Assessment Summary (2014-2016)
REU: Bringing Us Together, Improving Communications andLives

Demographics

The Communications REU program has supported a diverse group of students from different states. The figure below shows the home university program of the students who have been served by the program thus far.

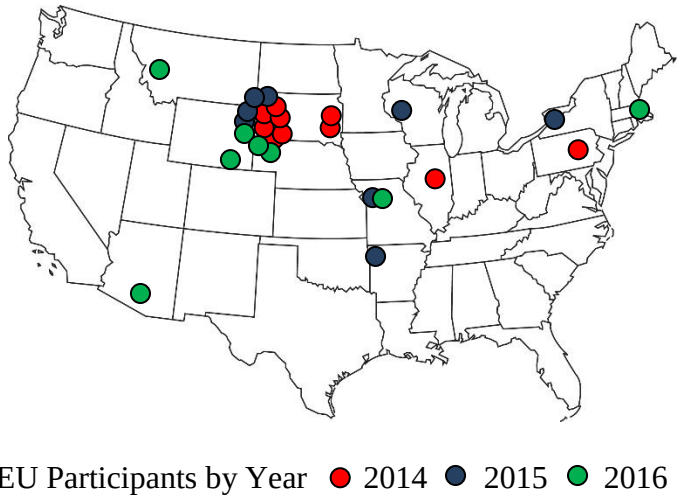
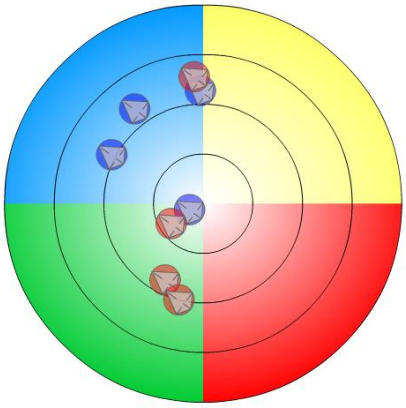


Figure 1. Geographic Location of REU Students 2014-2016

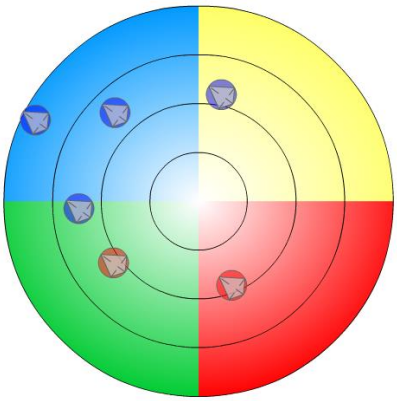
The program served a total of 26 students from 11 different states/universities. Of these 19 were men and 7 were women. A total of 7 of the program participants were military veterans. Majors included electrical engineering (15), mechanical engineering (2), computer engineering (5), physics (3), mathematics (4), and chemistry (2). Five students listed 2 majors as part of their undergraduate program of study.

Herrmann Brain Dominance Inventory

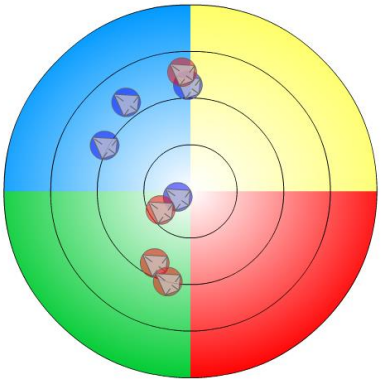
22 of the 26 students participating in the REU program completed the Herrmann Brain Dominance Inventory (HBDI). Interest in this instrument is two-fold. First, does the REU site tend to attract students with a stronger analytical thought process or does it attract an intellectually diverse group of students? The latter may be an important consideration for some areas, particularly if there is a strong interest in under-represented populations. A second interest in this instrument is to determine if the level of satisfaction with the REU experience is dependent on the thinking preference typology. Focus group interviews for the summer 2014 through 2016 did not indicate any degree of correlation between a student's typological profile and level of satisfaction. Results from the HBDI for 2014 through 2016 participants are shown in Figure 2 below.



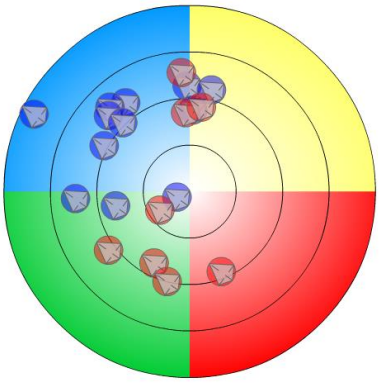
a. Team Composite Profile for 2014



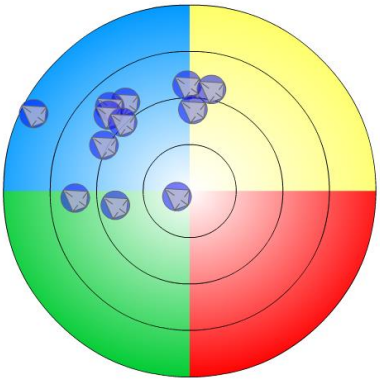
b. Team Composite Profile for 2015



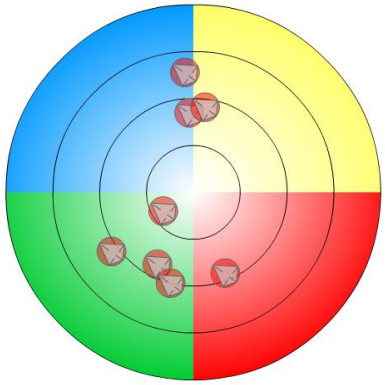
c. Team Composite Profile for 2016



d. Team Composite Profile for 2014-2016



e. Team Composite Profile for 2014-2016



f. Team Composite Profile for 2014-2016

Figure 2. HBDI Results from REU Participants (Summer 2014 - Summer 2016)

Figure 2(a) – 2(c) shows the combined team composite for REU participants for the individual years 2014, 2015, and 2016 respectively. Figure 2(d) shows the team composite for the entire three years the program has been offered (2014-2016). The blue circles denote typological preference for the men and the red circles denote the typological preference for the women. Educational research suggests that engineering students, particularly male engineering students, tend to persist in a highly analytical (blue) quadrant. Science researchers and innovators are more likely to flourish in a holistic, system oriented paradigm (yellow quadrant). While one would normally expect a higher concentration of participants in the blue and yellow quadrants, Figure 2 shows that, on average, REU participants have a stronger leaning

towards an analytical (blue) thought process and a task oriented (green) thought process. The program tended to attract a fairly intellectually diverse group of student researchers. This is commendable since this is not always the case.

Figure 2(e) shows the composite team profile for male participants over the three year period. Figure 2(f) shows the composite team profile for female students over the same period. Research suggests that male engineering students are more likely to respond favorably to an analytical (blue) curriculum. Female engineering students, on the other hand, tend to have a typology that is shifted downward and to the right. While capable of doing engineering research, female students are more likely to respond to a research project that meets a societal need. This research is certainly supported by Figures 2(d)-2(f).

By way of additional background, while first year engineering students are highly diverse, graduating seniors often tend to concentrate in the analytical (blue) quadrant. Since typology does not change significantly, such a shift would indicate a typological mismatch between a student's interest and the program offering. The fact that the REU program tends to attract diverse students, and that these same students display a generally positive view of research following the program, should be taken as a positive. A common perception is that students exhibiting green or red typologies are less likely to pursue engineering or science. Data shown in Figure (2) along with campus data collected from 2004-2016 tends to support this perception at the undergraduate level. The one exception for this program is that the Communications in Our Lives program tended to support task oriented (green) learners. This is an unexpected result if one looks at national research on typological profiles.

Figure 2(d) indicates a group of intellectually diverse learners were attracted to the program. The next question then is how well do participants from differing learning styles respond to engineering research? To address this question, REU participants were asked to give an overall evaluation 1-5 on the prospect of pursuing research or graduate education following graduation. Scores, while slightly lower for participants in the green quadrant were not statistically different from those in the blue or yellow quadrants. Average scores were 4.2, 4.0, and 3.9 for participants in the blue, yellow, and green quadrants respectively. The singleton in the red quadrant did not participate in focus group session.

A second mechanism by which to assess research interest is through the SALG survey. While REU participants indicated a slightly lower desire to pursue academic careers in 2016, at present, there is no mechanism to correlate HBDI results with those of the SALG instrument.

The data shown in Figures 2 is a flash file with an attached database. The database was updated with each subsequent REU program. Consequently, all plots composites and average kites can be explored on the fly. Currently this file is maintained at http://skellogg.sdsmt.edu/HBDIREUCM.htm .

Undergraduate Research Student Self-Assessment

The Undergraduate Research Student Self-Assessment is an NSF sponsored inventory specifically designed to address a number of issues of interest to undergraduate research. The site is maintained at the SALG site (http://www.salgsite.org).

Question 1 related to average gains in thinking and working like a scientist. Specific questions and average response scores (l=no gains, 5 = great gain) follow. Figure 3 below shows perceived gains in 2014-16 in thinking and working like a scientist as a result of the REU experience (data not yet available for 2016).

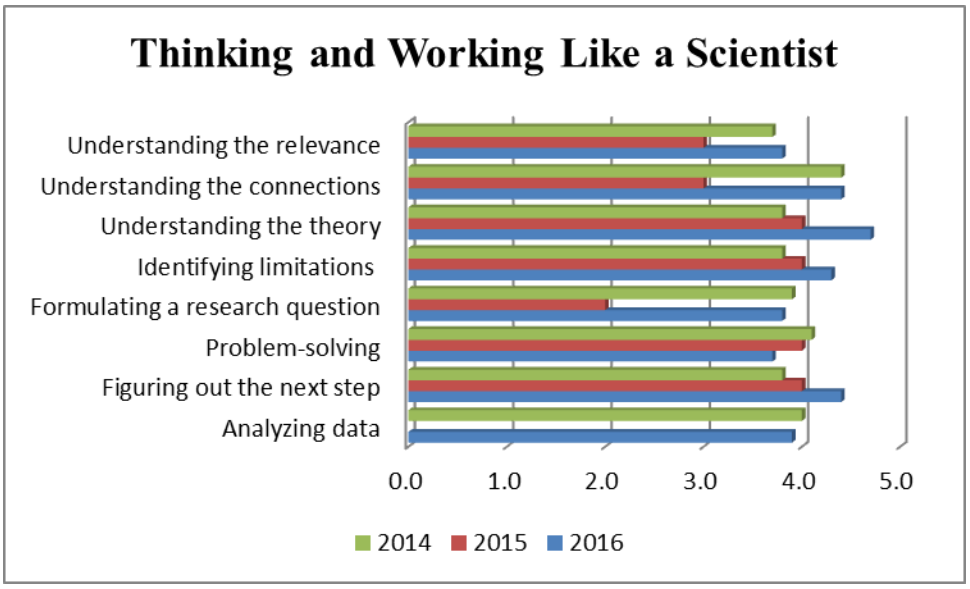


Figure 3 Perceived Gains for 2014-2016 for Question 1 Sub-items

Question 2 responses relate to personal gains related to the research work. Figure 4 below compares the average response for each item in question 2.

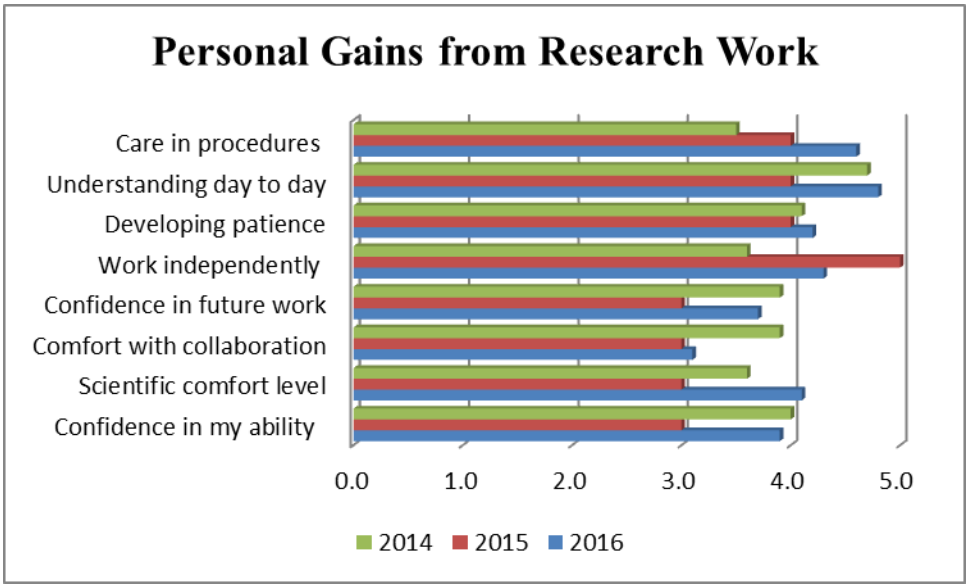


Figure 4 Personal Gains Related to Research Work

Question 3 student perceptions related to the skills they were able to develop during the REU experience. Figure 5 below compares the average response for each item in question 3. We note that there are some voids in Figure 5; using statistics for example. Voids are typically due to a low response rate or as a non-response for that particular skill. In 2015 only 3 of the participants completed the instrument and none of the projects that year incorporated statistics.

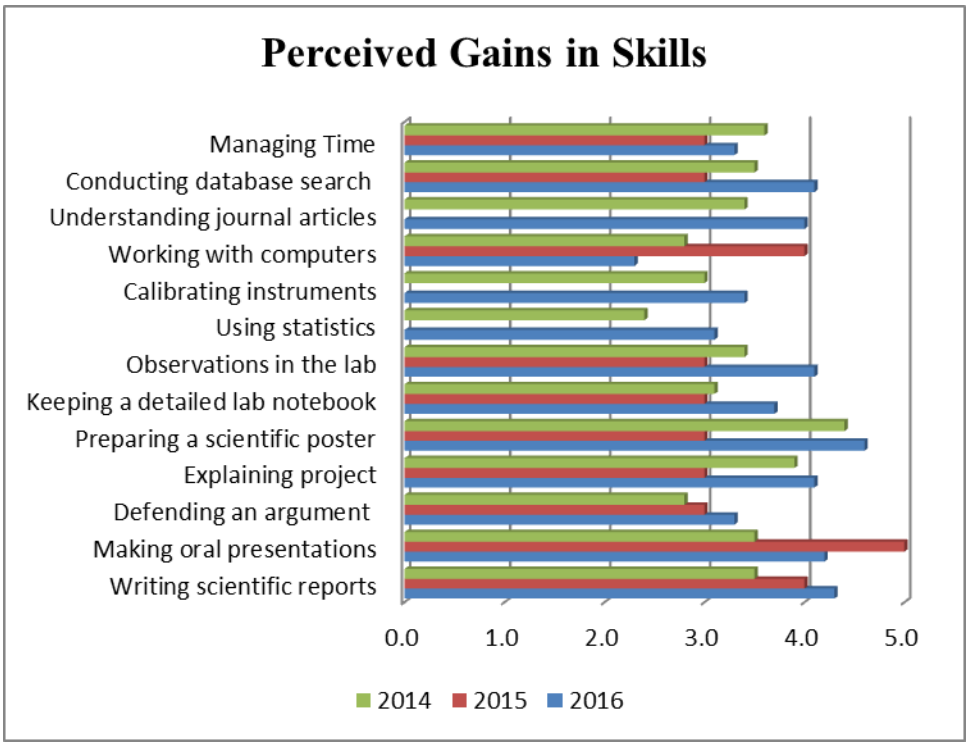


Figure 5 Personal Gains in Skill Development

Question 4 relates to changes in student attitudes towards research through involvement with the REU program. Participant responses by year are shown below in Figure 6.

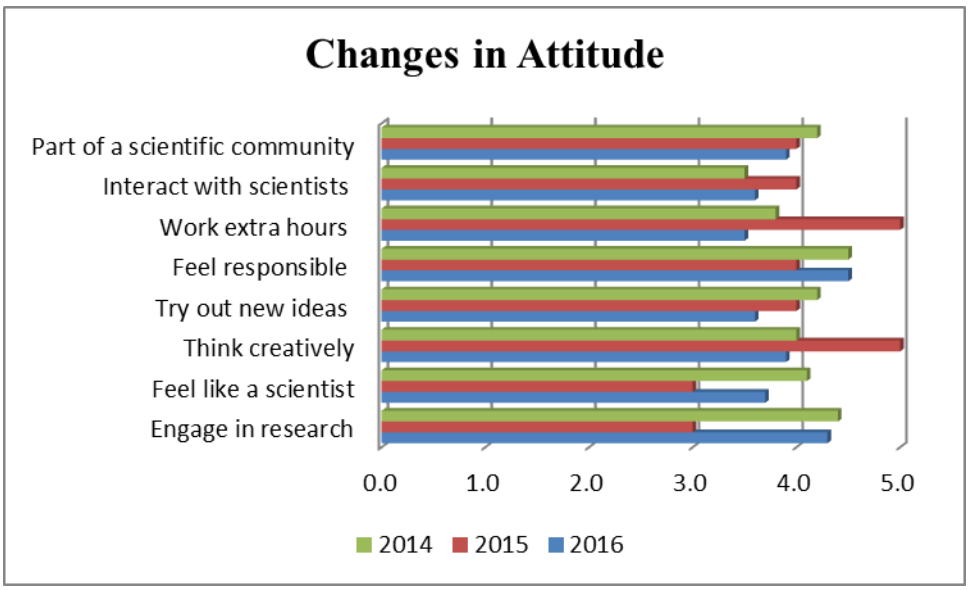


Figure 6 Changes in Attitude or Behaviors Through Research Involvement

Question 5 relates to the overall research experience. Average response results by year are shown below in Figure 7. With the possible exception of research mentors in 2014, students rated the research/mentoring experience quite highly.

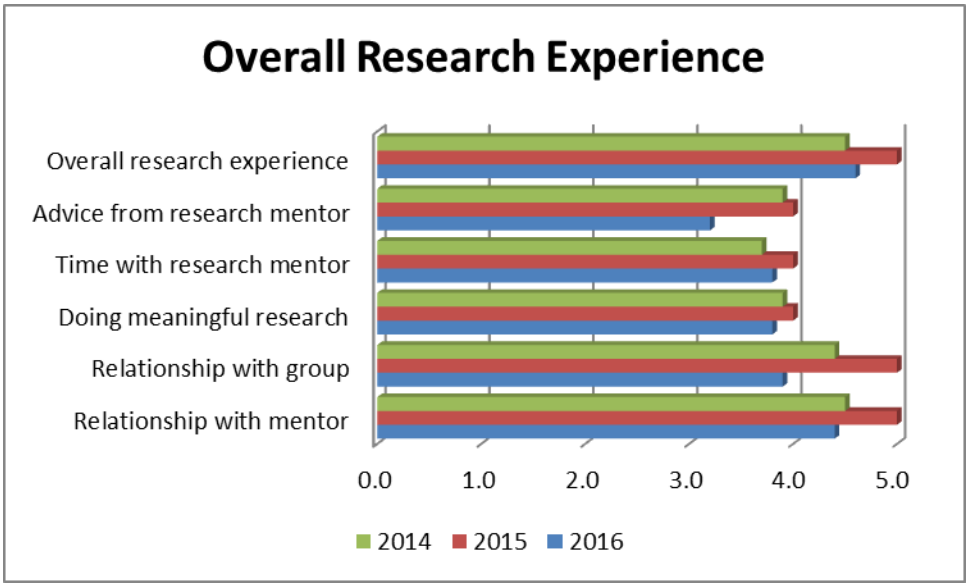


Figure 7 Student Perceptions Regarding the Overall Research Experience

Question 6 posits how well the REU experience helped to prepare students for a career in research and preparation for advanced academic work. Results are shown in Figure 8.

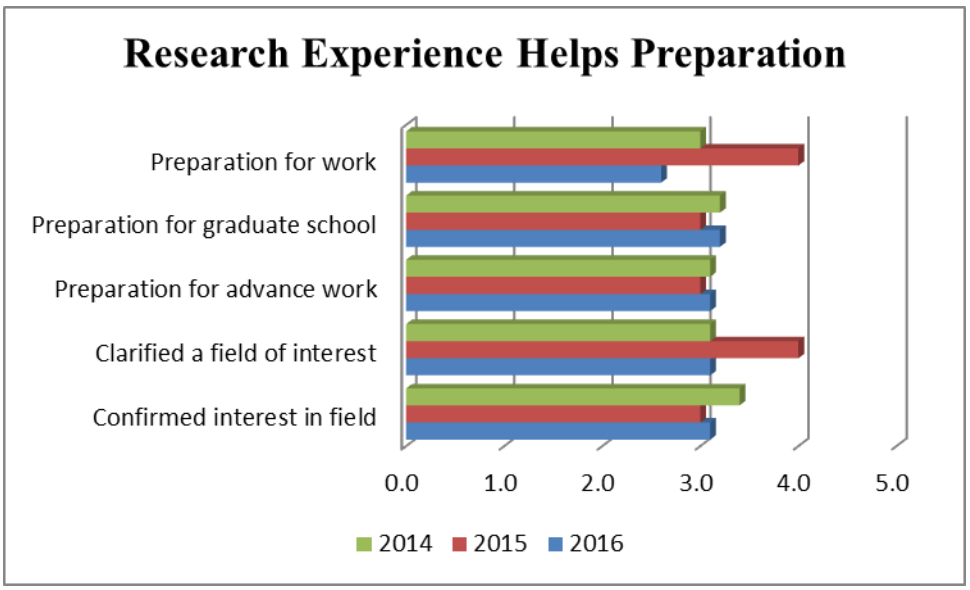


Figure 8 Student Perceptions Regarding Preparation for Advanced Work

The last question asked student participants about future plans. Results are shown below in Figure 9. In general student perceptions about graduate school, while lower than hoped, are consistent with other similar REU programs both on campus and nationally.

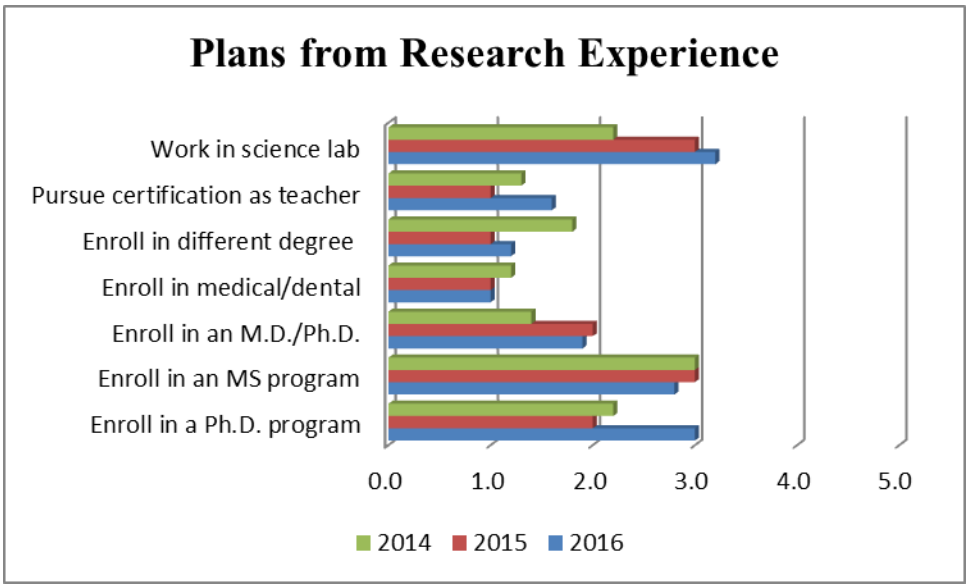


Figure 9 Future Plans for REU participants 2014-2016

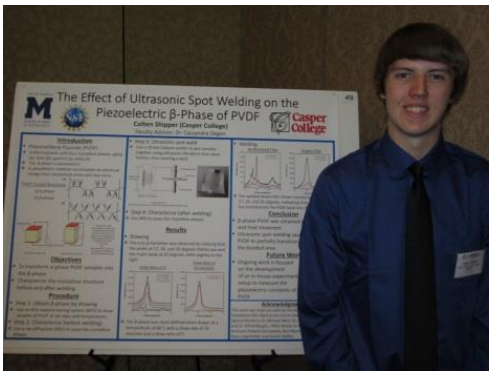
Student Satisfaction (Focus Groups)
A focus group is conducted near the end of each REU session. Over the past year as well as the previous years of the REU Communications in Our Lives program, research participants have been generally positive about the program. For most participants, positive aspects of the program include their relationship with the faculty mentor, the social connections built into the program, the professional development activities (particularly the graduate school seminar), and the food stipend. Of less interest to this group is some of the group seminar meetings and the library session. Students very much enjoyed the social activities which included a visit to Mt. Rushmore and Crazy Horse monuments. In 2016, the campus hosted three different REU programs which were collocated in one dormitory. Students noted a this was particularly positive and helped to develop cohesiveness both within the REU group and across REU groups.

One of the queries made during the focus session includes their thoughts about research and pursuit of the graduate program. While opinions vary slightly about their intent for continuing education two particular responses seem to reflect the general response of the group.

> "I thoroughly enjoyed this research experience. I thought I would attend graduate school prior to attending the REU. Now, I am certain I will."

> "I have debated whether to go on to graduate school or whether to enter a career in industry. While I remain undecided, I am quite the skills learned here will benefit me regardless of where I go."

Research Symposium



The state of South Dakota began offering combined research symposium for all institutions of higher learning beginning in summer 2013. The symposium provides an opportunity for all REU participants and undergraduate researchers an opportunity to experience a research forum and to collaborate with other undergraduate researchers. The REU: Communications students participated in the research symposium 2014, 2015, and 2016. One hundred forty four students participated in this symposium in 2016. For the most part, the posters were professional and very well done. They would be able to compete at any professional conference anywhere. This is certainly true of all Communications posters. Pictures were taken of all posters with posters given a score of up to 30 points with 10 points each for content, format, and clarity (could the evaluator make sense from the poster). The average score REU Communications posters was quite high averaging 24.8. This is higher than what this evaluator normally sees at professional poster sessions at conferences he normally attends.

Project Analysis

All projects are read and scored using the campus writing rubric which was adapted from a 2002 article in the *Journal of Engineering Education* and is given at the end of this report. One of the strengths of this REU is that REU participants are required to attend weekly communications sessions. Their first reaction is sometimes mixed, but when pressed most of the students

generally agree that the communications block not only keeps them on task but provides considerable more guidance on technical writing than they thought they might need at the start of the REU. The evaluator scored the projects on a 60 point basis with each outcome area scored from 0-10. This just gave a better gradation of project reports rather than the S, A, W scoring given on the campus rubric

A total of 22 project reports from 26 students were scored utilizing the campus writing rubric. While one should also keep in mind that this evaluator is not qualified to fully evaluate content; only that I felt it should be relatively clear from early in the paper that project and research approach should be clear. A very good score on a project or design paper for juniors and seniors in my own classes would be 50 and I only see a few of those. An overall average of 40 would then be considered quite good. The average score of 50.5 for 2016 speaks well of the overall program, the faculty mentors, the communications component, the REU participants or some combination of all. Given the improvement noticed from the first to final drafts, it seems clear much can be attributed to the mentors and communications instructor. There remained just a few items of note from my perspective.

- A few projects would provide analysis or results with limited discussion. Graphs and charts can be very meaningful but without some description to tie them together it is difficult to build a picture that supports a full scope of the research. It is sometimes helpful to have someone read the work before final submission to see if the project makes sense.
- Graphs and tables should be able to stand alone and convey the same meaning as is in the text. While generally true this was not always the case.
- In one or two instances formula were given without explanation.
- Referencing in some cases seemed either incomplete or unconventional.

Results comparing 2014 through 2016 are shown in Figure 10 below.

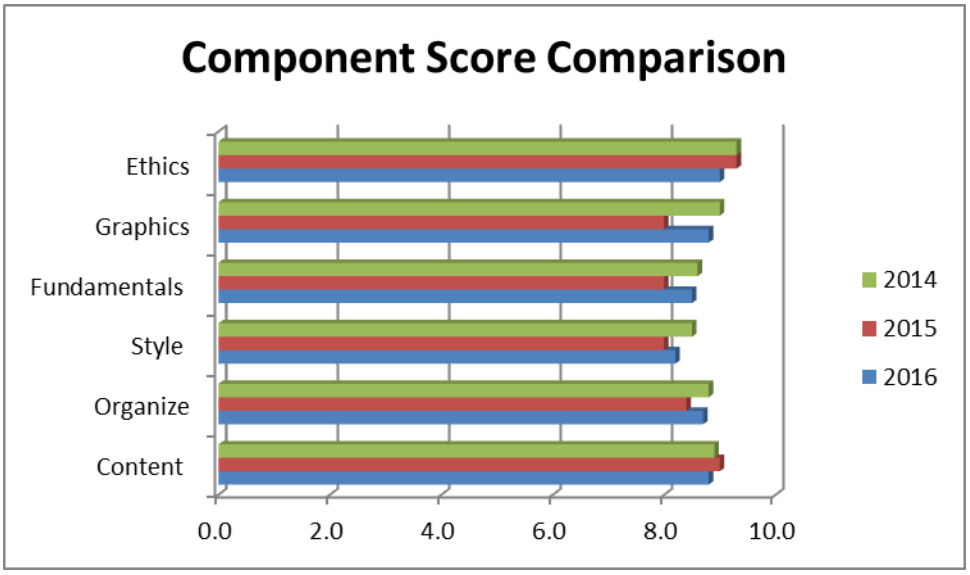


Figure 10 Component Score Comparison for the Communications REU **Writing Rubric**

South Dakota School of Mines and Technology

S = Strong
A = Acceptable
W = Weak

OUTCOMES	EVALUATION		
	S	A	W
1. The CONTENT of the document is effective.			
2. The document is ORGANIZED and FORMATTED appropriately for its intended audience and purpose.			
3. STYLE and TONE are appropriate for the intended audience and purpose.			
4. The document shows knowledge of writing FUNDAMENTALS.			
5. The NON-TEXTUAL ELEMENTS (graphs, charts, equations) are appropriate for the intended audience and purpose.			
6. The writing demonstrates an understanding of the ETHICS governing writing.			
Overall Evaluation			

KEY TO EVALUATING OUTCOMES

1. CONTENT

- Clearly states the purpose, providing an explicit justification for the document.
- Supports the purpose thoroughly and concisely.
- Explicitly defines the scope for the reader.
- Is factually correct.
- Substantiates claims and, when appropriate, addresses alternative claims

2. ORGANIZATION/FORMATTING

- Conforms to conventions or requirements of the document type.
- Structures the content to represent a logical progression of ideas from introduction, to body, to conclusion sections.
- Uses a title, paragraphing, headings, and subheadings as appropriate to make the organization apparent to the reader and to facilitate navigation through the document.
- Uses effective transitional language to connect the pieces of the argument or document.

3. STYLE/TONE

- Holds the reader's interest.
- Includes a variety of sentence structures.
- Shows appropriate use of active and passive voice.
- Uses vocabulary that demonstrates an understanding of the content, concepts, and methods in the discipline.

The tone (the writer's attitude toward the reader, the topic, and themselves):

- Takes the reader's knowledge into consideration.
- Matches the purpose in the level of formality.
- Presents a voice that is authentic and credible, so the reader knows that the writer understands the topic.

4. FUNDAMENTALS

- Uses correct punctuation, grammar, usage, and spelling.
- Uses proper citation form.

5. NON-TEXTUAL ELEMENTS

- Uses non-textual elements as necessary to enhance clarity and conciseness.
- Refers to, explains, and places non-textual elements appropriately in the text.
- Provides clear labels for tables, figures, and equations and sufficient space around these non-textual elements.

6. ETHICS

- Includes citations for any ideas, information, and/or non-textual material used from sources outside the writer.
- Does not use data selectively to manipulate reader.
- Acknowledges ideas or data that challenge the writer's conclusions.

Adapted from Carolyn Plumb and Cathie Scott, "Outcomes Assessment of Engineering Writing at the University of Washington," *Journal of Engineering Education*, 91, no. 3 (July 2002): 333-338.