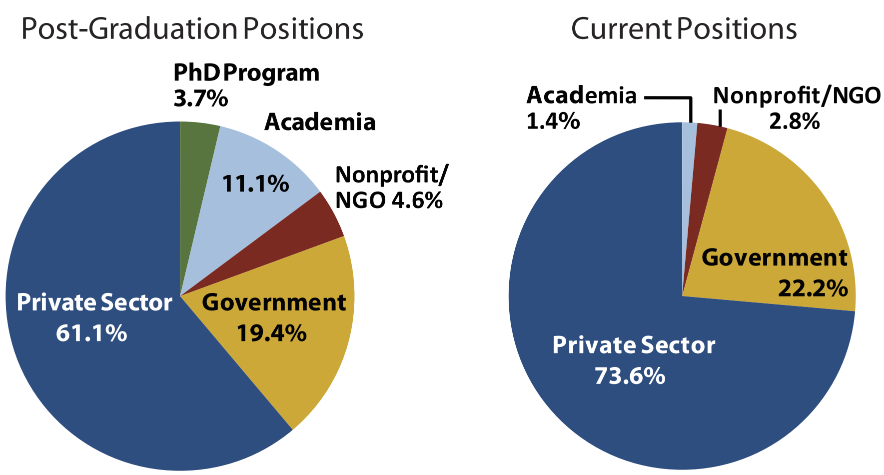


Figure 4.2: Geology Professionals' Post-graduate and Current Positions



GEOGRAPHY

KEY:
- Very Often/Likely
- Often/Likely
- Somewhat Often/Likely
- Not Often/Likely
- Not Applicable/ I don't know

Geography Faculty: n = 59
Geography Students: n= 39
Geography Professionals: n = 24

Figure 4.3: Geography Students' Accepted/Desired Positions

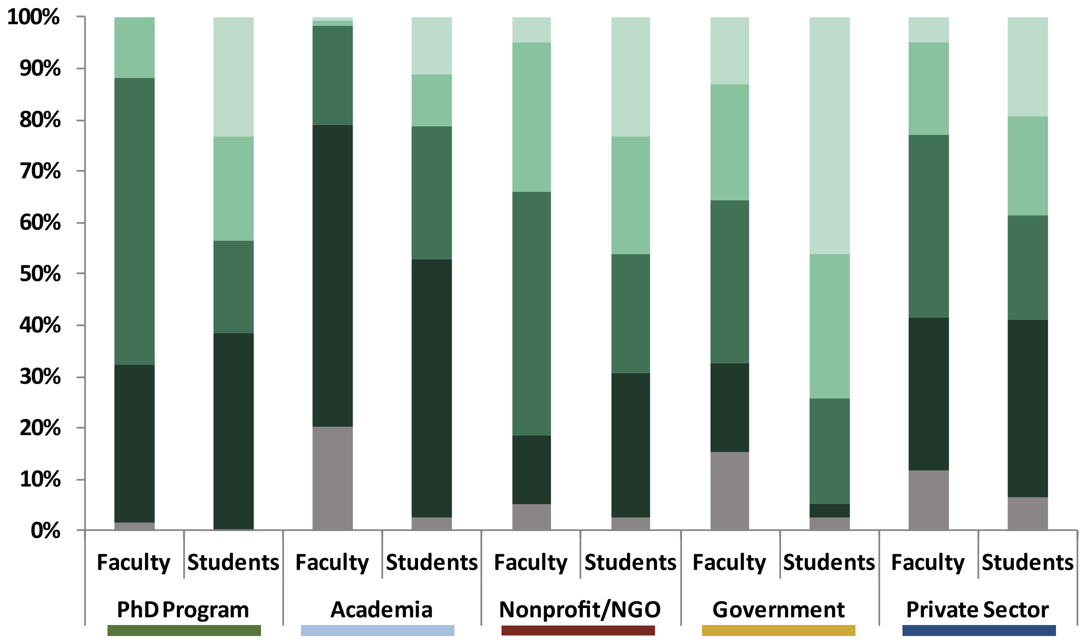
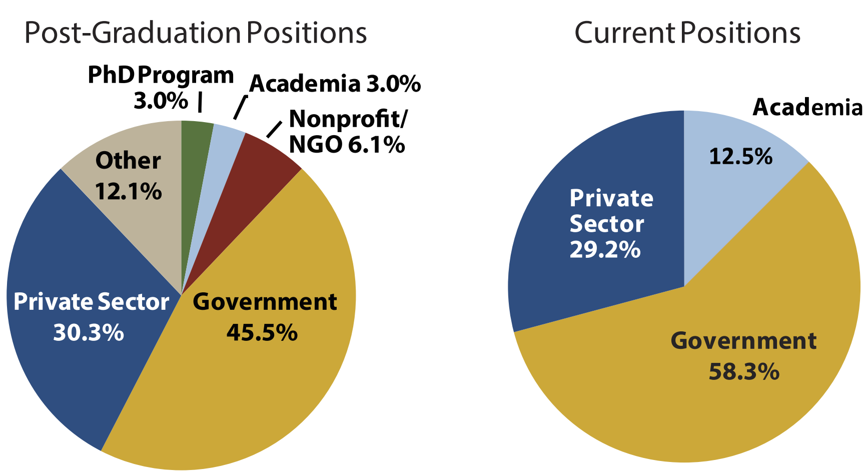


Figure 4.4: Geography Professionals' Post-graduate and Current Positions



HYBRID

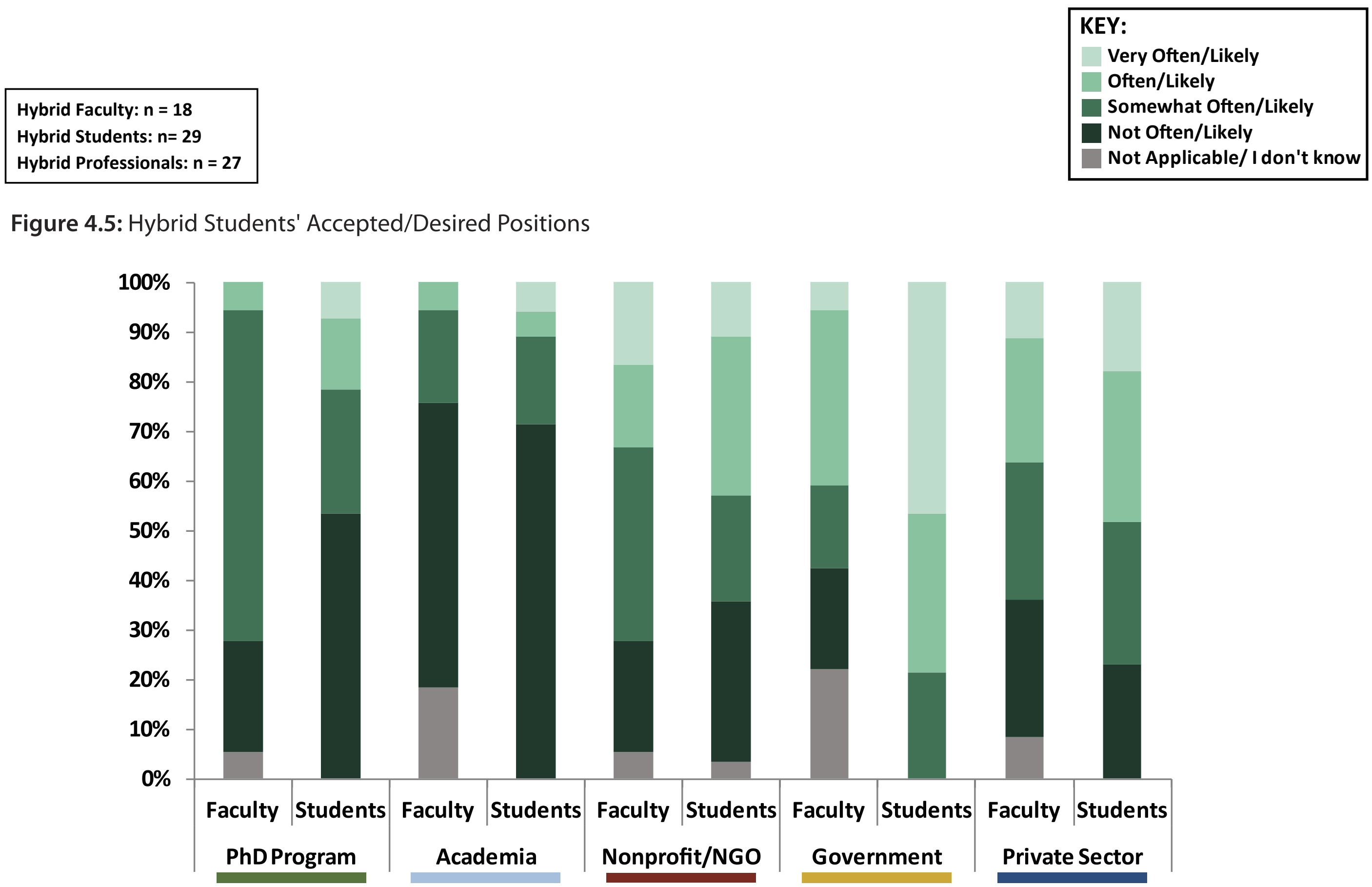
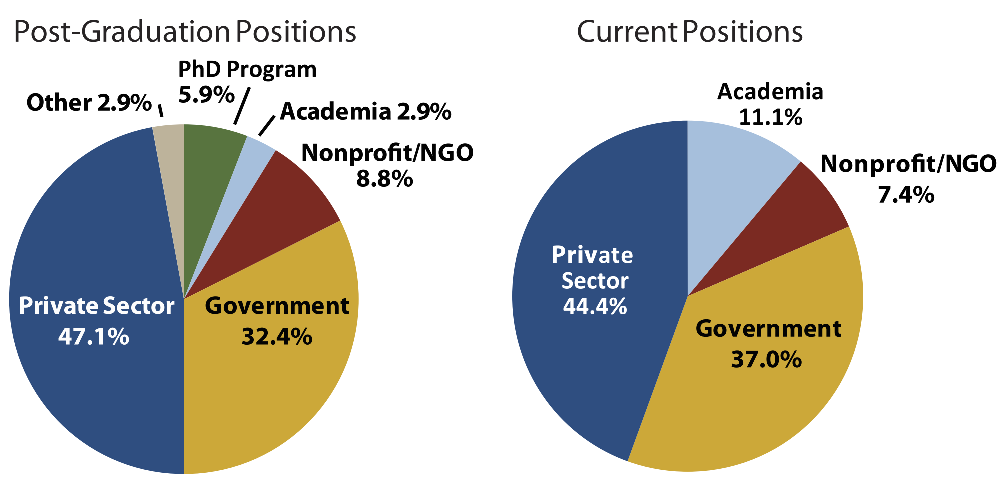


Figure 4.5: Hybrid Students' Accepted/Desired Positions

Figure 4.6: Hybrid Professionals' Post-graduate and Current Positions



Section 5 — Academic Preparation and Importance of Non-Technical Skills for Geoscience Employment

Faculty and students were asked about students' academic preparation. The survey listed 28 non-technical skills, ranging from various communication skills to critical-thinking and management skills. These non-technical skills, commonly referred to as "soft-skills," were developed from AAG's EDGE survey, which were used to maintain consistency of data between each of the department types (Geology, Geography and Hybrid departments).

Faculty were asked, "How prepared are your Master's advisees in each of the following skill areas for post-graduation employment in geoscience-related positions?" Students answered, "How much preparation have you received in the following skill areas for post-graduation geoscience employment?" Non-academic professionals responded to two questions. First, they were asked about their own preparation in each of these non-technical skills. They were also asked how important each skill is to their current positions: "Now that you've indicated how prepared you feel for each of these items, please indicate how important each skill area is for employment in your current position."

The blue bars indicate how prepared geoscientists are in each of the skills. The red and gold bars indicate how important each of these skills is to non-academic professionals' employment. Professionals' preparation is abbreviated as "Prof. Prep." and the importance is abbreviated by "Prof. Imp."

Image submitted by Amy Edwards to AGI's 2014 Life in the Field contest.

Geology Faculty: n = 58
Geology Students: n= 31
Geology Professionals: n = 72

KEY Preparation:
- Extensively Prepared
- Adequately Prepared
- Somewhat Prepared
- Not Prepared
- Not Applicable/ I don't know

KEY Importance:
- Very Important
- Important
- Somewhat Important
- Not Important
- Not Applicable/ I don't know

Figure 5.1: Geology Non-Technical Skills, part 1

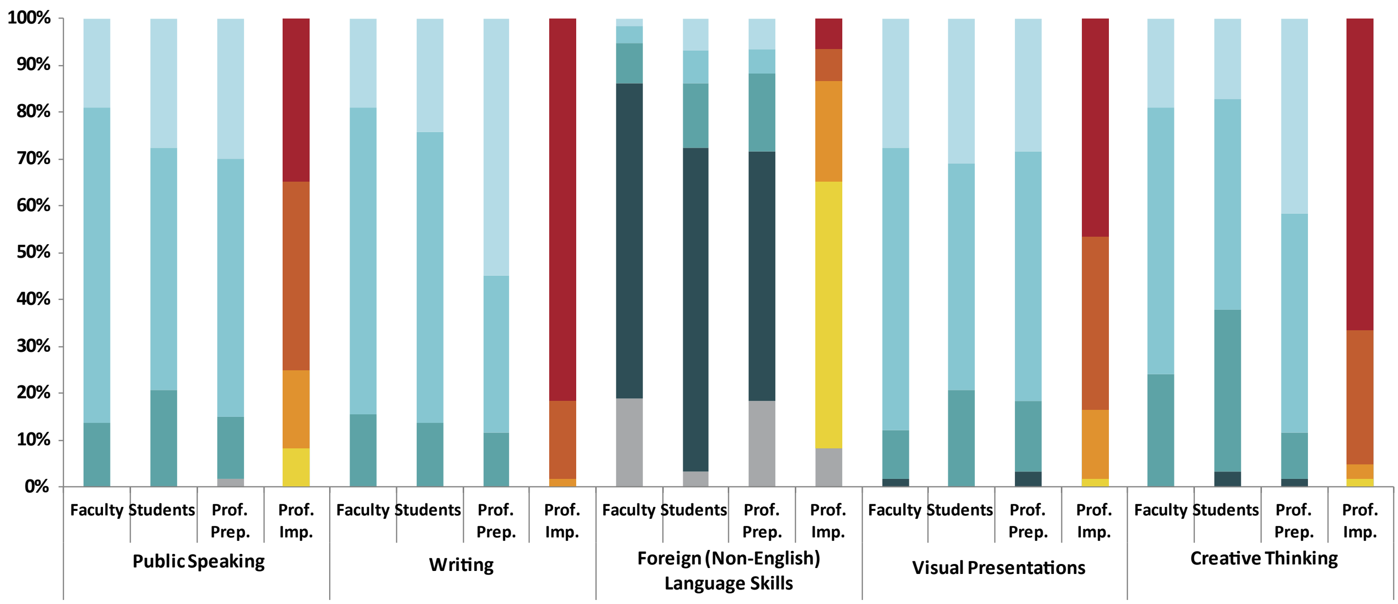
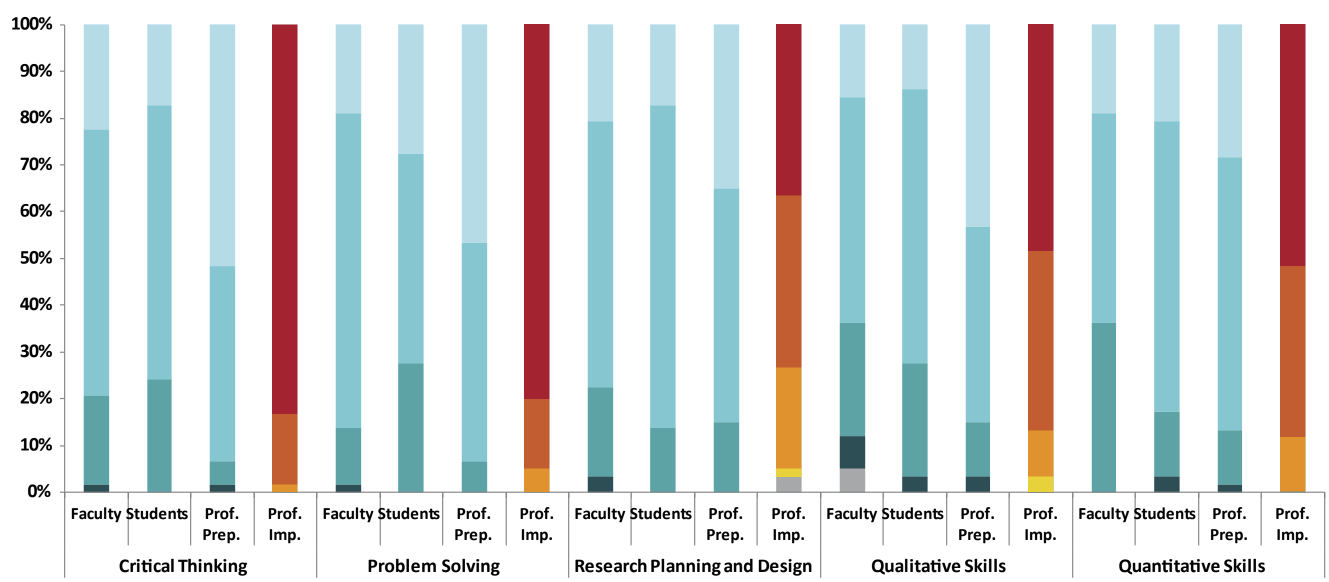


Figure 5.2: Geology Non-Technical Skills, part 2



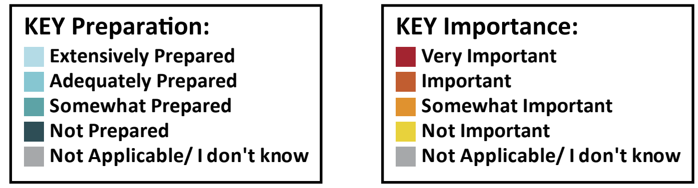


Figure 5.3: Geology Non-Technical Skills, part 3

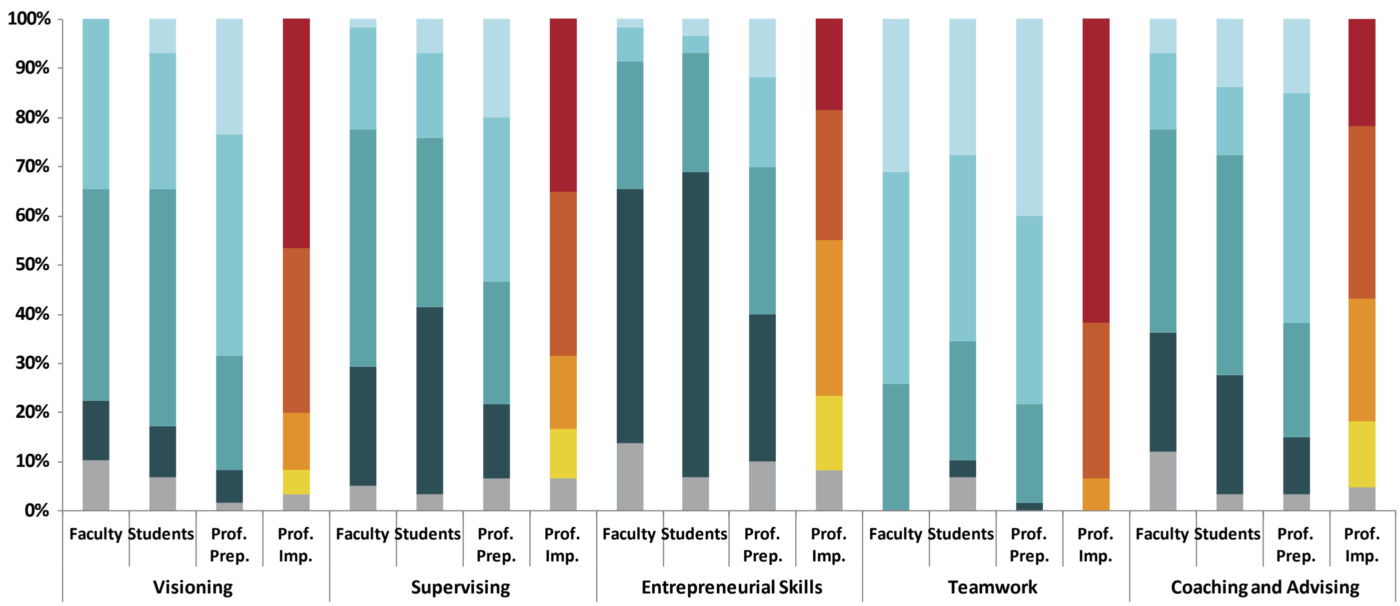
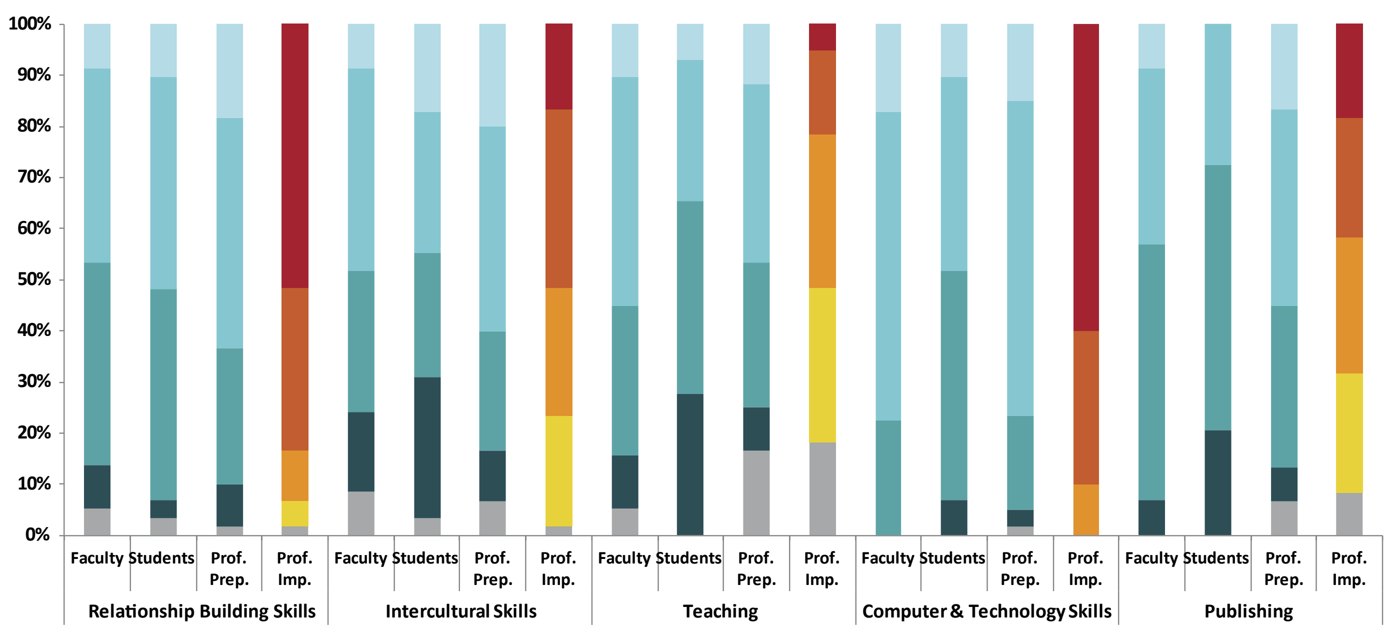


Figure 5.4: Geology Non-Technical Skills, part 4



KEY Preparation:
- Extensively Prepared
- Adequately Prepared
- Somewhat Prepared
- Not Prepared
- Not Applicable/ I don't know

KEY Importance:
- Very Important
- Important
- Somewhat Important
- Not Important
- Not Applicable/ I don't know

Figure 5.5: Geology Non-Technical Skills, part 5

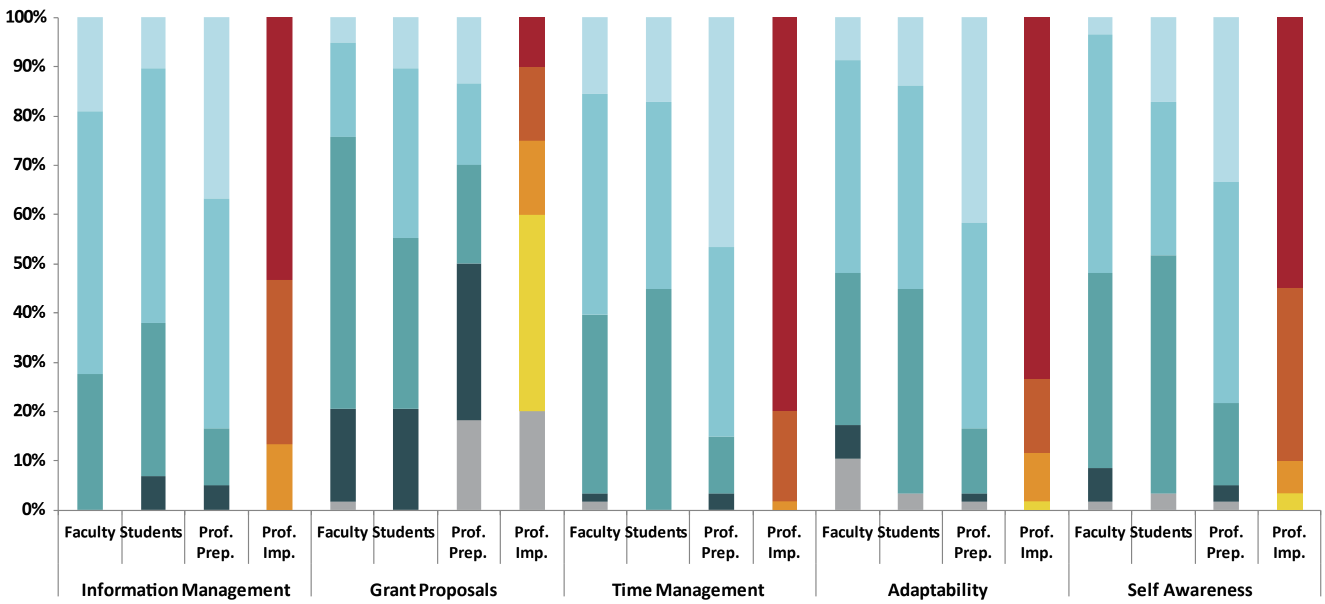
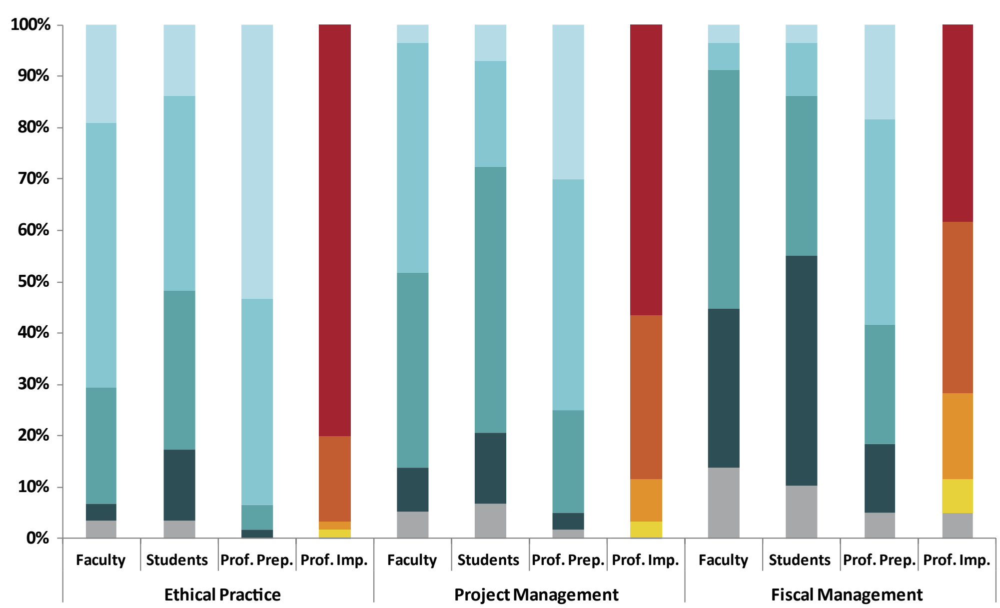


Figure 5.6: Geology Non-Technical Skills, part 6



GEOGRAPHY

Geography Faculty: n = 59
Geography Students: n= 39
Geography Professionals: n = 24

KEY Preparation:
- Extensively Prepared
- Adequately Prepared
- Somewhat Prepared
- Not Prepared
- Not Applicable/ I don't know

KEY Importance:
- Very Important
- Important
- Somewhat Important
- Not Important
- Not Applicable/ I don't know

Figure 5.7: Geography Non-Technical Skills, part 1

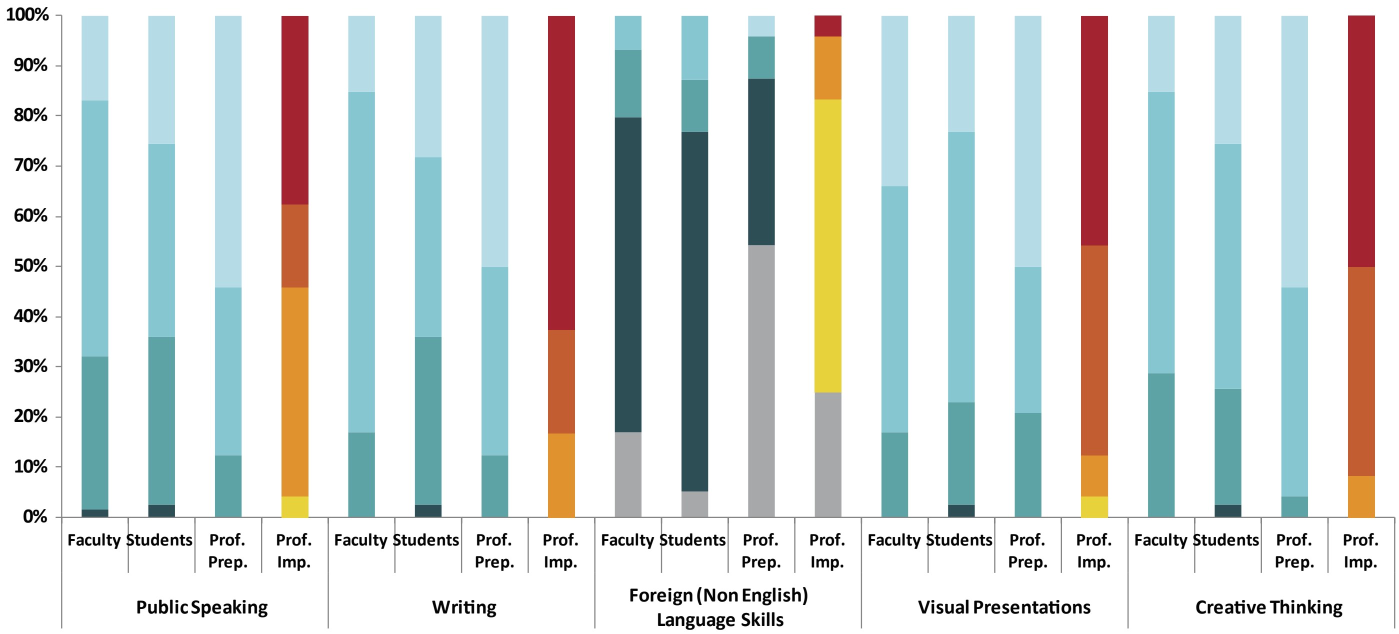
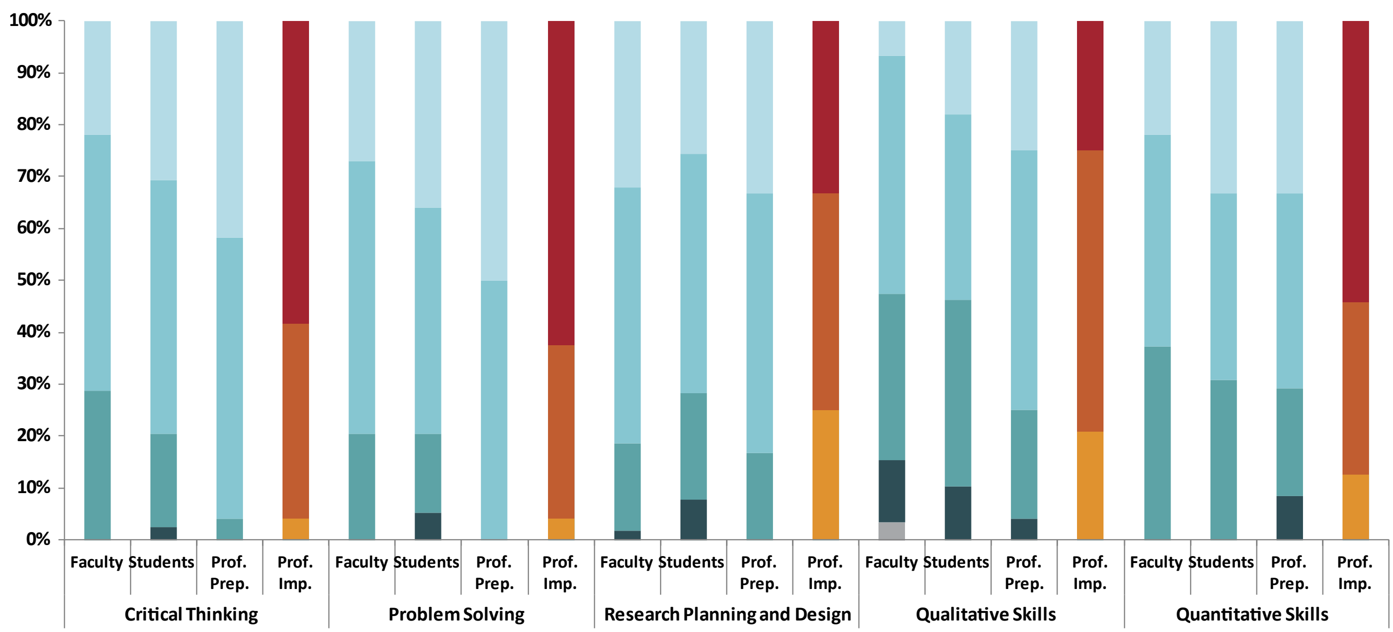


Figure 5.8: Geography Non-Technical Skills, part 2



KEY Preparation:
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- Adequately Prepared
- Somewhat Prepared
- Not Prepared
- Not Applicable/ I don't know

KEY Importance:
- Very Important
- Important
- Somewhat Important
- Not Important
- Not Applicable/ I don't know

Figure 5.9: Geography Non-Technical Skills, part 3

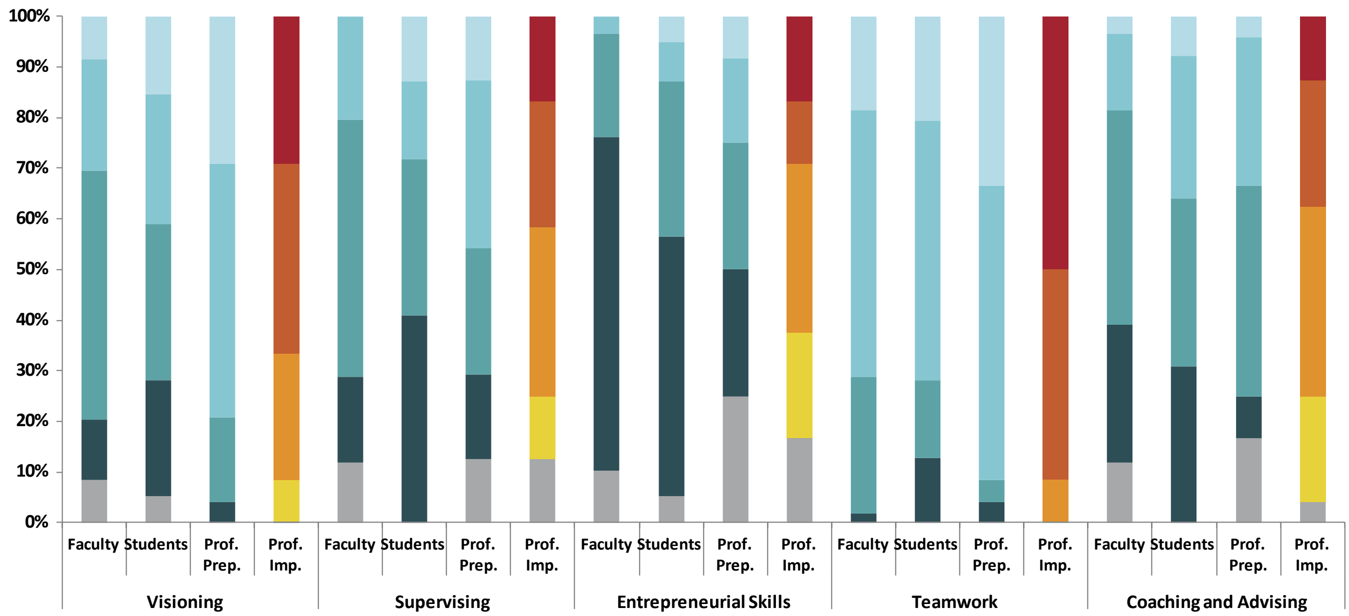
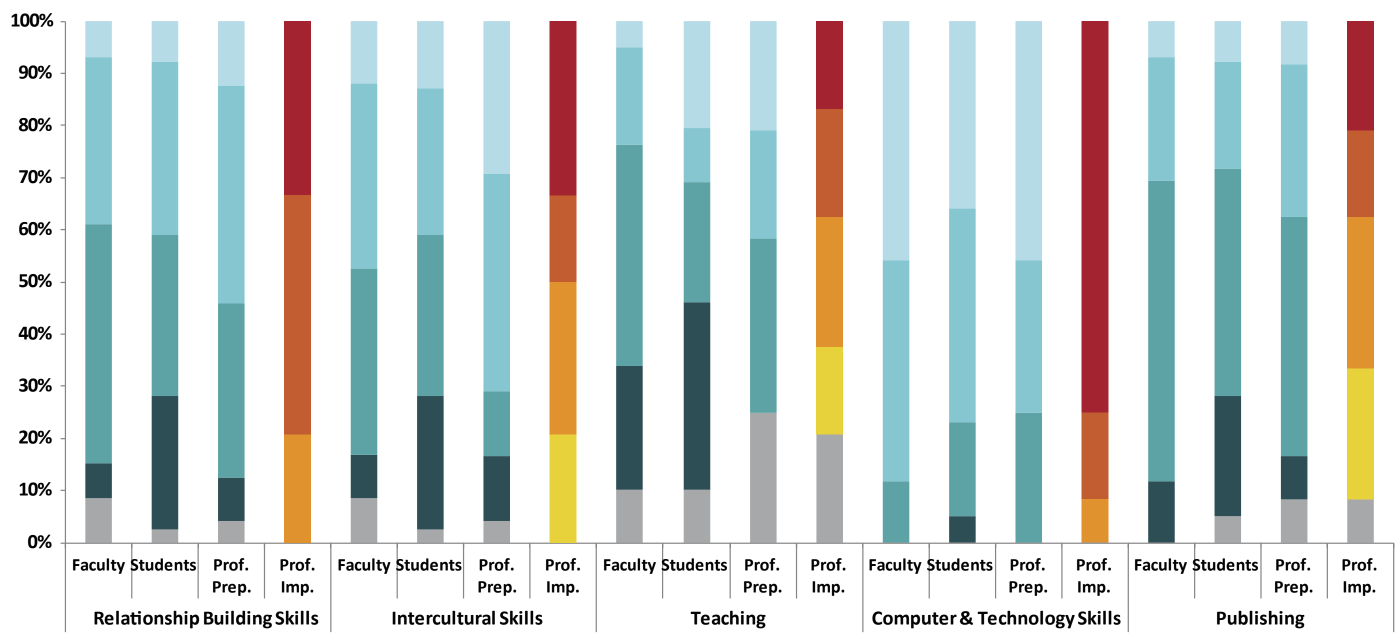


Figure 5.10: Geography Non-Technical Skills, part 4



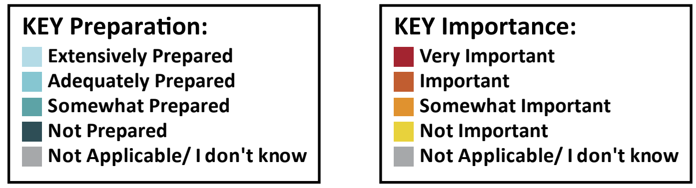


Figure 5.11: Geography Non-Technical Skills, part 5

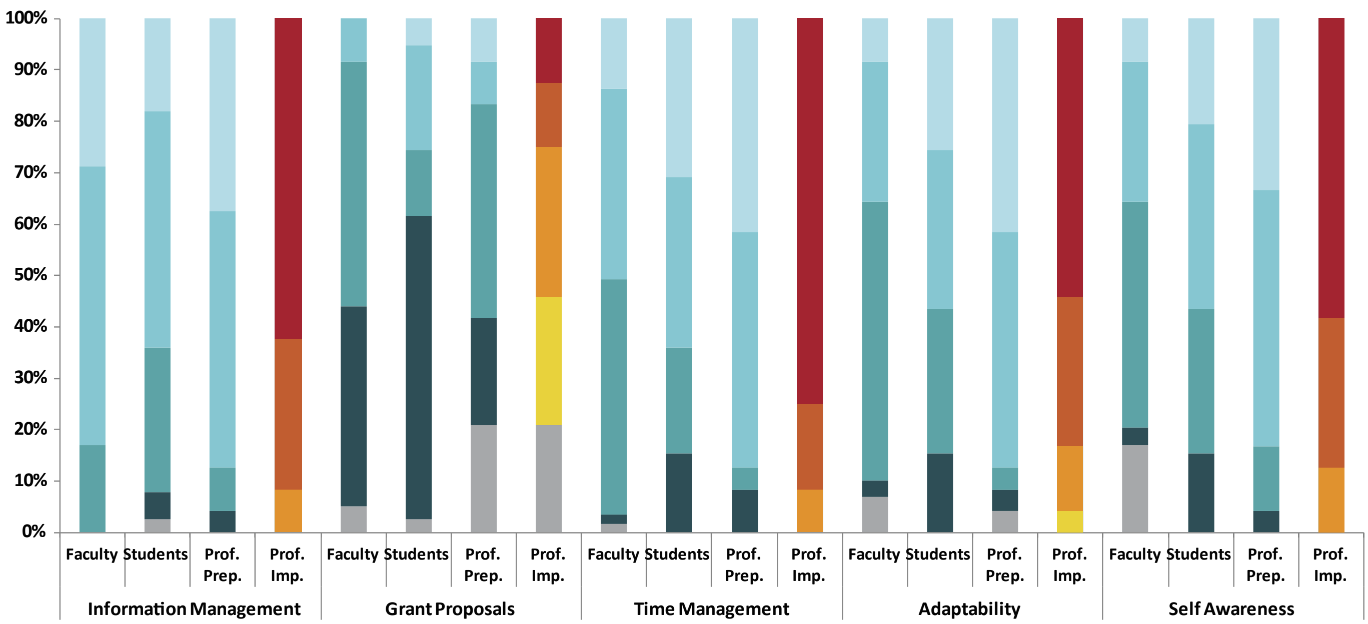
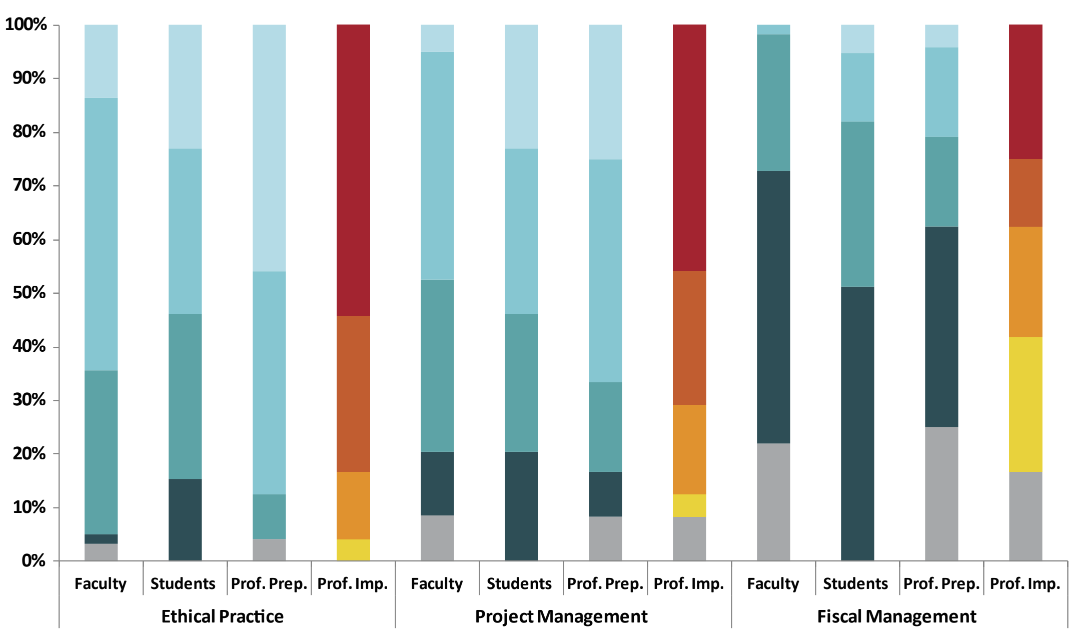


Figure 5.12: Geography Non-Technical Skills, part 6



HYBRID

Hybrid Faculty: n = 18
Hybrid Students: n= 29
Hybrid Professionals: n = 27

KEY Preparation:
- Extensively Prepared
- Adequately Prepared
- Somewhat Prepared
- Not Prepared
- Not Applicable/ I don't know

KEY Importance:
- Very Important
- Important
- Somewhat Important
- Not Important
- Not Applicable/ I don't know

Figure 5.13: Hybrid Non-Technical Skills, part 1

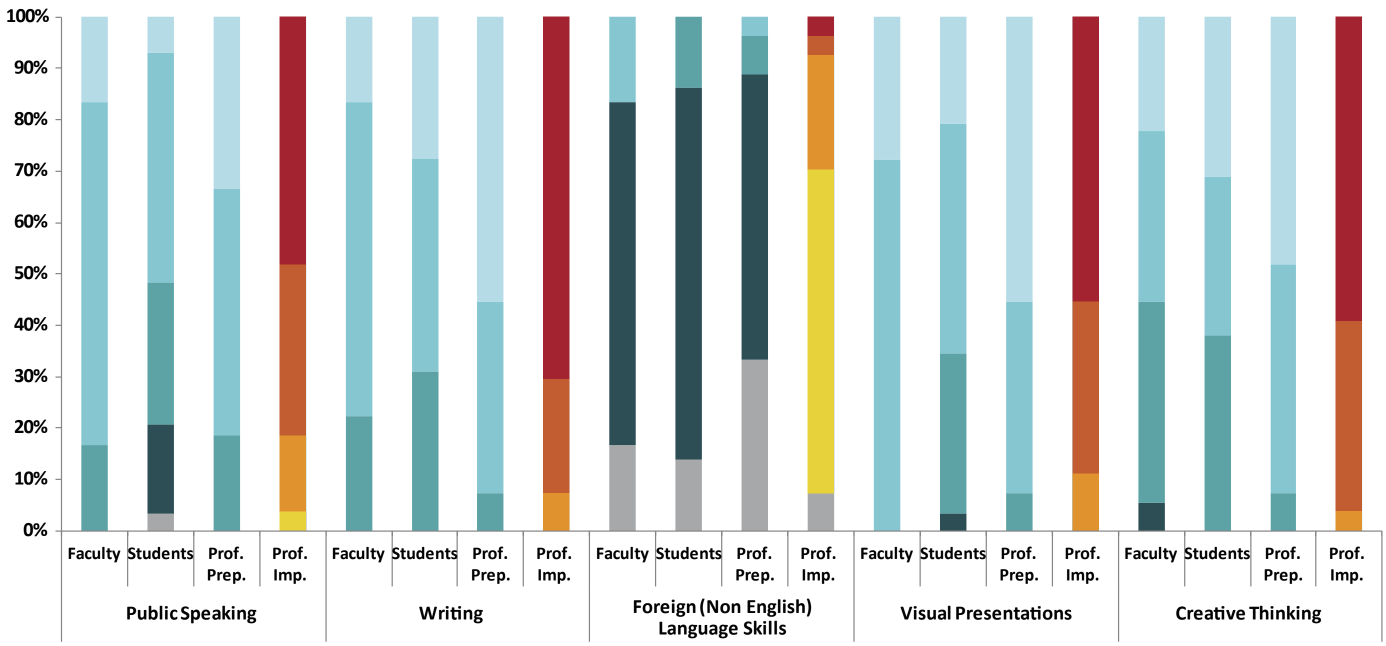
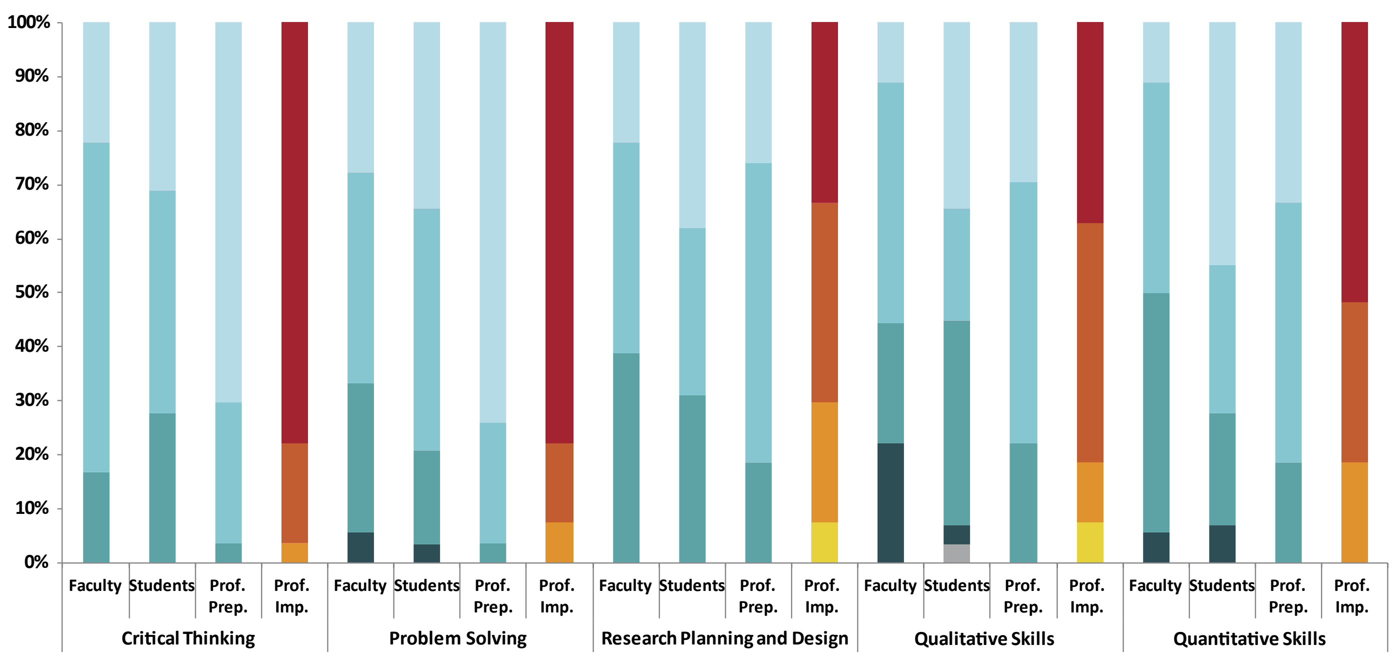


Figure 5.14: Hybrid Non-Technical Skills, part 2



KEY Preparation:
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- Adequately Prepared
- Somewhat Prepared
- Not Prepared
- Not Applicable/ I don't know

KEY Importance:
- Very Important
- Important
- Somewhat Important
- Not Important
- Not Applicable/ I don't know

Figure 5.15: Hybrid Non-Technical Skills, part 3

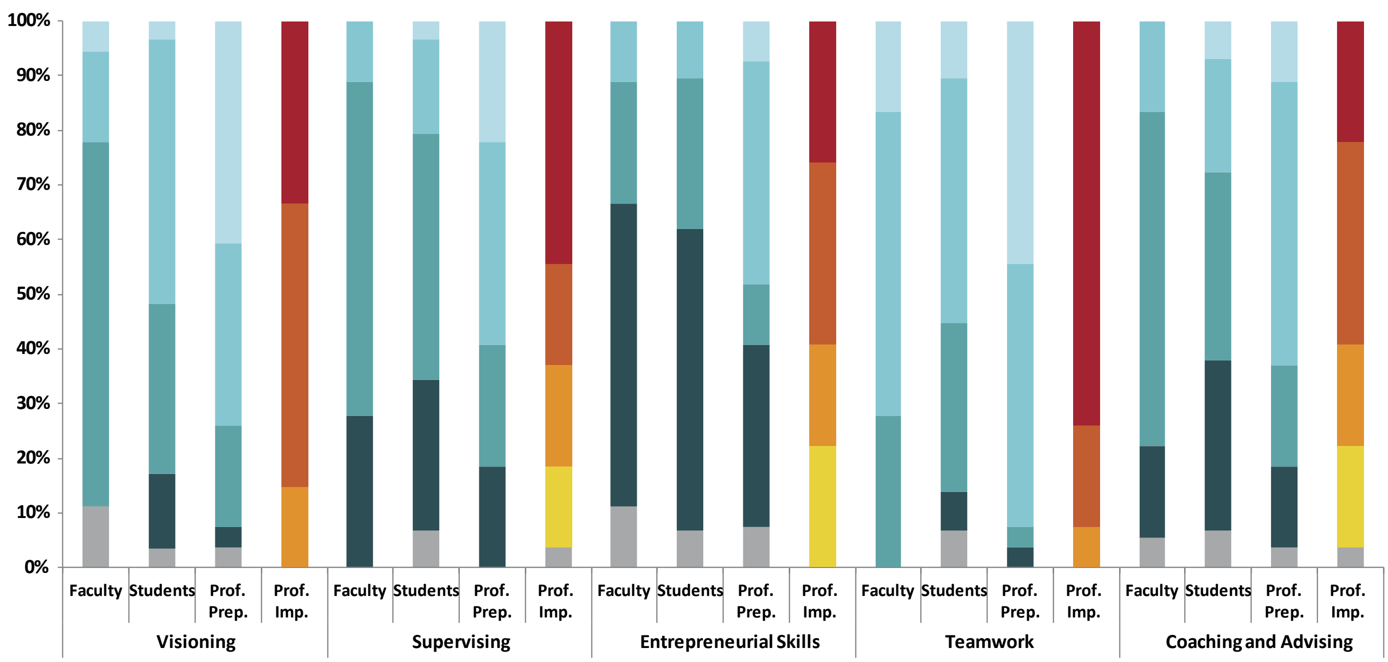
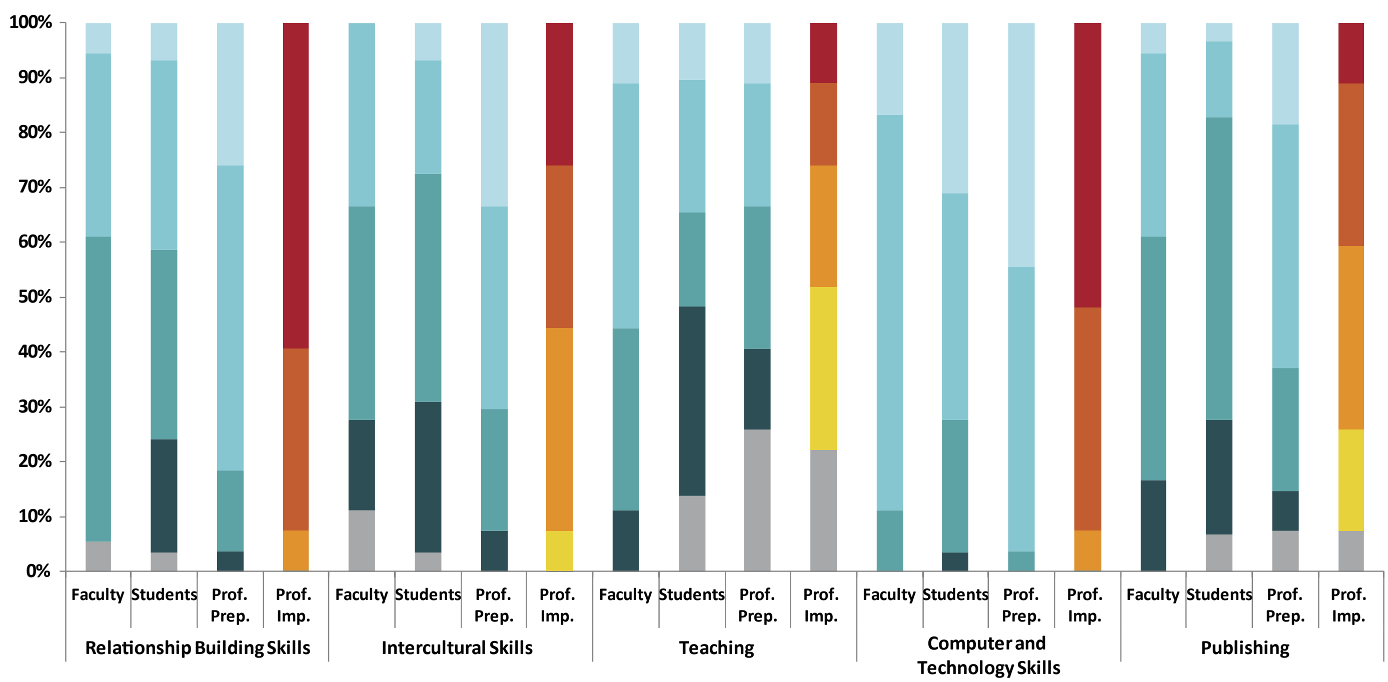


Figure 5.16: Hybrid Non-Technical Skills, part 4



KEY Preparation:
- Extensively Prepared
- Adequately Prepared
- Somewhat Prepared
- Not Prepared
- Not Applicable/ I don't know

KEY Importance:
- Very Important
- Important
- Somewhat Important
- Not Important
- Not Applicable/ I don't know

Figure 5.17: Hybrid Non-Technical Skills, part 5

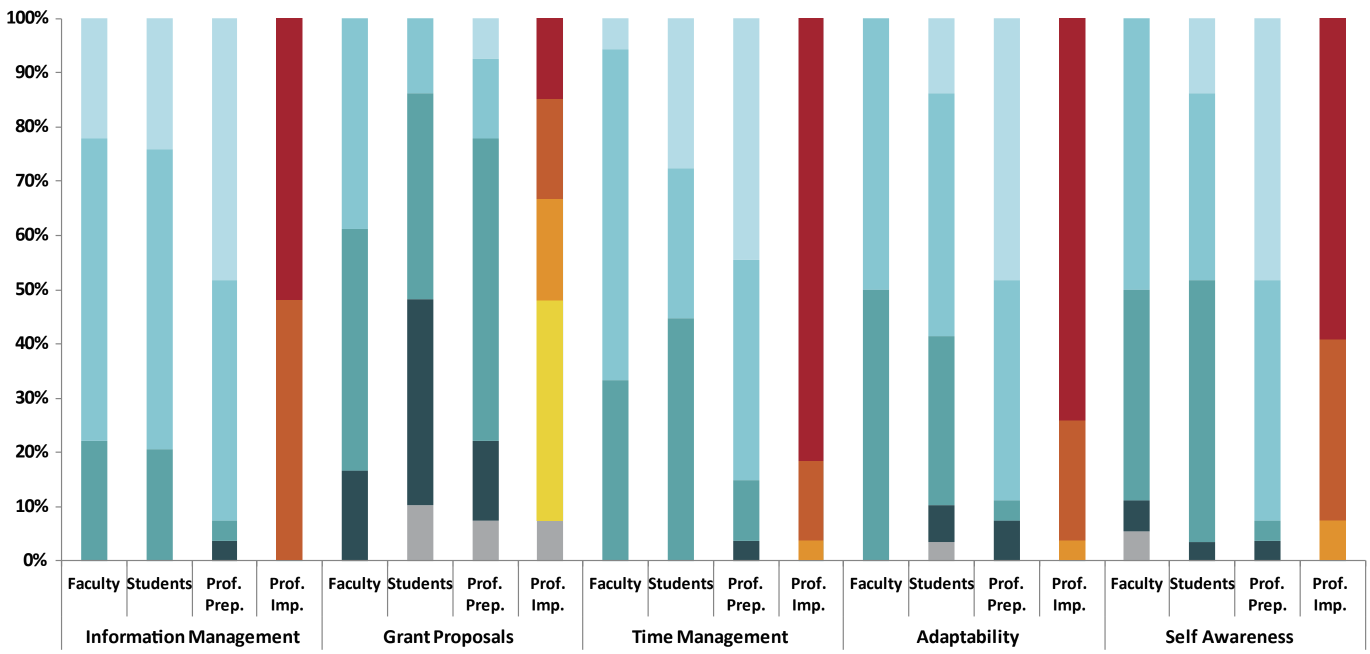
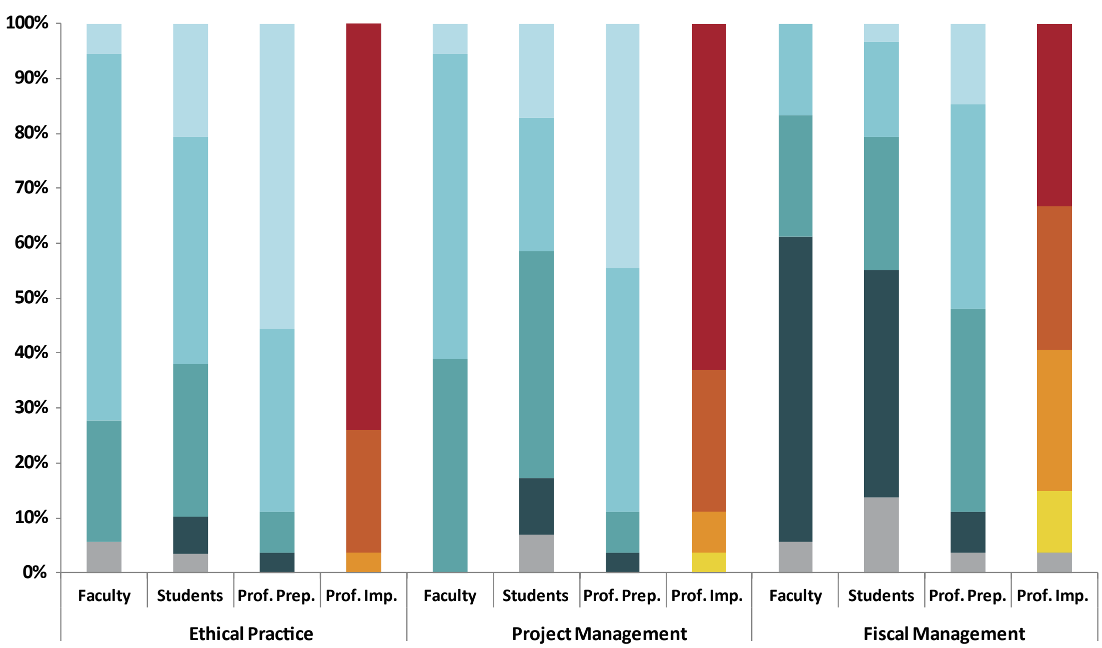


Figure 5.18: Hybrid Non-Technical Skills, part 6



Section 6 — Academic Preparation and Importance of Geology and Geography Technical Skills

The technical skills taught within geology Master's programs differ from those within geography and hybrid programs. Therefore, we asked faculty, students, and non-academic professionals with geology versus geography backgrounds to answer different sets of questions regarding their training and competencies. Hybrid programs' questions about preparation and importance of technical competencies were a mixture of the geology and geography competency questions.

We asked faculty from each of these departments to "indicate the amount of preparation students receive in your degree program for each of the following geoscience competencies." Geology, geography, and hybrid department students were asked, "Indicate the amount of preparation you receive in your Master's degree program for each of the following geoscience competencies." Geoscience non-academic professionals were asked about their preparation and the importance of each of the skills: "Indicate the amount of preparation you received in your Master's degree program for each of the following competencies" and "Now that you've indicated how prepared you feel for each of these items, please indicate how important each skill area is for employment in your current position."

Thirty-six different geology and twenty different geography competencies were listed in the respective surveys. The Hybrid survey combined competencies from geology and geography, and listed 30 different items. The geology competencies were organized by theme: General and Field Geology; Mineralogy, Petrology, and Geochemistry; Sedimentology, Stratigraphy, and Paleontology; Geomorphology, Surficial Processes, and Quaternary Geology; Structure, Tectonics, and Seismology; Hydrology and Hydrogeology; Economic Geology, and Energy Resources.

The 36 geology competencies were identified from the National Association of State Boards of Geology (ASBOG) Task Analysis Survey. These are the specific competencies required to pass the Fundamentals of Geology and Practicing Geology examinations for state licensure. Therefore, by aligning the survey to this portfolio of ASBOG competencies, it allows the measurement of preparation level of Master's students for professional employment within the geoscience workforce. For more information about ASBOG, and how to help prepare students for the licensing examination, please go to: www.asbog.org.

The 20 geography competencies were adopted directly from AAG's Enhancing Departments & Graduate Education (EDGE) survey. For more information about EDGE, its research, resources, and publications, please visit: www.aag.org/cs/edge.

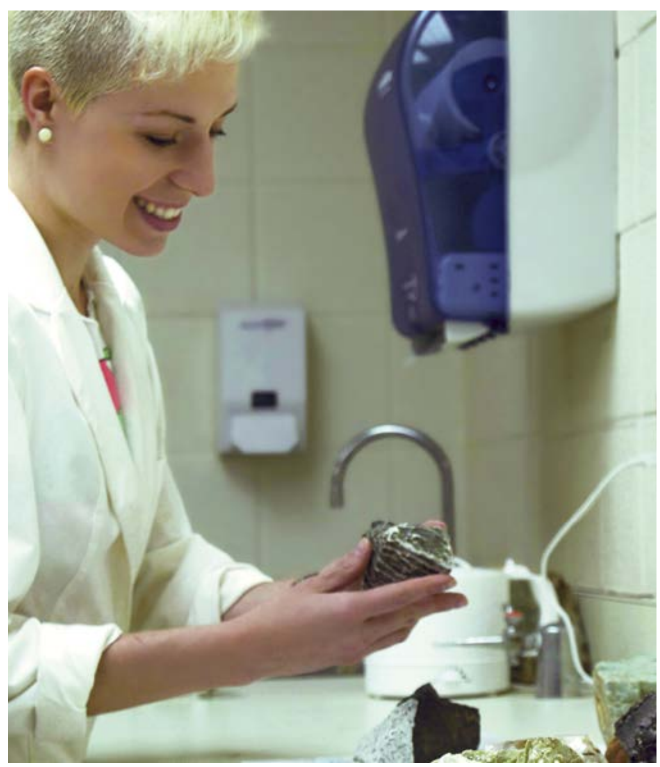


Image submitted by Alisa Kotash to AGI's 2014 Life in the Field contest.

KEY Preparation:
- Extensively Prepared
- Adequately Prepared
- Somewhat Prepared
- Not Prepared
- Not Applicable/ I don't know

KEY Importance:
- Very Important
- Important
- Somewhat Important
- Not Important
- Not Applicable/ I don't know

Geology Faculty: n = 58
Geology Students: n= 31
Geology Professionals: n = 72

Figure 6.1: Geology Technical Skills, part 1

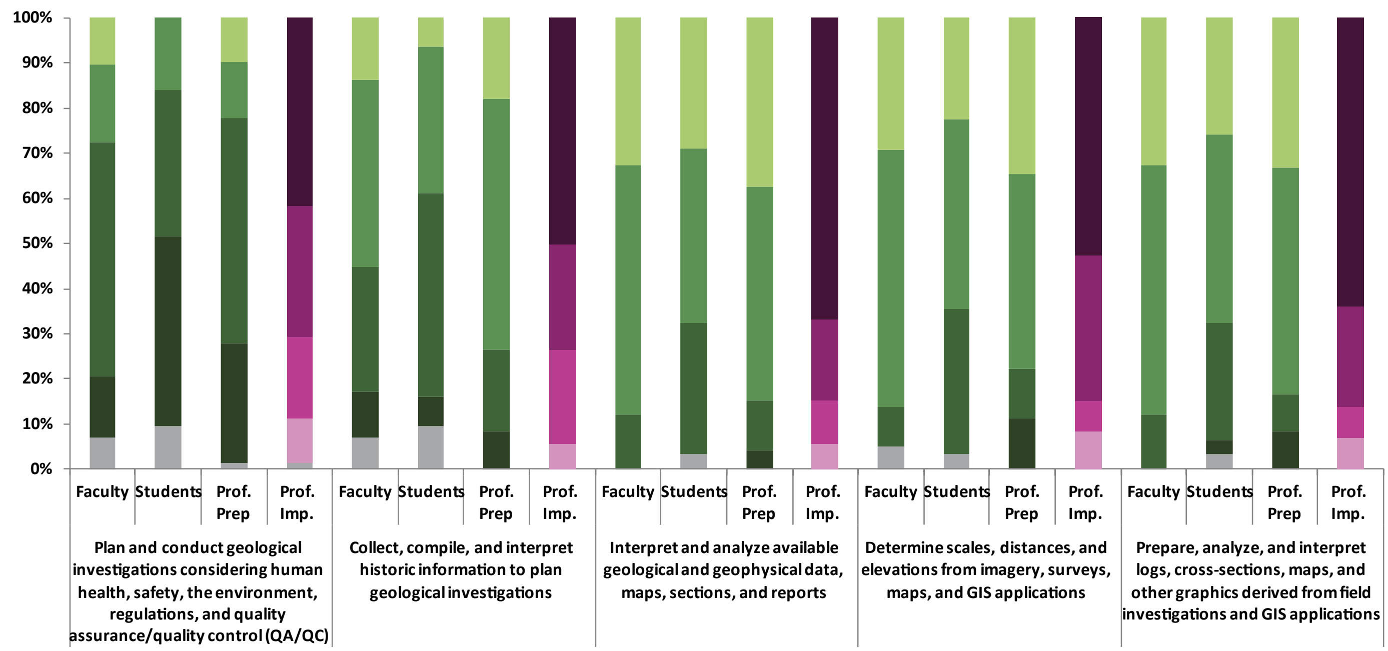
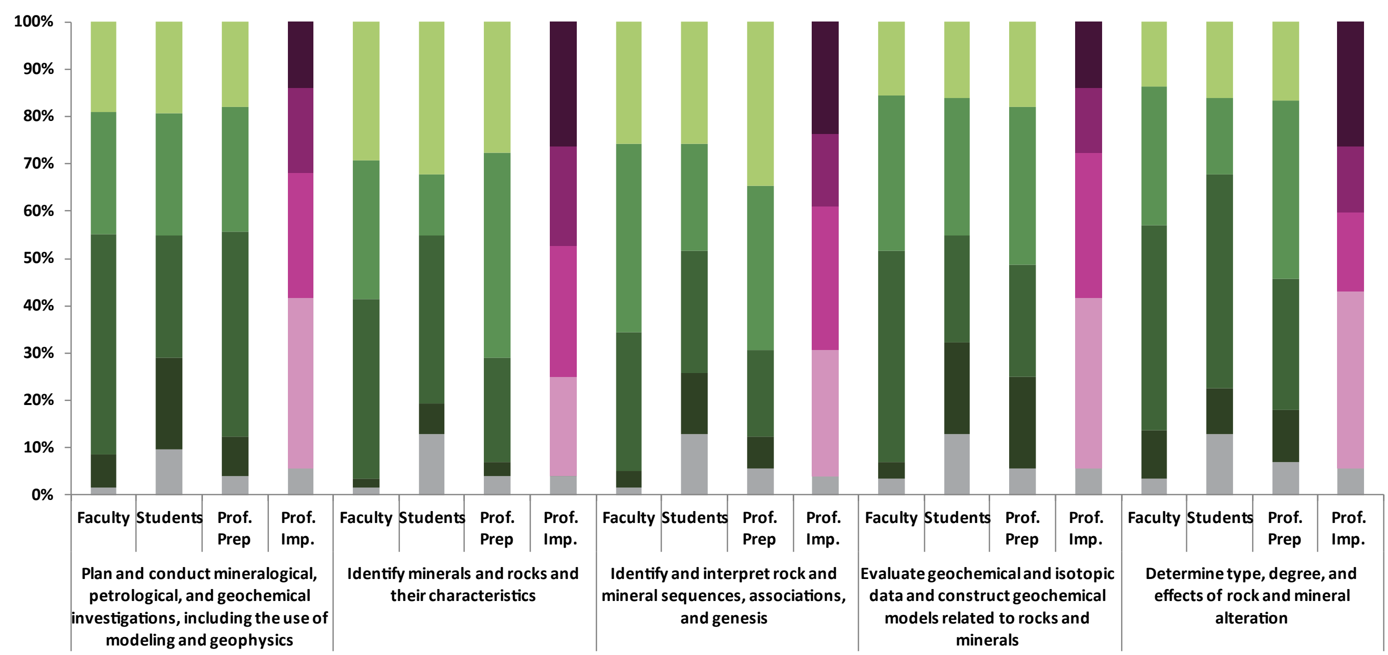


Figure 6.2: Geology Technical Skills, part 2



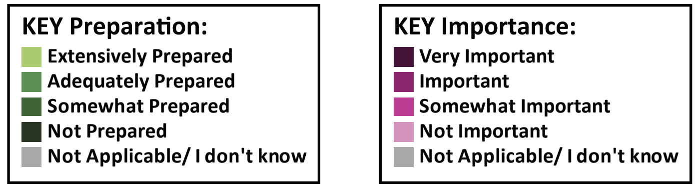


Figure 6.3: Geology Technical Skills, part 3

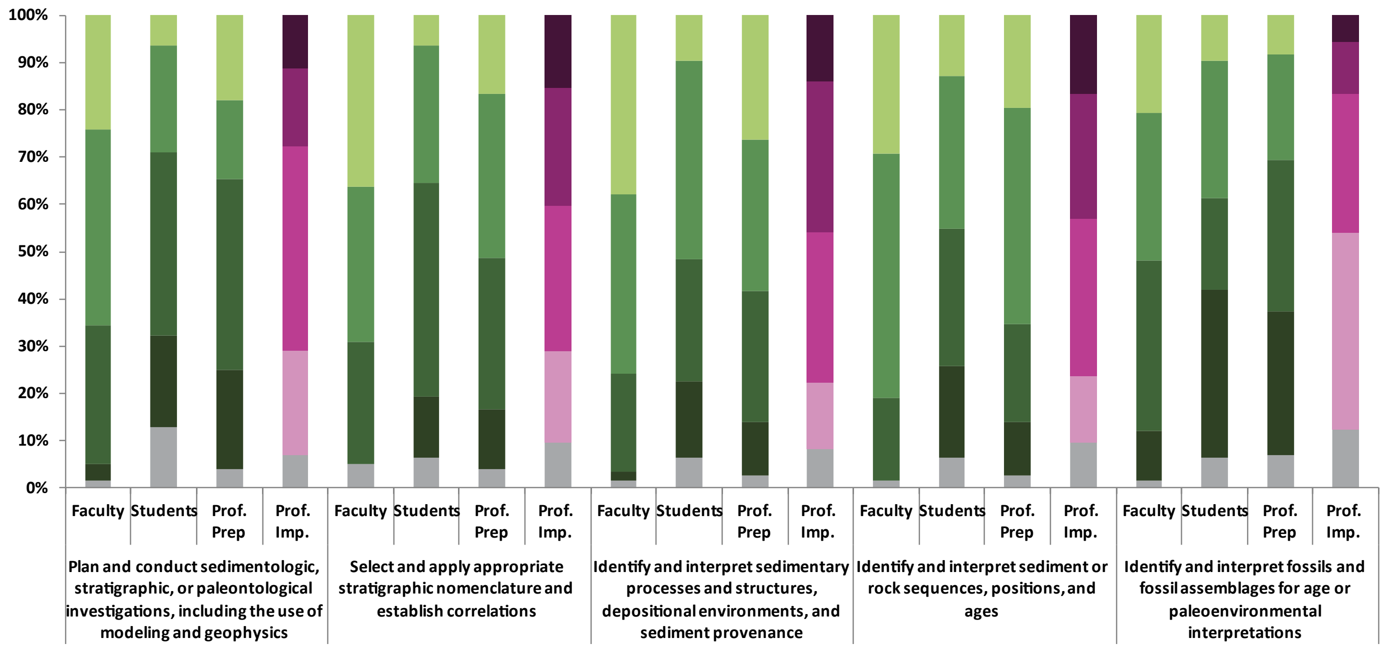
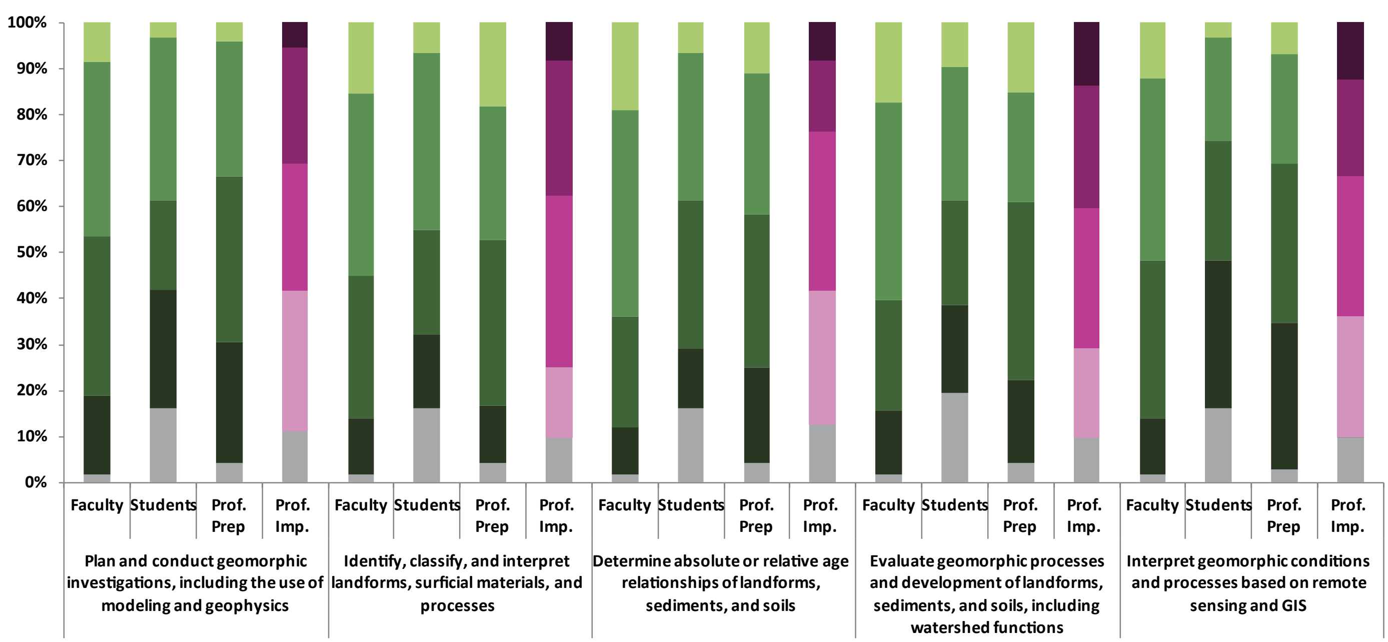


Figure 6.4: Geology Technical Skills, part 4



KEY Preparation:
- Extensively Prepared
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- Somewhat Prepared
- Not Prepared
- Not Applicable/ I don't know

KEY Importance:
- Very Important
- Important
- Somewhat Important
- Not Important
- Not Applicable/ I don't know

Figure 6.5: Geology Technical Skills, part 5

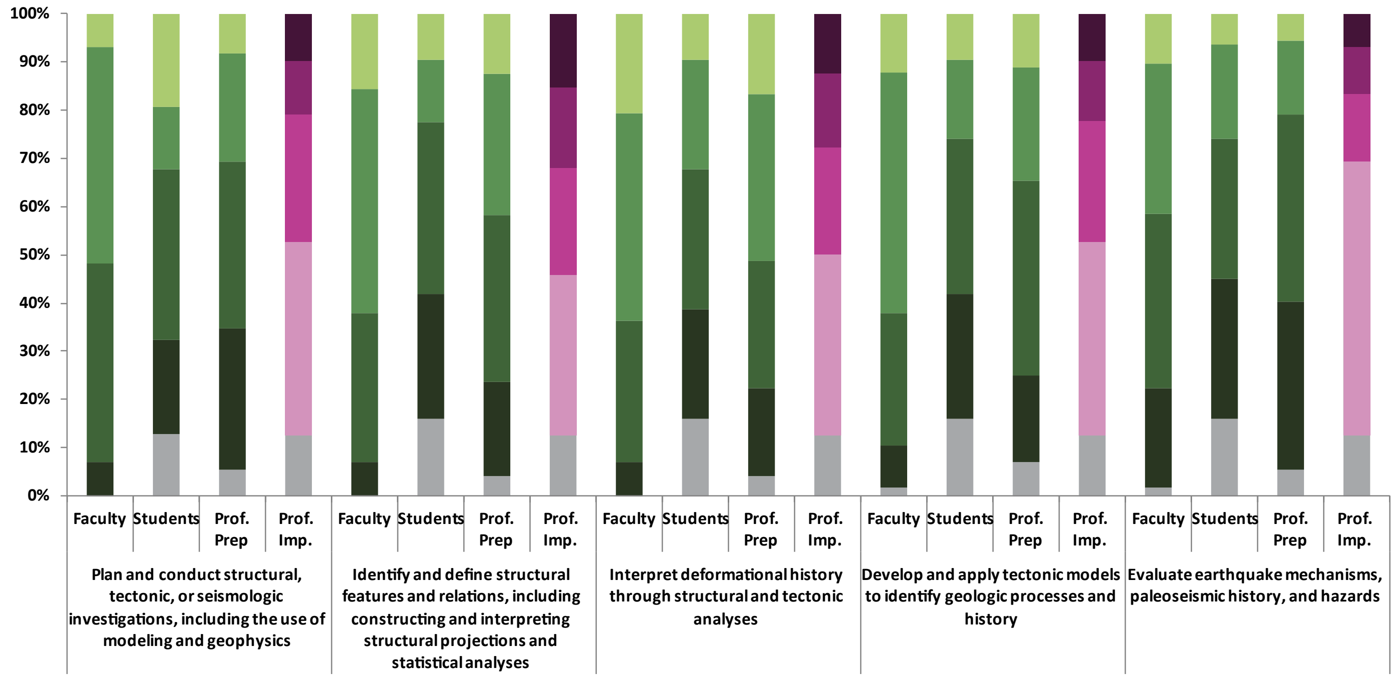
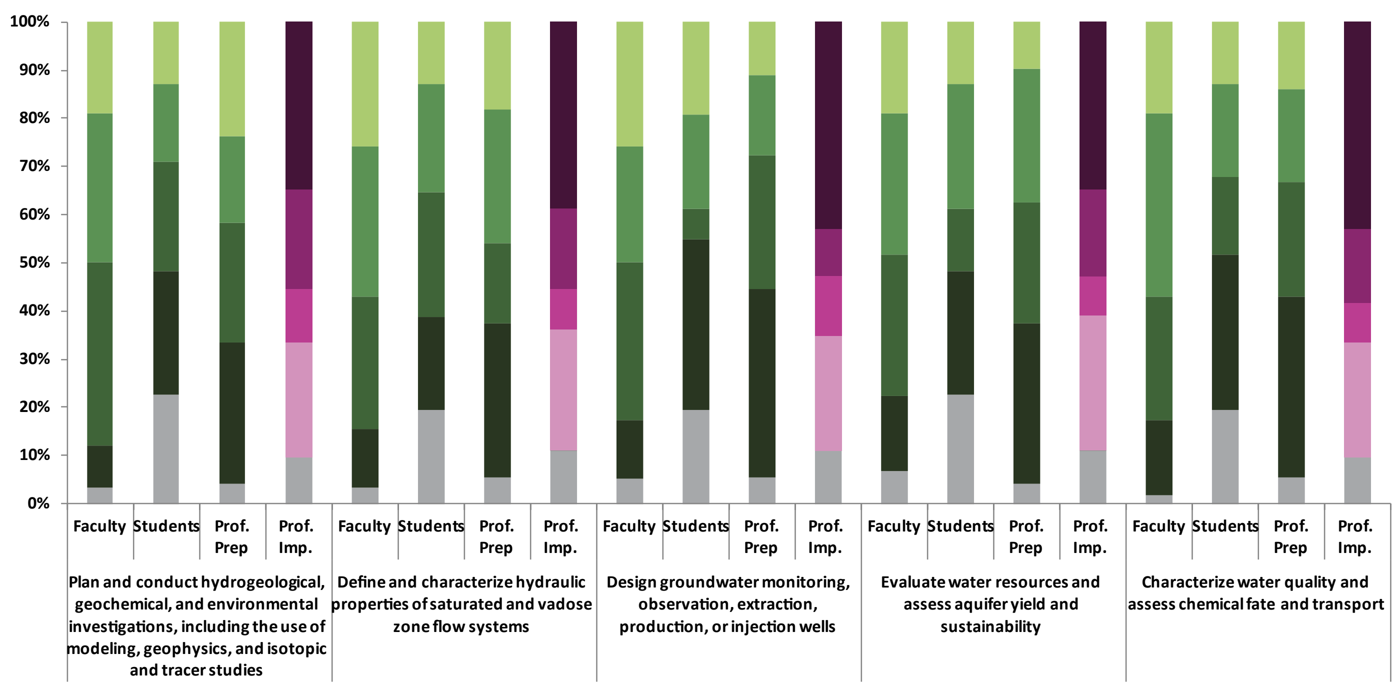


Figure 6.6: Geology Technical Skills, part 6



KEY Preparation:
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- Not Prepared
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KEY Importance:
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- Important
- Somewhat Important
- Not Important
- Not Applicable/ I don't know

Figure 6.7: Geology Technical Skills, part 7

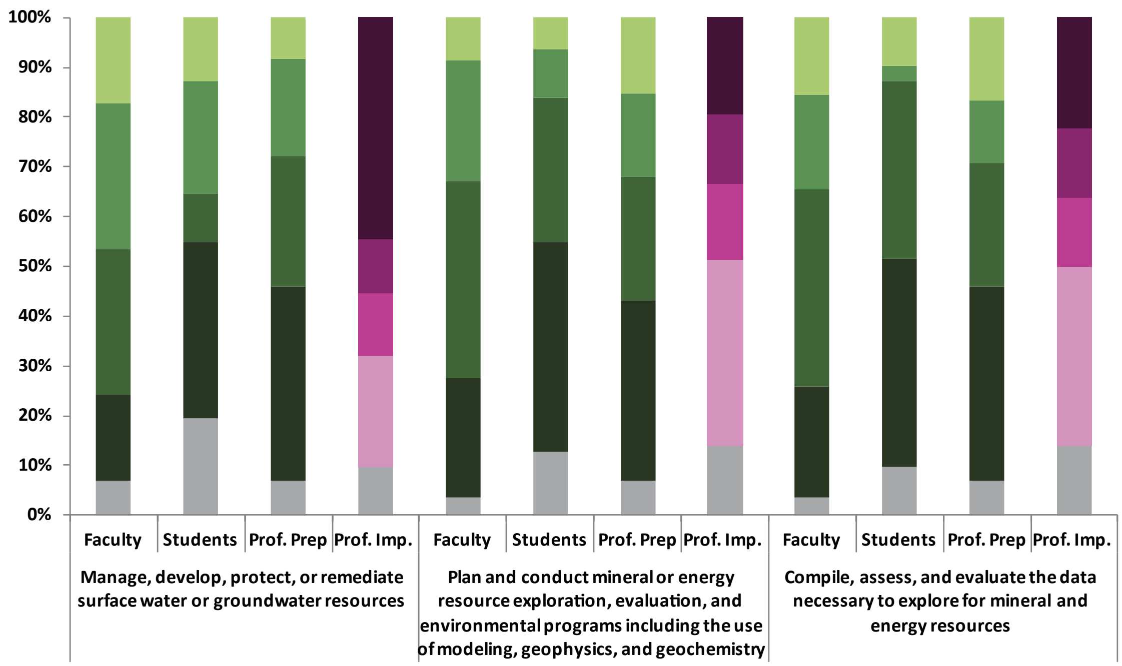
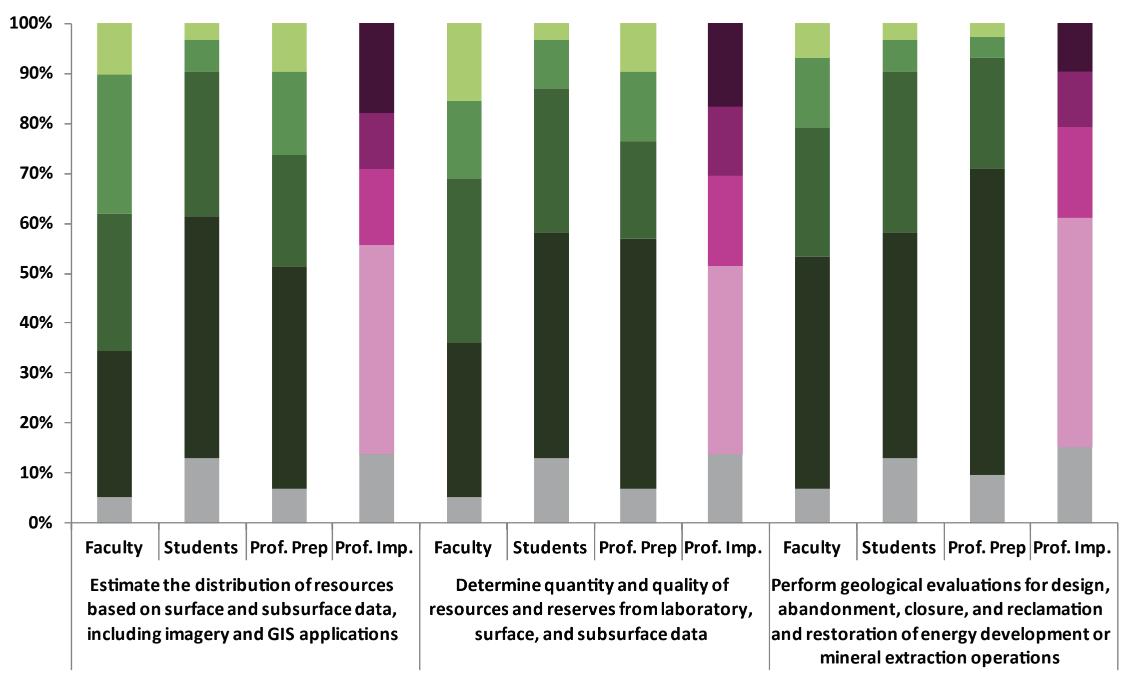


Figure 6.8: Geology Technical Skills, part 8



GEOGRAPHY

KEY Preparation:
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- Somewhat Prepared
- Not Prepared
- Not Applicable/ I don't know

KEY Importance:
- Very Important
- Important
- Somewhat Important
- Not Important
- Not Applicable/ I don't know

Geography Faculty: n = 59
Geography Students: n= 39
Geography Professionals: n = 24

Figure 6.9: Geography Technical Skills, part 1

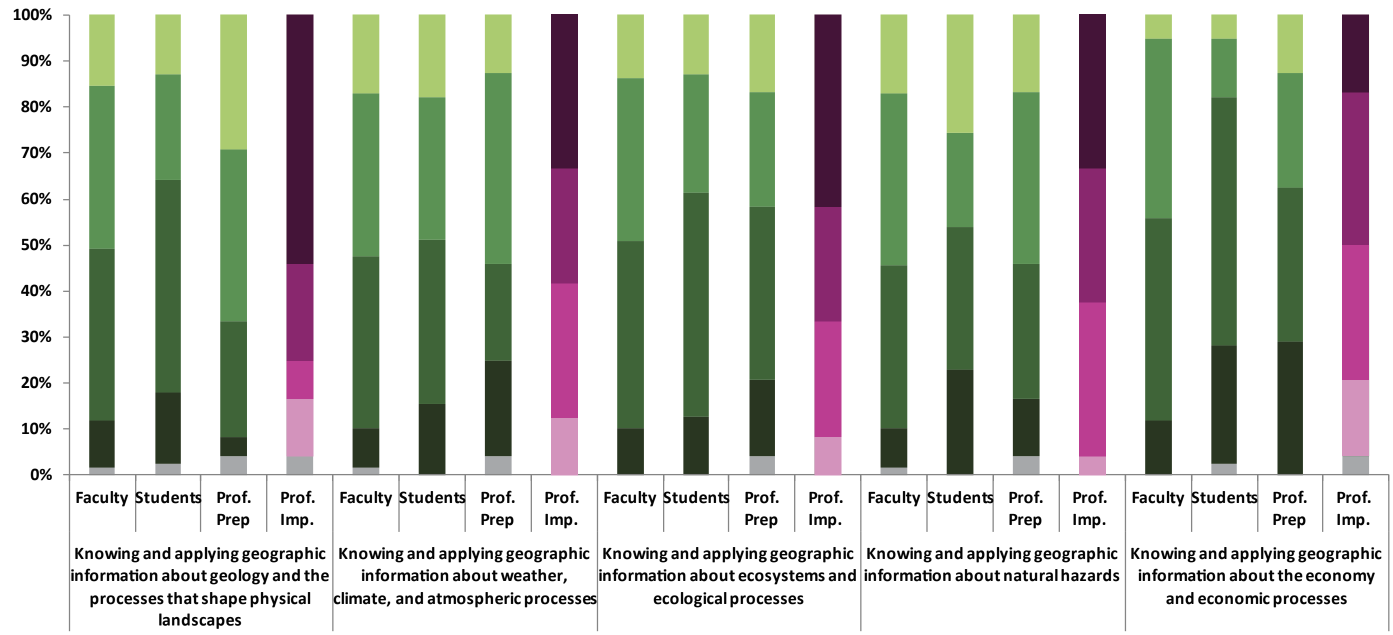
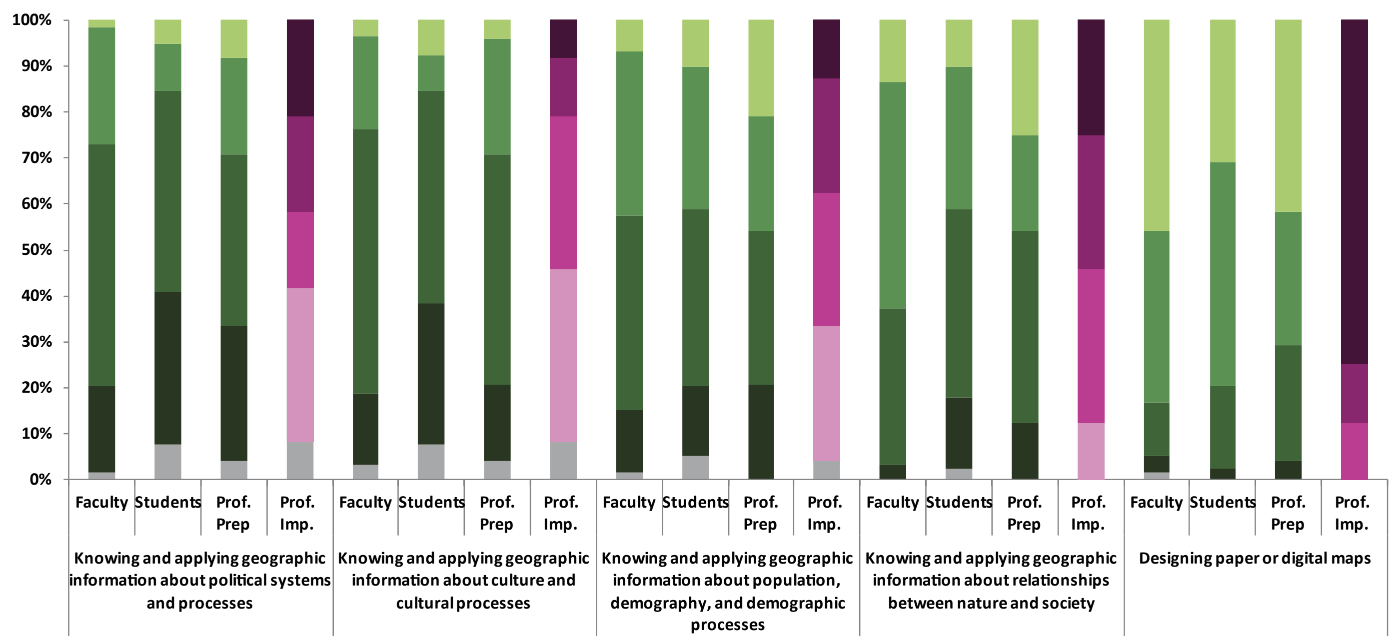


Figure 6.10: Geography Technical Skills, part 2



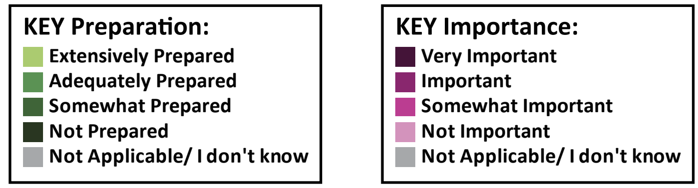


Figure 6.11: Geography Technical Skills, part 3

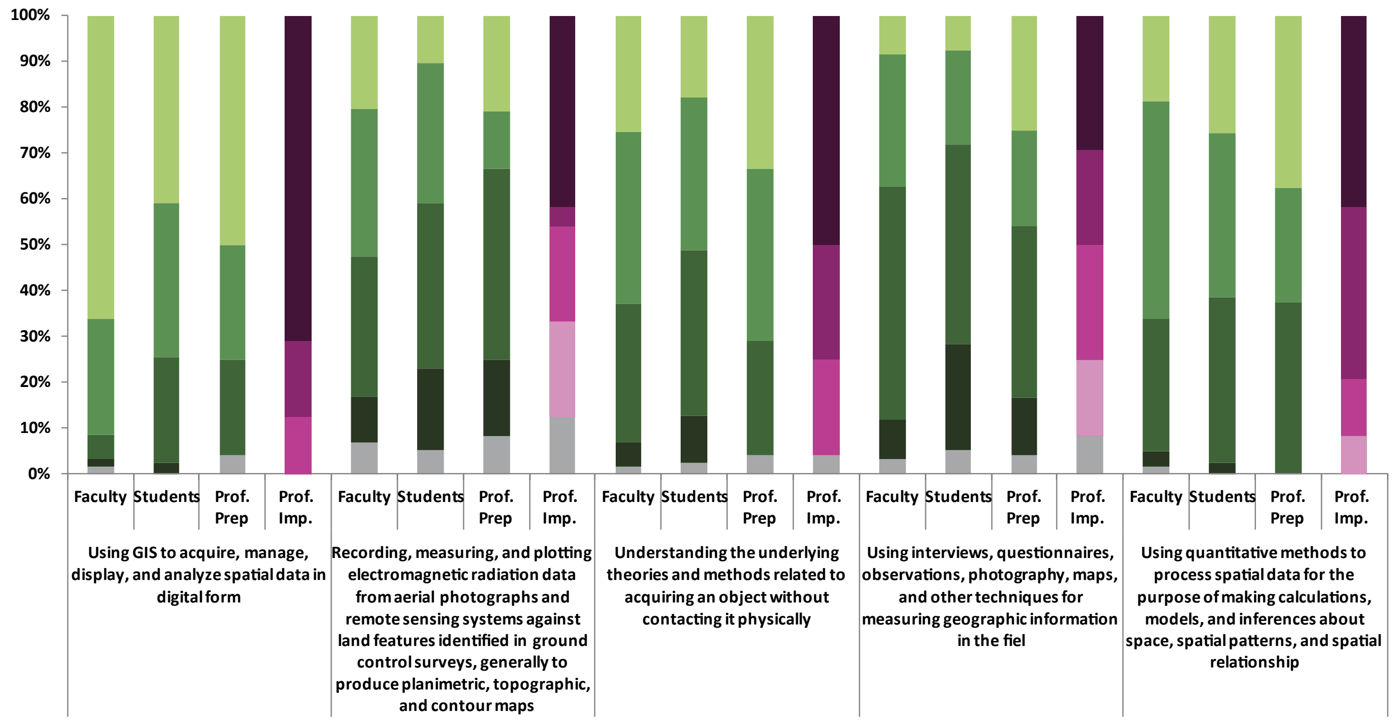
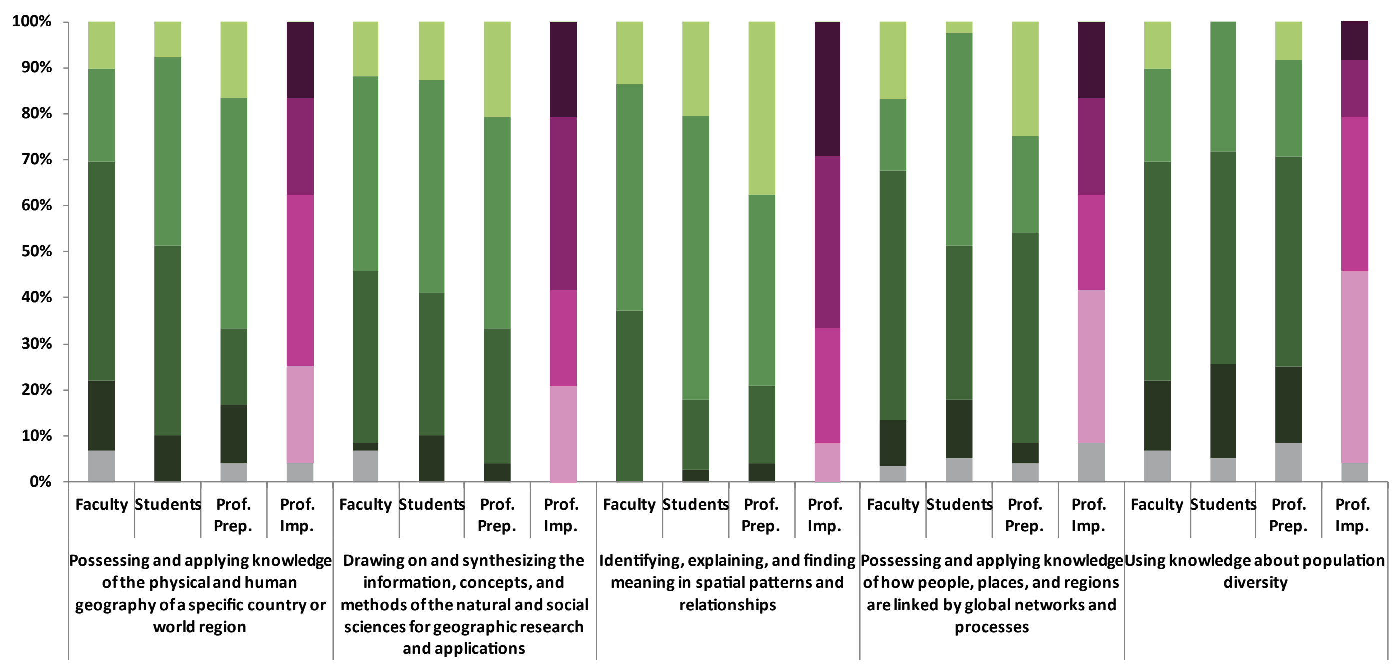


Figure 6.12: Geography Technical Skills, part 4



HYBRID

Hybrid Faculty: n = 18
Hybrid Students: n= 29
Hybrid Professionals: n = 27

KEY Preparation:
- Extensively Prepared
- Adequately Prepared
- Somewhat Prepared
- Not Prepared
- Not Applicable/ I don't know

KEY Importance:
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- Important
- Somewhat Important
- Not Important
- Not Applicable/ I don't know

Figure 6.13: Hybrid Technical Skills, part 1

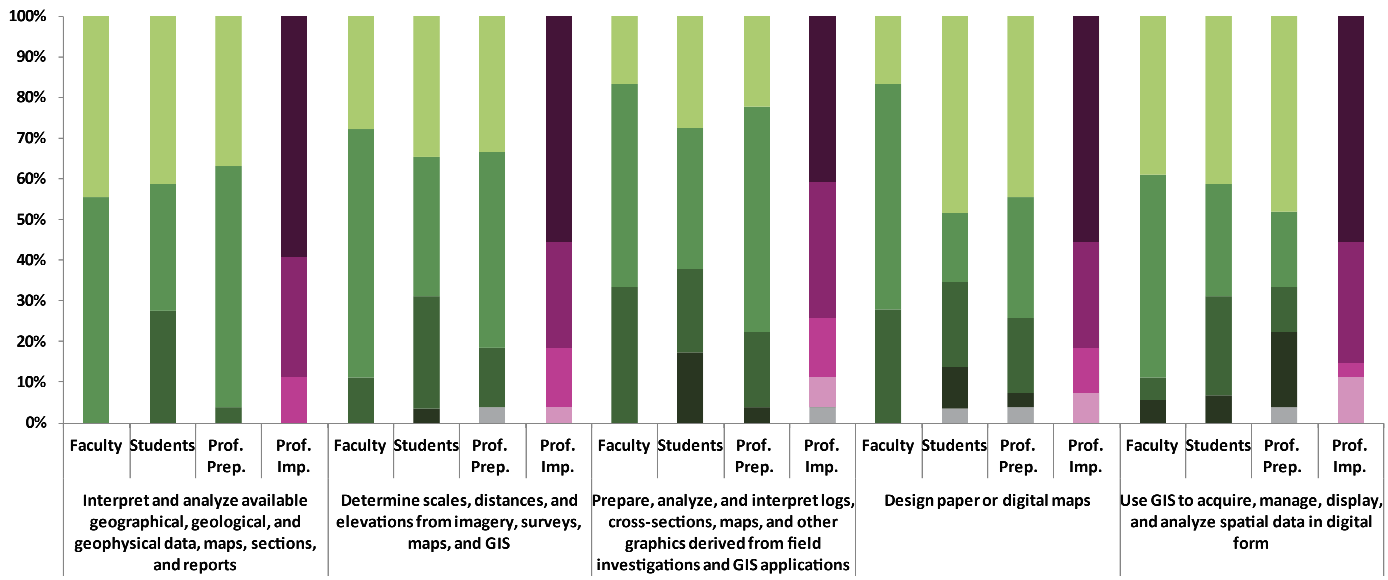
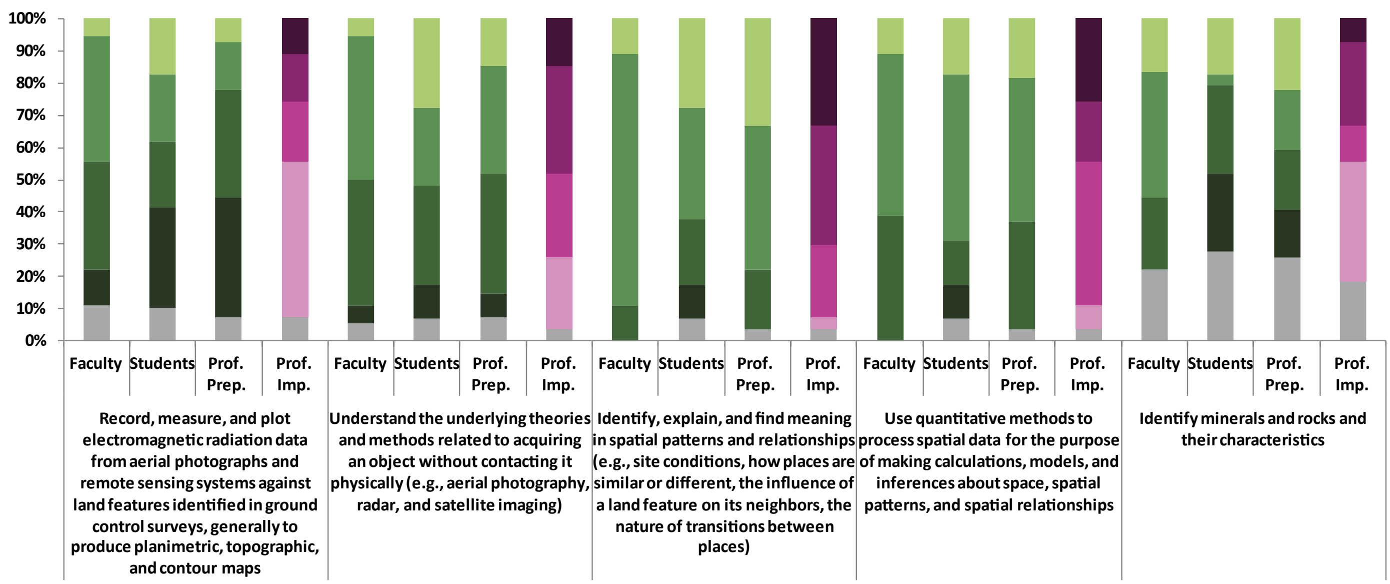


Figure 6.14: Hybrid Technical Skills, part 2



KEY Preparation:
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- Somewhat Prepared
- Not Prepared
- Not Applicable/ I don't know

KEY Importance:
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- Important
- Somewhat Important
- Not Important
- Not Applicable/ I don't know

Figure 6.15: Hybrid Technical Skills, part 3

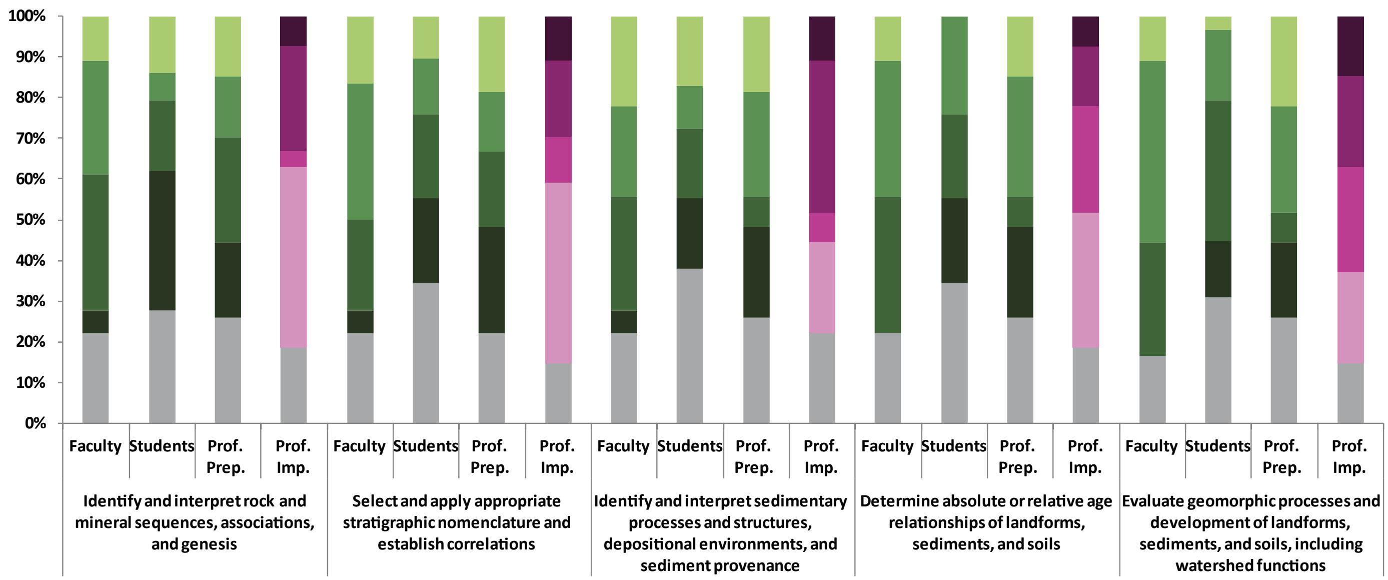
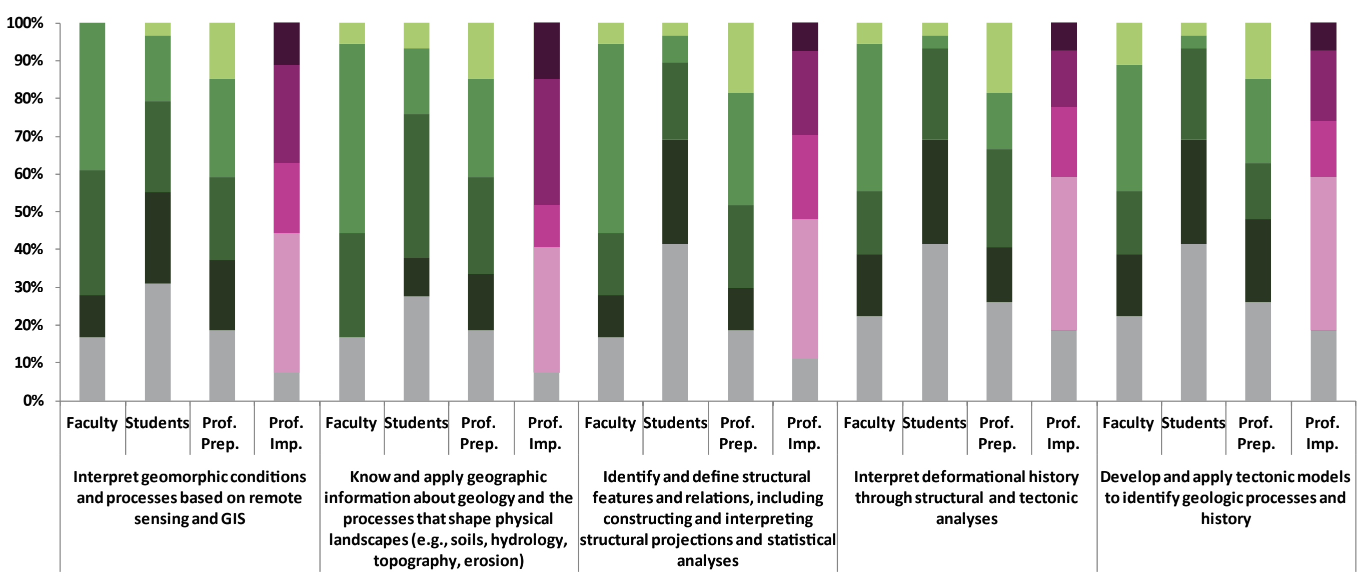


Figure 6.16: Hybrid Technical Skills, part 4



KEY Preparation:
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- Not Prepared
- Not Applicable/ I don't know

KEY Importance:
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- Important
- Somewhat Important
- Not Important
- Not Applicable/ I don't know

Figure 6.17: Hybrid Technical Skills, part 5

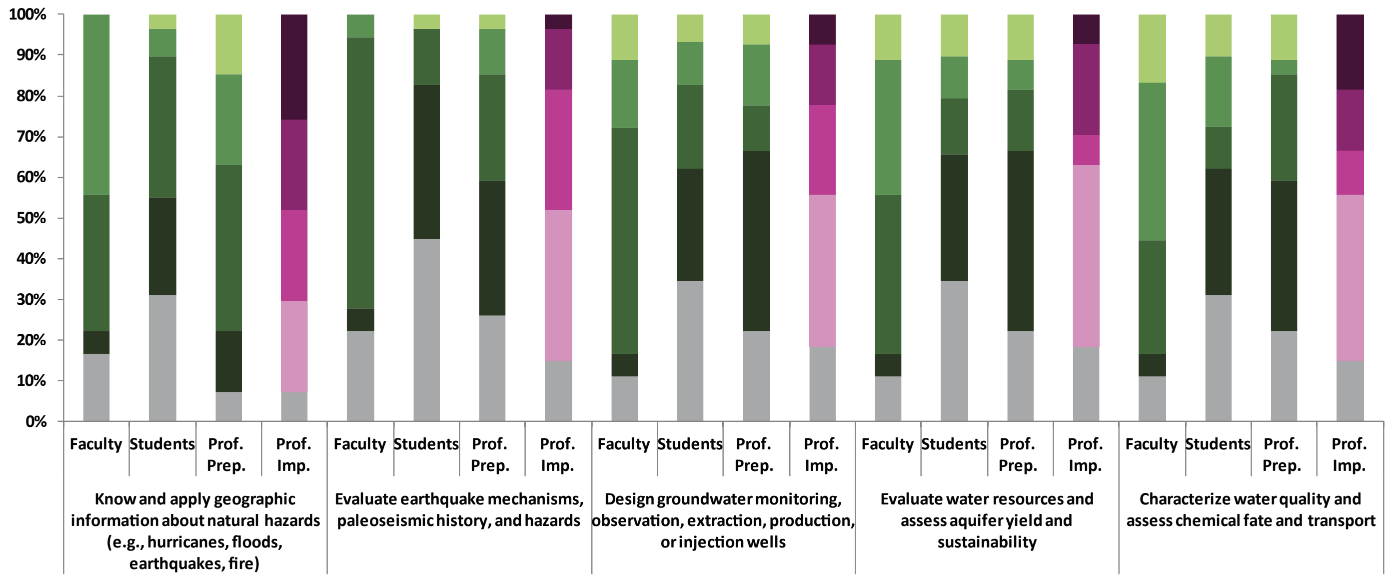
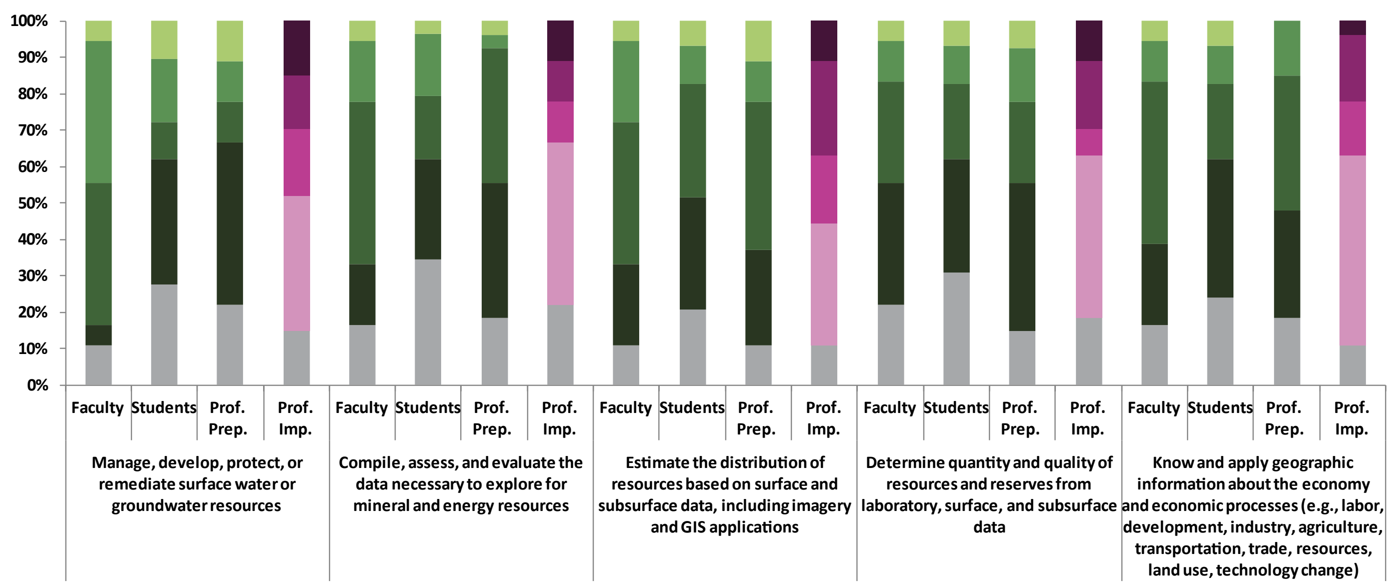


Figure 6.18: Hybrid Technical Skills, part 6



Conclusion

The Geoscience Career Master's Preparation Survey sought to investigate four lines of inquiry. These questions included issues of student motivations, career goals, and career decisions. The survey inquired about faculty and students' satisfaction with their degree programs, the competencies that are taught within the programs, and what types of positions students desire and typically secure upon graduation. Additionally, the survey investigated how important these competencies were to employment within non-academic sectors.

1. **What are the motivations and career goals of Master's students who pursue graduate study in geology and geography? What factors influence and inform these decisions?**

The majority of student respondents indicated that they enrolled in a graduate program due to extrinsic factors regarding career advancement. As one would expect, the majority of students enrolled in their graduate programs to prepare for a better job upon graduation and to increase salary potential throughout their careers. In addition to these extrinsic career factors, students indicated that purely academic and intellectual pursuits were also important in their enrollment decisions. Students typically want to be intellectually challenged during their degree programs, and gaining more education and appreciation of ideas was particularly salient for geology students.

To supplement the information collected about students' enrollment decisions, the survey also investigated their career goals post-graduation. Geology students most often cited working within the private sector in education, environmental consulting, and energy exploration as career prospects. Furthermore, many geology students indicated that they wish to grow into management positions during their careers. Geography students typically want to work within GIS careers, in education, preservation and conservation, meteorology, or within industry in general. Students within hybrid programs had more diverse career goals including those listed above, as well as geochemistry, economic geology, and water resource challenges.

The top factors that influenced students' career decisions were the individuals that students seem to have the most interaction with, including research advisors, faculty within their departments and at other institutions, and students' significant others or family members. Some of the least influential factors included campus administrators, and geoscience or non-geoscience professional societies, perhaps due to the relative lack of involvement of these entities in students' daily lives.

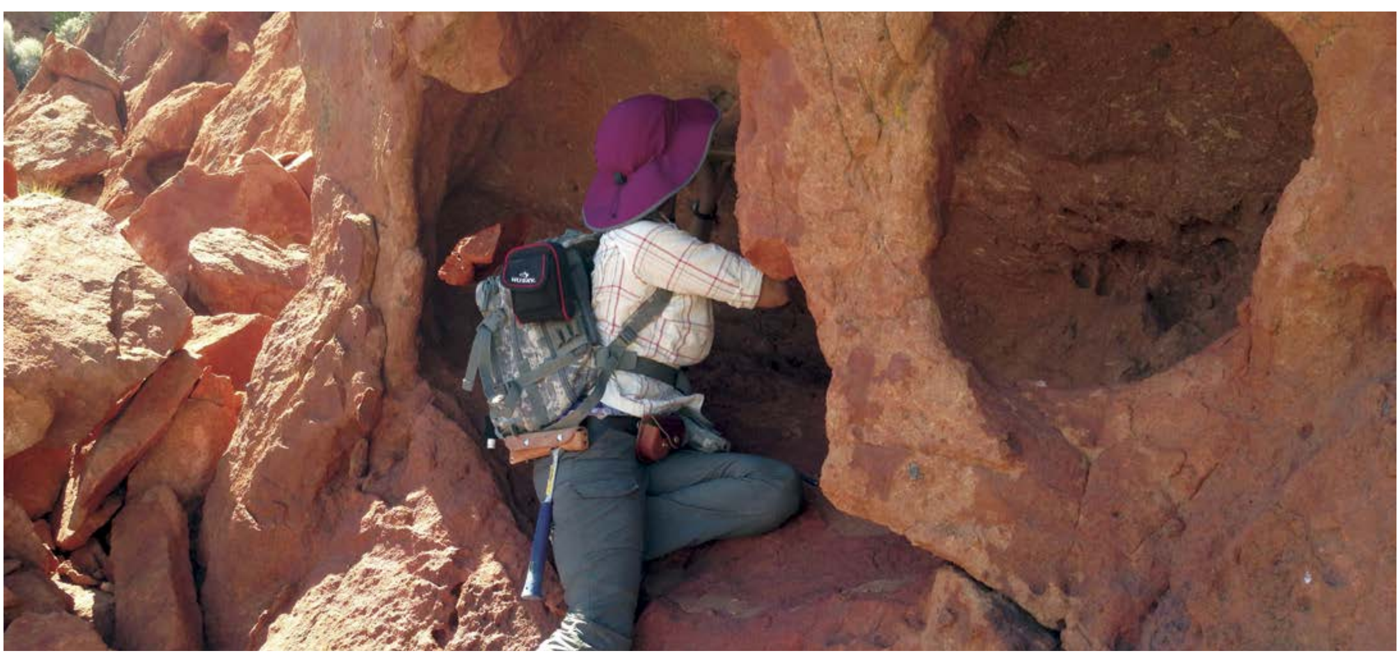


Image submitted by Abijah Bauer to AGI's 2014 Life in the Field contest.

Image submitted by Robert Witter/Alaska Geological Survey to AGI's 2014 Life in the Field contest.

2. **What entry-level positions are most commonly taken by graduates of Master's programs in geology and geography?**

Though many geology students hope to secure government positions, the reality is that faculty report only about 10% find employment within the government. The 50% of geology students interested in the private sector have more realistic expectations – geology faculty indicated that nearly half of their graduates accepted these positions. These trends mirror non-academic professionals' career trajectories. Well over half of non-academic geologists secured positions within the private sector after their Master's degree programs, and fewer than 20% secured government positions. As their careers advanced, 75% of participants currently hold positions in the private sector. Therefore, despite what students hope to pursue in the future, the majority of them end up working within the private sector, according to these trends.

Geography differs from geology in that nearly one-third of faculty indicated that their graduates secure positions within a non-profit or NGO. This is in contrast to the less than 10% of geology graduates who typically secure similar positions. Additionally, over 30% of geography graduates secure government positions, a contrast to the 10% of geology graduates, with geography students seeing stronger employment prospects at the state and local level given their tendencies towards GIS careers. However, less than one-quarter of geography graduates secure positions within the private sector. These trends are similar to non-academic professionals' positions; almost half of professionals accepted government positions after graduating from their Master's programs, and about a third of them transitioned into the private sector. Unlike the employment trends that geography faculty report, less than 10% of professional geographers accepted a position within a non-profit or NGO. A stark contrast from geology non-academic professionals, the majority of geographers currently work in the government and less than one-third work within the private sector.

Career trends for hybrid-program students and professionals are similar to the geography community. Faculty in hybrid programs indicate that over a third of their graduates secure positions within the non-profit/NGO sector and nearly half of students want to pursue these kinds of careers post-graduation. These are different career goals compared to the less than 20% of geologists who are interested in a non-profit/NGO position. According to faculty reports, there is a greater chance that graduates from hybrid programs secure positions within the government, compared to geology students, which is reinforced by the fact that the majority of students want to pursue government careers once they graduate. One third of faculty indicated that their students typically secured private sector positions and nearly half of non-academic professionals from hybrid departments secured and still currently hold these positions.

3. How satisfied are faculty and students with the curriculum, advising, and professional development opportunities provided by Master's programs?

Overall, faculty in geology, geography, and hybrid departments are consistently more satisfied than students with the curriculum, course offerings, applicability of coursework to students' career aspirations, and the quality of instruction. The differences in satisfaction are more prominent in geology programs than in geography or hybrid programs.

Geology faculty and students are satisfied with career counseling and advising services. In addition, almost 40% of students are very satisfied with the amount of contact they have with faculty. Similar trends are observed in geography programs: nearly half of both faculty and students are very satisfied with the amount of faculty-student interaction. On the other hand, the majority of faculty from hybrid programs are not happy with career counseling and advising, which is not what students reported – about 60% indicated they were satisfied with those services.

There is a consistent trend within all three programs with the lack of satisfaction faculty and students have regarding job and internship opportunities available both within and outside of the departments. Research opportunities, however, don't present such consistent trends. Research opportunities are robust, according to faculty, in hybrid Master's programs, and about half of student respondents indicated they are happy with the opportunities available. In geography programs, however, the majority of faculty and students are not impressed with the opportunities presented. Across the board, students and faculty are not particularly satisfied with training in teaching methods – about 75% of students across all three programs were not happy with or aware of training opportunities available in teaching methods.

4. What types of geoscience, geographic and general competencies are taught and developed in Master's programs? How prepared were current non-academic professionals in their field of employment when entering the workforce from their Master's degree programs? What are the skills and competencies required of new hires in geology and geography employing industries, and how important are these to employment?

The study divided the competencies into two types – non-technical skills ("soft-skills") and technical skills. The top non-technical skills that geology students are very prepared in include making visual presentations, teamwork skills, and public speaking. The most important skills, according to non-academic professionals, are writing, critical thinking, problem solving, time management, adaptability, and ethical practice. There seems to be a gap in what geology students are most prepared in versus what is actually used in the workplace. In geography, students' skills are more analytical, including problem solving skills, critical thinking, quantitative, and computer and technology skills. Non-academic geographers' most important skills include writing, critical thinking, problem solving, computer and technology skills, and time management skills. There seems to be more alignment between geography students' preparation and the non-technical skills which are most important for geographers' careers. Similar to geography departments, students from hybrid programs are most prepared in creative thinking skills, critical thinking, problem solving, research planning and design, and quantitative skills. The most important skills to gainful employment include critical thinking, problem solving, time management, and ethical practice. It is interesting that ethical practice was a reoccurring skill that is very important in the workplace, yet it never appeared as something students had any formal preparation in learning.

Image submitted by Robyn Haney of Global Geophysical Services to AGI's 2014 Life in the Field contest.

In addition to non-technical competencies, the study investigated different technical competencies for each type of program. Geology students are most prepared in interpreting and analyzing geological data and maps, and determining scales, distances and elevations from imagery and maps, of which over 50% of professionals indicate as very important to their careers. However, identifying and interpreting minerals, rocks, their characteristics, their sequences, associations and genesis is not as important in the workplace, and yet, students are prepared in these skills. Students don't have as much preparation in incorporating human health concerns, safety, regulations or quality assurance/quality control, or collecting and interpreting historic information to plan geologic investigations, which nearly 50% of professionals indicate that these skills are very important to their positions. The data suggest overall that geology students are more prepared to work with, interpret, and manipulate a well-defined dataset, yet they are missing the applied skills which focus on understanding the full context of complex problems and developing creative solutions when given a diverse toolset.

Concerning the overlap of geology and geography, over half of non-academic geographers indicated knowing and applying geographic information about geology and geologic processes is very important to their careers. This is in contrast to the over 50% of students and faculty who feel students lack preparation in this topic. Conversely, geography students are most prepared in designing paper or digital maps and using GIS to acquire and analyze spatial data, which are well aligned with workforce needs. About 75% of professional geographers indicated designing paper or digital maps is very important, and over 50% indicate using GIS to acquire and analyze spatial data is vital to their careers.

Similar to geography students, hybrid students are well prepared in designing paper or digital maps, using GIS to acquire and analyze spatial data, and additionally, interpreting and analyzing geographical and geological data, maps and reports. These three competencies were aligned with workforce needs – over 50% of professionals indicated that they are very important to their careers. However, students were not as prepared to know and apply geographic information about natural hazards and yet almost half of professionals indicate that this is important. Students generally were not as prepared in skills that incorporated geologic content, knowledge or skills, and surprisingly, this finding is aligned with how important these skills typically are to the non-academic professionals who came from hybrid departments.

These emerging trends may be helpful in informing administrators, heads and chairs of departments, and faculty about the viability of non-PhD preparatory Master's programs in the geosciences. With the development of robust Professional Science Master's Programs (PSMs) and online Master's degree programs, many outside of the geoscience discipline, the academic enterprise is continually evolving to match students' acquired skills with workforce demand. Bolstering and offering more of these programs within the geosciences is imperative to matching students' career expectations with the skills qualifications employers require.

Image submitted by Sam Robinson to AGI's 2014 Life in the Field contest.

Appendix 1: References and Resources

REFERENCES AND RESOURCES

References:

Wilson, C. (2014). Status of the Geoscience Workforce 2014. American Geosciences Institute.

Resources:

- American Geosciences Institute (AGI) website: www.americangeosciences.org
- AGI's Workforce Program website: www.americangeosciences.org/workforce
- Statistical Analysis Report for Geo Career MaPS: www.americangeosciences.org/workforce/geo-career-maps
- AGI's Workforce Reports Page: www.americangeosciences.org/workforce/reports
- Association of American Geographers (AAG) website: www.aag.org
- AAG's Enhancing Departments and Graduate Education (EDGE) website: www.aag.org/edge
- National Association of State Boards of Geology: www.asbog.org

Image submitted by Alisa Kotash to AGI's 2014 Life in the Field contest.

Appendix 2: List of Figures

Image submitted by Alison Dorsey to AGI's 2014 Life in the Field contest.

AGI Geoscience Workforce Program
(www.americangeosciences.org/workforce) tracks the supply and demand of geoscientists by collecting original data and by analyzing existing data from federal, industry, and other sources. The Geoscience Workforce Program informs the geoscience community by reporting on workforce and higher education trends and by making predictions for future workforce needs.

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