2018 Annual Report

Faculty as Change Agents: Transforming Geoscience Education in Two-year Colleges

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Project Overview, Goals, and Strategies

This third annual report summarizes data and information analyzed by the research and evaluation team affiliated with the *Supporting and Advancing Geoscience Education in Two-year Colleges (SAGE 2YC): Faculty as Change Agents* project.[1] This 4-year initiative focuses on effecting change to improve 2YC geoscience education at the course and program levels. The project also supports geoscience educators, who are referred to as "change agents", in spreading instructional, student access and success, and career/professional pathway improvements across their colleges and to other 2YC geoscience programs in their region.

The project began with a cohort of 23 2YC geoscience faculty affiliated with 10 teams and has expanded to include 11 change agent teams with 24 2YC geoscience faculty. A second cohort was formed in 2017 and now includes six change agent teams with 13 team members giving the project a total of 17 teams and 37 geoscience faculty change agents (averaging two members per team). The project has experienced some turnover within both cohorts, with one cohort 1 team splitting two teams producing one team of two change agents and the other a team of three change agents. Over time the change agents affiliated with cohort 2 have shifted in membership but appear to have stabilized for this last phase of the project.

Three overarching goals that were stated in the project proposal that continue to guide the project are:

- Build a **national network** of 2YC geoscience faculty change agents who catalyze change at multiple levels, from their courses and program/departments to their colleges and local regions.
- Implement **high-impact, evidence-based, instructional and co-curricular practices that:**
  - support the academic success of all students
  - broaden participation, and
  - facilitate professional pathways into geoscience for students.
- **Investigate professional development models** for full-time and adjunct 2YC geoscience faculty that promote the cycle of innovation, where faculty learn from the research of others, make changes in their own practice, and share what they learn more broadly with the education community.

Research and Evaluation Questions

The research and evaluation design associated with this project is purposefully focused on critical dimensions of the project, as noted below in the theory of change. The evaluation and research team includes Dr. Pamela Eddy, Professor at the College of William and Mary, who is leading qualitative research on the project; Dr. Ellen Iverson, Evaluation Director at SERC, Carleton College, who is leading the internal evaluation, and Dr. Debra Bragg, President, Bragg & Associates, Inc. and Director of Community College Research Initiatives at the University of

[1] The *Supporting and Advancing Geoscience Education in Two-year Colleges (SAGE 2YC): Faculty as Change*

Washington-Seattle, who is leading the external evaluation. Other members of the team are Ms. Kristin O'Connell who is an Evaluation Specialist for SERC, Ms. Yi Hao who is a PhD student and graduate research assistant at the College of William & Mary, and Ms. Cari Bishop who is a Senior Data Analyst with Bragg & Associates, Inc.

Figure 1 provides an updated visual depiction of the major questions for the SAGE 2YC project pertaining to the internal evaluation, external evaluation, and research. These questions have been vetted with the project principal investigator (PI) team and may continue to evolve somewhat over the rest of the grant. The questions focus the three major foci of the grant on academic achievement, broadening participation, and pathways and the ways in which the change agents engage in their work to create outputs and outcomes related to their action plans and implemented strategies.

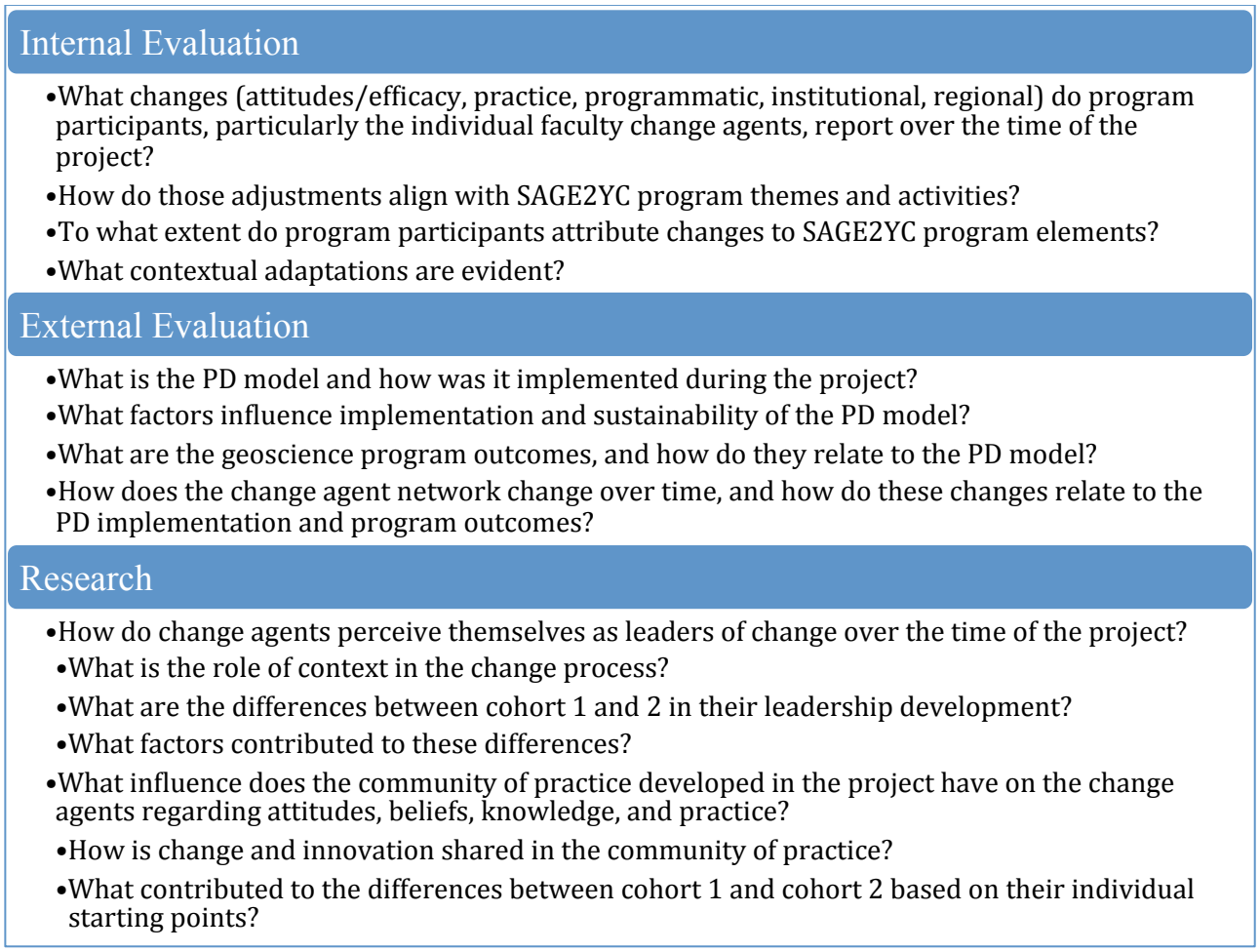

Figure 1. Key evaluation and research questions aligned to project goals.

The Theory of Change

A logic model developed at the beginning of the project provides a visual representation of the theory of change for the SAGE 2YC project is shown in Appendix A. This basic graphic provided a useful beginning point for the project, but it did not fully represent the evolving project components. As a result, a new logic model was created during this third year of the project to better reflect the project's theory of change. The process of developing this new graphic model was led by the evaluation/research (ER) team, especially Kristin O'Connell and Ellen Iverson, with critical feedback from PI team members. In June 2018, feedback was gathered from the cohort 1 change agents who attended the workshop held in Albuquerque, New Mexico. Information gathered at this workshop is being analyzed as the theory of change continues to evolve to continue to create a visually meaningful representation of what the SAGE 2YC project is attempting to accomplish.

Figure 2 displays the current graphic representation of the theory of change with the two major goal domains to increase evidence-based practices and build sustainable leadership at the top of the graphic and individual actions involving individual change shown as an on-going cycle of change at the bottom of the graphic. The middle section of the graphic shows the critical components needed to operationalize change, specifically the teams, engagement modalities (in person and virtual), resources, and network (of networks) that comprise the SAGE 2YC professional development model as a community of practice.

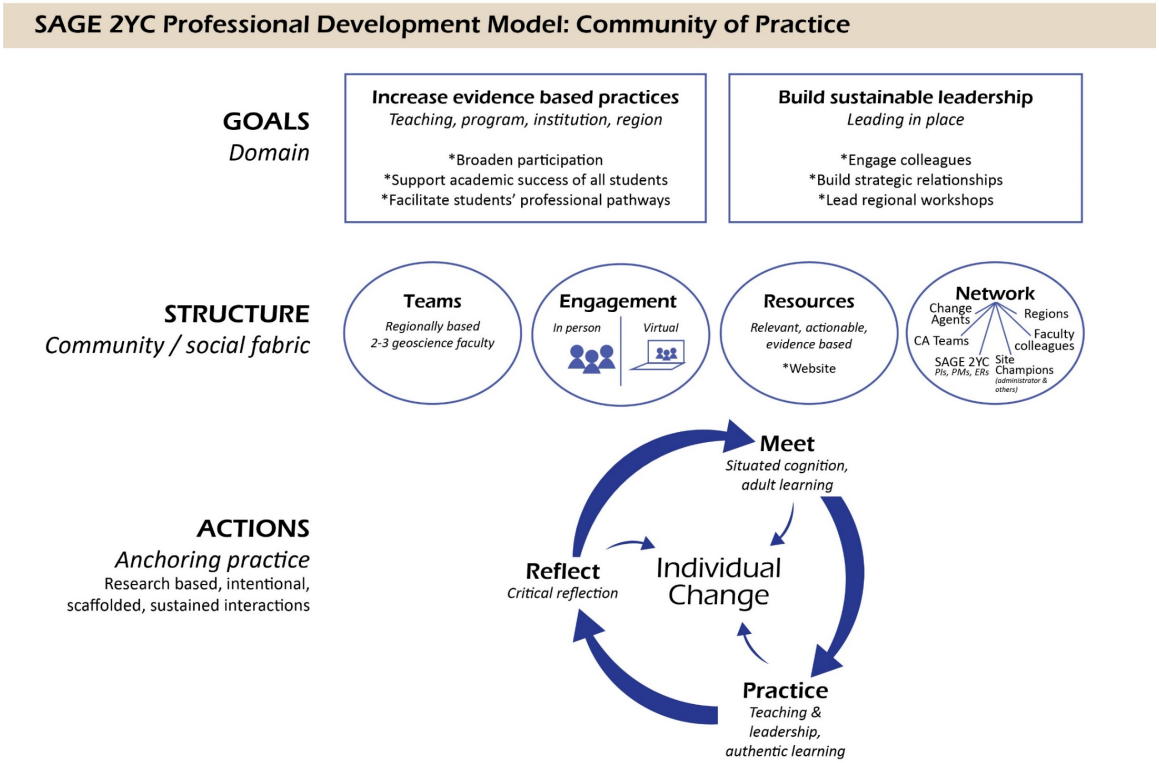

Figure 2. The SAGE 2YC theory of change pertaining to change agent actions and communities of practice.

The theory of change being developed for the project also shows the cycle of innovation that was articulated from the beginning of the project plan at the time the proposal was developed. In Figure 3, we see in the top row of the graphic how change spreads from an individual change agent, to the program, to the institution, to the region, and ultimately to a sustained state of being. In the second row of this graphic, we see the increasing power of the network that starts with substantial scaffolding and influence from the SAGE 2YC project team and gains strength from the change agents, their colleagues and their regions as time goes by. (Note how the weight of the lines changes as the project evolves.)

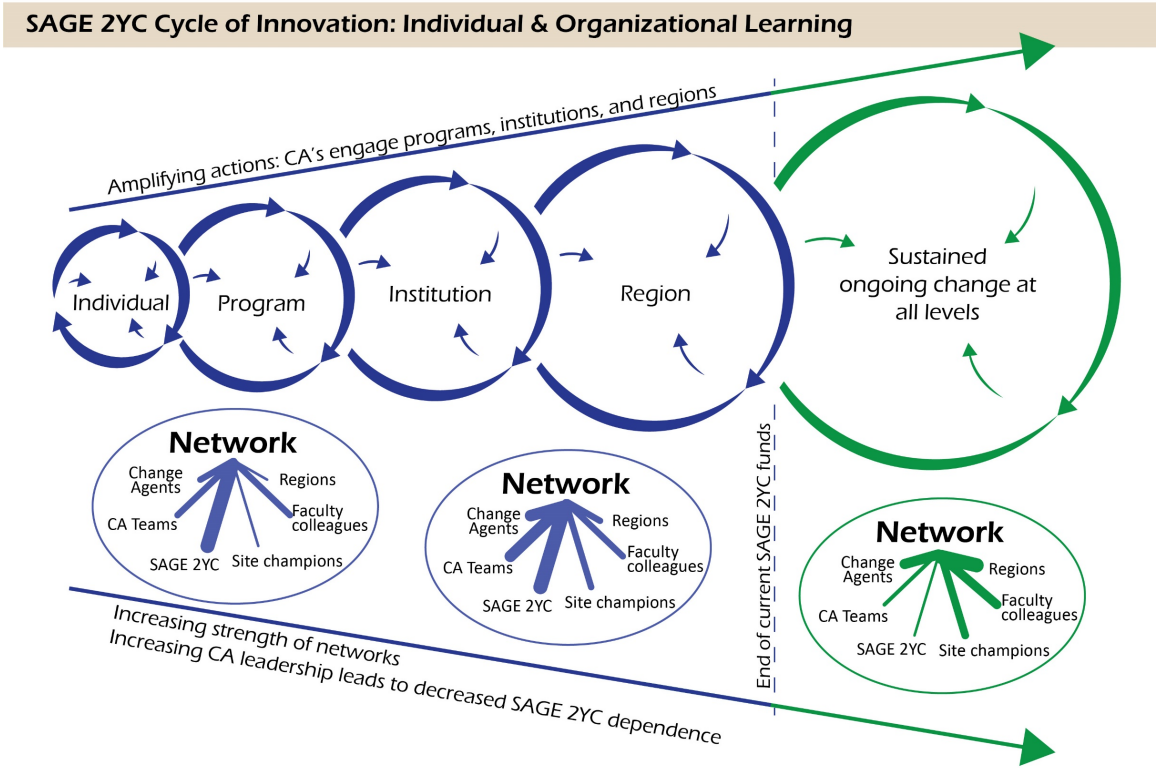

Figure 3. The theory of change pertaining to the cycle of innovation involving individual and organizational learning.

SAGE 2YC Program Change

The first two annual external evaluation reports (Bragg & McCambly, 2016, 2017) for the SAGE 2YC project documented the action plans created by the cohort 1 change agent teams and summarized the evaluator assessments toward implementing action plans and achieving the desired outputs and outcomes. During year three of the project, the cohort 1 change agent teams continued making progress, and they documented their accomplishments in posters displayed at the June 2018 workshop. Appendix B presents results of an analysis of the change agent plans completed by Bragg and McCambly in July-August 2017 based on the action plans that the cohort 1 change agents developed at the June 2017 workshop in Tacoma, Washington.

Reviewing the results from earlier reports, we see that half of the ten CA teams made one or more changes from their initial plan in 2016 to the updated plan in 2017, and the remaining CA teams continued on with their 2016 plans. Looking at change agent team plans for 2018, instructional practices continued to be the strongest area of focus for the change agent teams, with numerous strategies focusing on improving student academic achievement (retention, grades, completion).

Figure 4 shows the average level of priority that the cohort 1 change agent teams give to the three major practice areas specified in the project goals. These averages are based on a scale of 0 to 2, with 0 representing no priority, 1 representing moderate priority and 2 representing extensive priority. These rates were assigned by the external evaluation team based on reading and analyzing the series of action plans, posters, PowerPoint presentations, and other documentation associated with the project. One observation about these results is that the priority given to the three practice areas seems to reflect the level of control and influence that the change agent teams sense that they have over their own ability to bring about change. With respect to changing instructional practice and broadening participation, there seems to be a stronger sense of ability to influence these practices. However, with respect to professional pathways, the change agents tend to see their own ability to influence change as more modest, if at all. They recognize that professional pathways, including creating and offering curriculum that leads to transfer and employment, is the responsibility of a collection of faculty affiliated with programs and institutions. Whereas a preponderance of the change agents understand the need for improvement in this area, they appear to feel less certain of how to make change happen and are therefore less likely to identify practices in this area as within their realm of responsibility pertaining to the SAGE 2YC project.

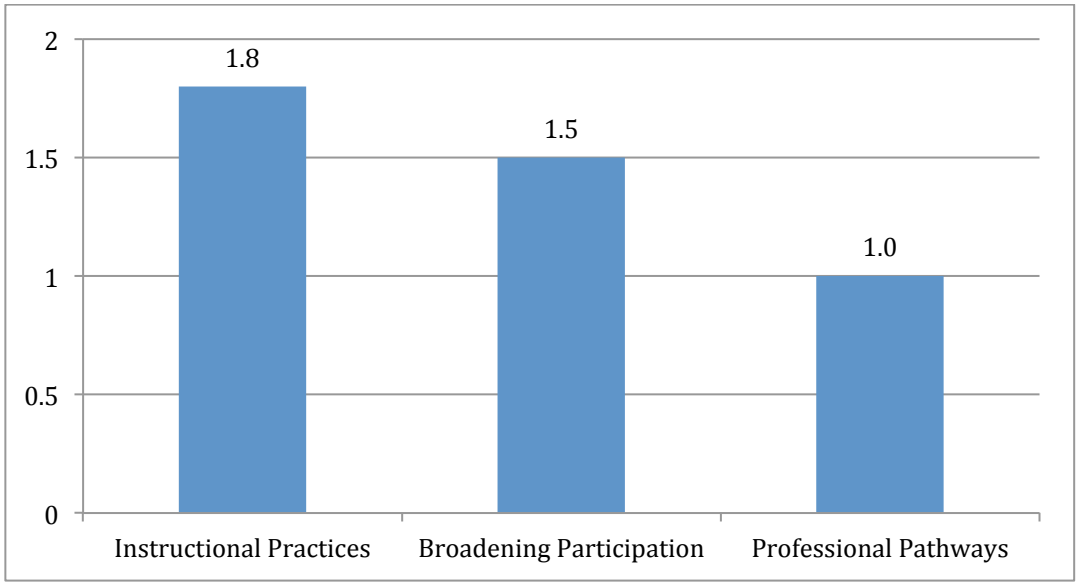

Figure 4. Average level of priority assigned to the three major practice areas in the change agent team action plans at the mid-point of the grant (summer 2017).

Two instruments were developed by the evaluation/research team and used to gather information on cohort 1 change agent involvement in the implementation of various instructional strategies in their own practice and program/departmental practices. These two instruments are titled the Educational Practices Inventory (EPI), which was administered to cohort 1 change agents in December 2016/January 2017, and the Departmental Practices Inventory (DPI), which was administered to the same group in February 2017. The EPI was administered to cohort 2 in the Fall of 2017. Cohort 2 completed the DPI in the Spring of 2018. The Educational Practice Inventory (EPI) focuses on teaching strategies, including answering questions on engagement with communities of practice (Wenger, 2011). The DPI requires that the faculty change agents work collaboratively with other faculty in their programs/departments to assess changes in program/departmental culture and document various curricular and instructional strategies used within the program/departmental unit. Results from 23 cohort 1 change agents and 11 cohort 2 change agents are included in the following section summarizes major findings for cohort 1. It is worth noting that cohort 2 had comparable results. We use brief summary text and bar graphs to provide an understanding of these results, which represent professional practices at the midpoint of the grant period. Another round of data collection using the EPI and DPI instruments will occur in the final year of the grant (2018-19) to determine if changes have been made toward the latter period of the grant.

Figure 5 shows responses of 23 cohort 1 change agents on EPI items pertaining to educational practices that are thought to be linked to student success. The figure displays stacked bars representing the aggregate percentage of change agents by frequency of implementing the educational practices aligned to student success, with the frequency scale of no response, never, 1-2 times per term, several times per term, and every session. The bars display results for the total change group from the educational practices most fully implemented toward the left of the graph to the right of the graph where less frequently implemented educational practices are shown. For example, these results show lecture and high standards are the two bars to the far left, displaying the highest level of frequency of implementation, whereas self-affirmation and careers appear to the far right, displaying much less frequent implementation. Demonstrations, small group, current events, student instruction, connections to other disciplines, validation, and inquiry are other educational practices that show a higher level of frequency of implementation than some of the other practices that were measured (e.g., online, metacognition, cooperative learning, and wikis).

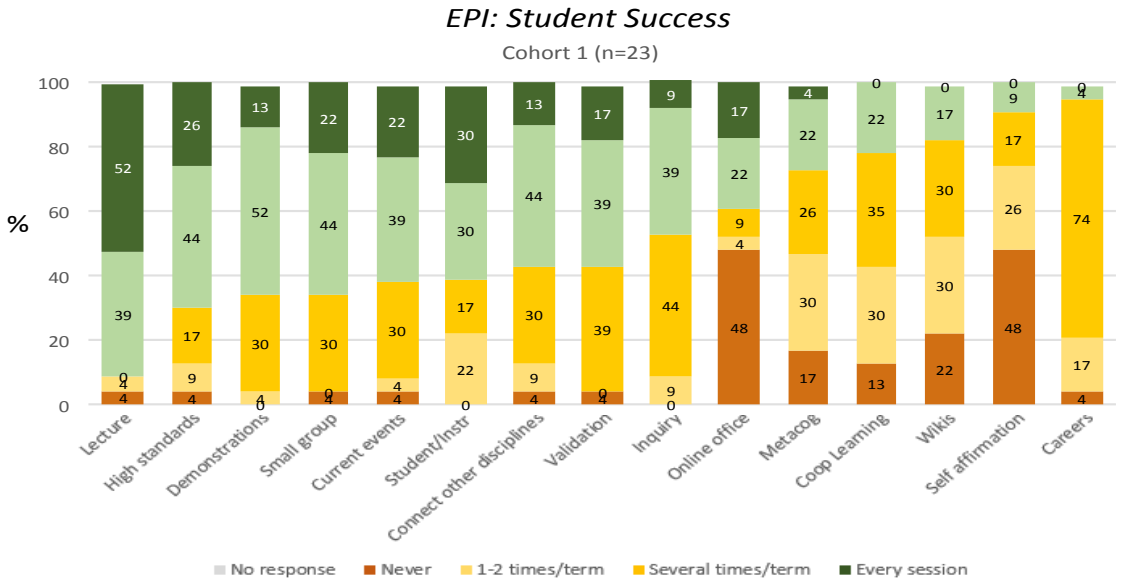

Figure 5. Cohort 1 change agent responses on the EPI items pertaining to student success.

Figure 6 shows the responses of 23 cohort 1 change agents on EPI items pertaining to teaching strategies. Similar to the last figure, this figure presents a stacked bar charge showing results on the frequency of implementation scale extending from the most frequently implemented teaching strategies at the left of the graph to the least frequently implemented teaching strategies on the right, with diminishing frequency of implementation from left to right. Specifically, problem solving and written communications appear to the far left of the graph wherein a sizable percentage of change agents indicated these strategies are implemented weekly or every session. Other teaching strategies implemented fairly frequently include quantitative skills, oral communications, and authentic data use. On the other end of the scale is service learning, which the majority of change agents indicated that they never implement.

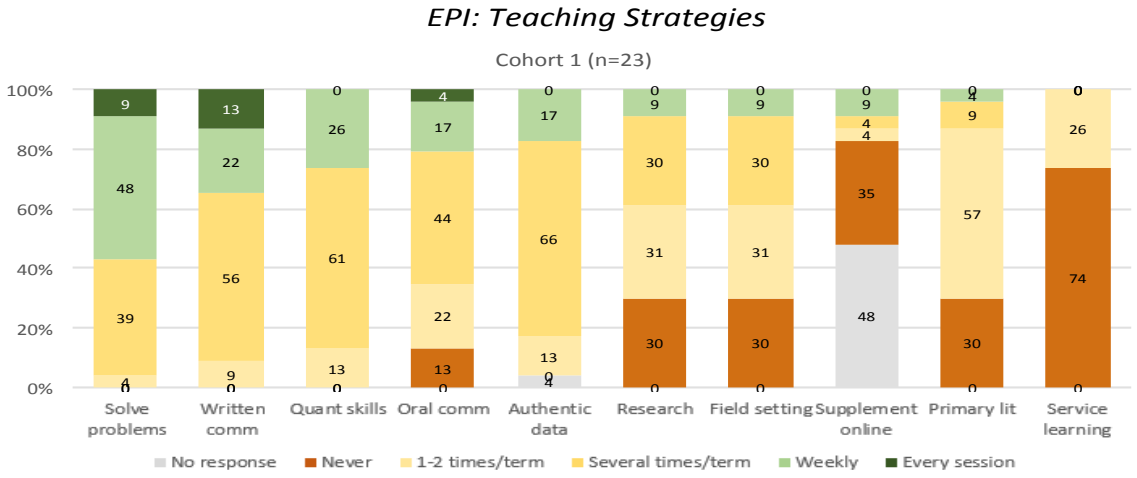

Figure 6. Cohort 1 change agent responses on the EPI items pertaining to teaching strategies.

Figure 7 summarizes the types of classroom strategies that might be employed. A broader level of classroom strategies were compiled that looked at teaching practices more holistically. This macro view of practices resulted in the use of a different scale of measure. For the set of these questions, change agents noted if they never or rarely used the strategies across their courses or used the strategies only in some of their classes versus all of their classes. Most of these strategies were used by the majority of the change agents in all of their classes. Opportunities for changes in classroom strategies by the change agents exist in making midterm changes, and in offering information on career options, including assignments related to careers. Featuring diverse geoscientists in more classes represents another area of opportunity for the change agents.

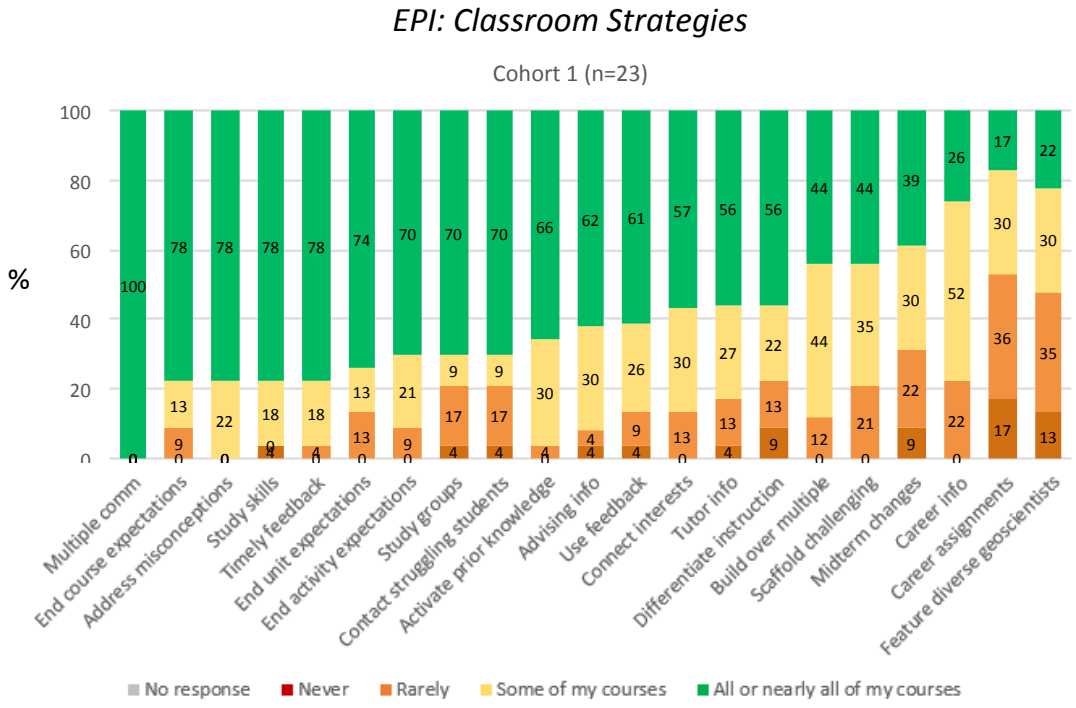

Figure 7. Cohort 1 change agent responses on the EPI items pertaining to classroom strategies.

Figure 8 shows a range of ways in which information might be shared by faculty with their students. We were interested in learning about the range of information sharing approaches with students. For example, faculty might share information with a single student who asks about a particular opportunity such as working on a research project or faculty might inform an entire class about research opportunities available to them by getting involved in fieldwork. In the first example, only one student gets access to information while in the second example an entire class learns about the opportunity. Results show the most common area of information sharing involved the change agents telling their personal stories, announcing opportunities for fieldwork or research opportunities, and hosting geoscience speakers. In all these cases, the change agents were using their courses to inform all of their students. In addition, some change agents also told some students about some types of opportunities (e.g., degrees required for geoscience jobs), or the did not share information with anyone or have information to share (e.g., information on geoscientist alumni).

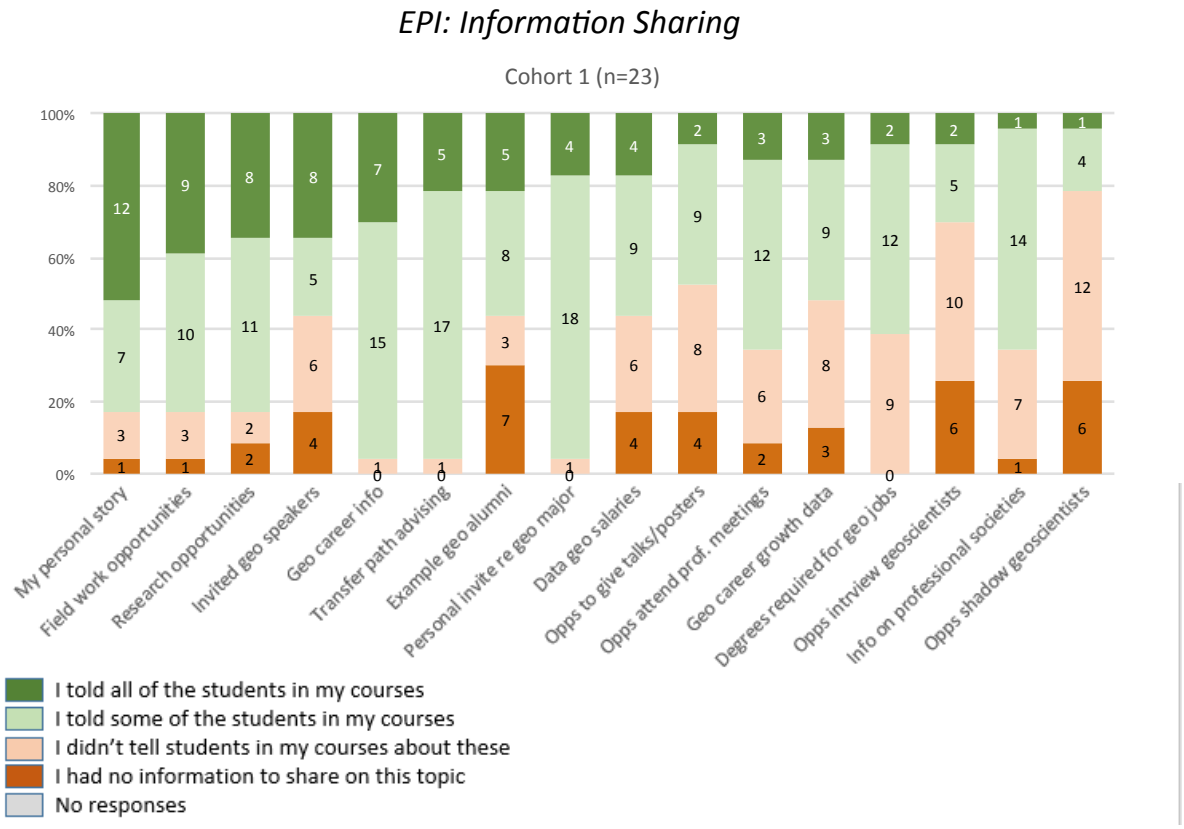

Figure 8. Cohort 1 change agent responses on the EPI items pertaining to information sharing.

Figure 9 shows the summary of information CA and their program/department colleagues supplied on the Departmental Practices Inventory (DPI) for strategies to support student success. Here, the group of faculty came to a consensus of a self-assessment of how the unit was doing in supporting student success. The scale that characterized the program/department behavior ranged from being absent (no one in the unit was doing this activity) to exemplar (all the faculty were engaged in the activity. Most programs are engaged in some form of data collection for assessment of course outcomes and program outcomes. Many programs were developing classroom practices to support student success (such as employing active learning, growth mindset, articulation audits). Several other areas were just beginning to receive the attention of program faculty, or were absent. Auditing career information as part of programs, disaggregating retention data, using data for program revisions, and measuring student success via job placement were among these areas.

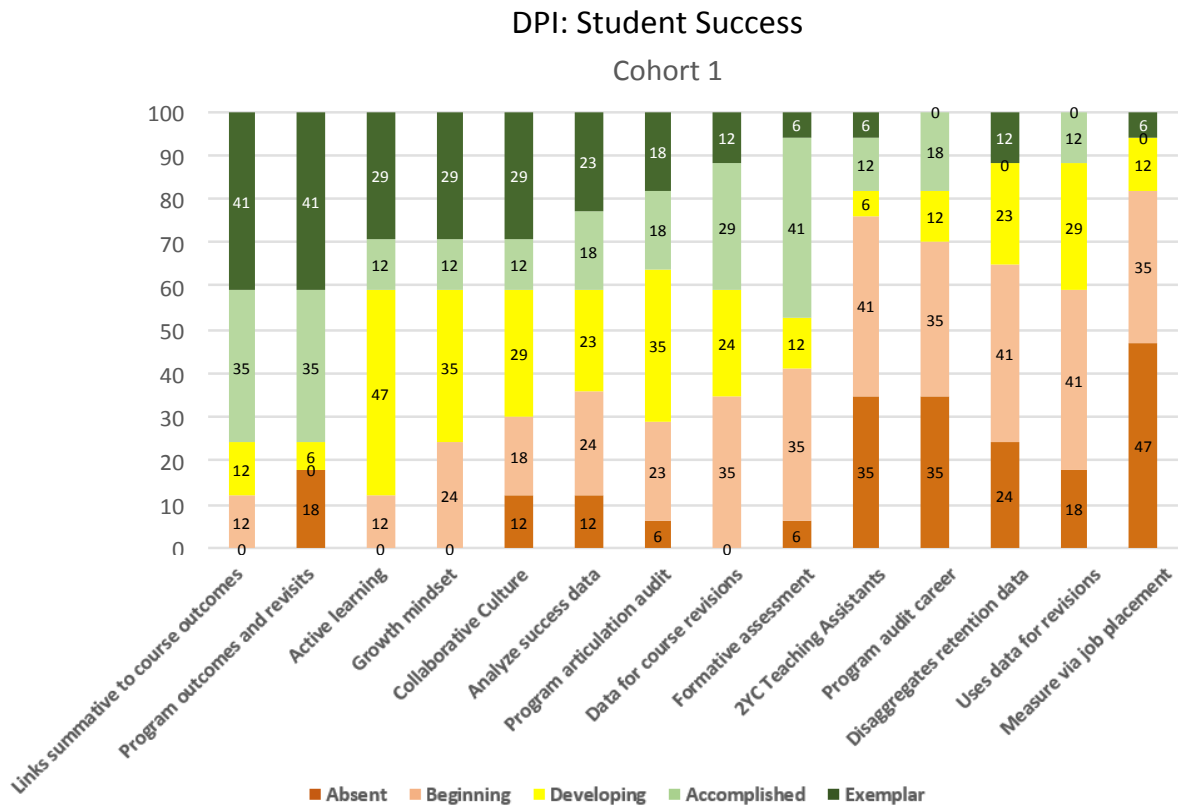

Figure 9. Cohort 1 change agent and program/departmental peer responses on the DPI items pertaining to student success strategies.

Figure 10 shows the summary of information CA and their program/department colleagues supplied on the Departmental Practices Inventory (DPI) related to broadening participation. Here again, the group of faculty came to a consensus of a self-assessment of how the unit was doing in implementing strategies for broadening participation. The scale is the same as the previous figure in characterizing the program/department behavior in a range from being absent (no one in the unit was doing this activity) to exemplar (all the faculty were engaged in the activity. The figure is organized into three types of broadening participation strategies, 1) strategies that involve coordinating with other groups such as the local K-12 schools or existing campus offices, 2) strategies that are implemented as program efforts such as incorporating culturally relevant pedagogy and science content or provide a mechanism for students to earn financial support as teaching assistants, and 3) strategies that involve a written statement or awareness of particular aspect such as implicit bias or the cultural backgrounds of the student population. Most programs have awareness and have engaged in some of the written efforts. Many programs have adopted some of the program efforts such as using geoscience courses to promote the program and identifying potential majors with room for growth on program and departmental events that involve students. There is also room for growth in the strategies that involve coordination with other groups.

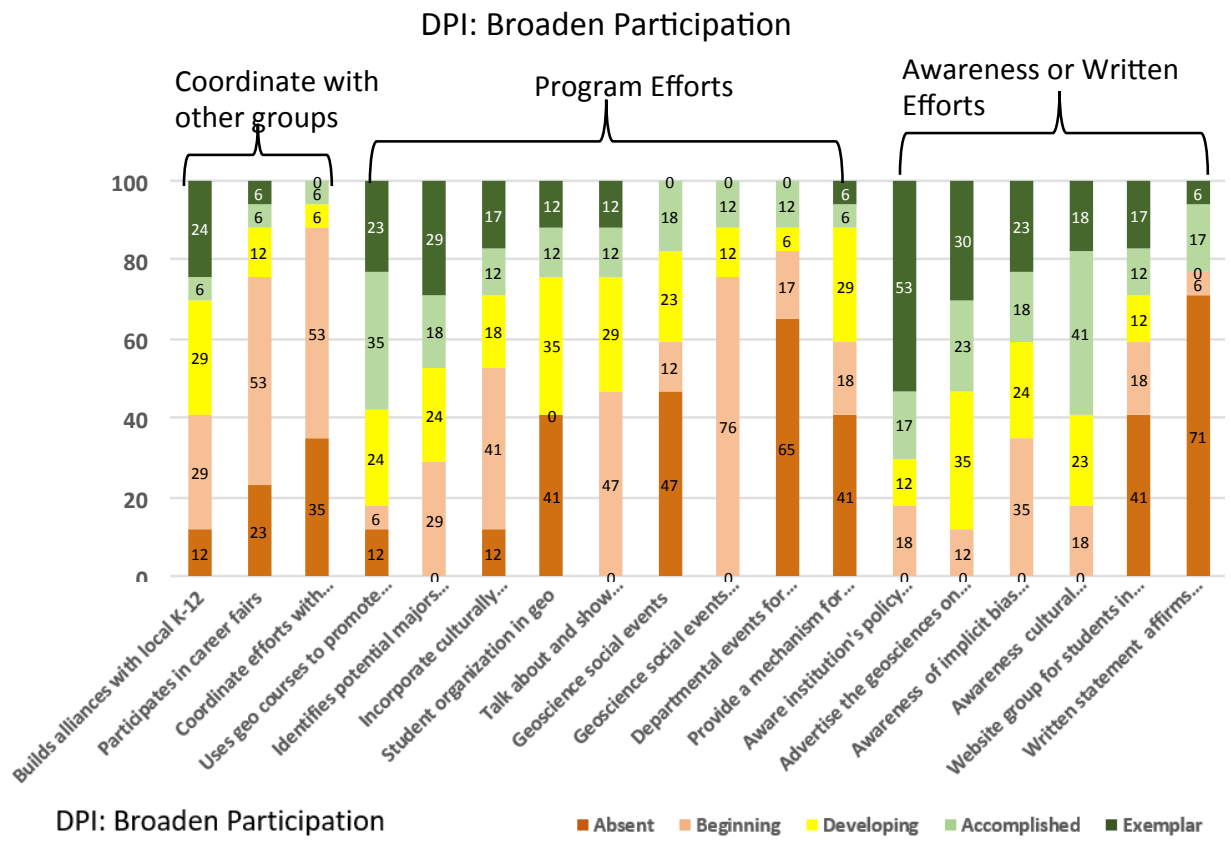

Figure 10. Cohort 1 change agent and program/departmental peer responses on the DPI items pertaining to broadening participation.

Figure 11 shows the summary of information CA and their program/department colleagues supplied on the Departmental Practices Inventory (DPI) related to facilitating career pathways. The scale is the same as previous figures in characterizing the program/department behavior in a range from being absent (no one in the unit was doing this activity) to exemplar (all the faculty were engaged in the activity. The figure is organized into three types of facilitating career pathway strategies, 1) strategies that center on career strategies such as invited speakers to talk about specific geoscience careers, 2) strategies that focus on transfer such as track advisee progress toward degree or transfer, and 3) strategies that involve students gaining skills or knowledge related to career pathways such as interviewing or job seeking. All three types of strategies show that programs have room for change. Many programs have awareness of careers in traditional geoscience areas and know where geoscience students transfer. Many programs have room for growth in areas such as visiting 4YCU transfer institutions or having joint activities with target transfer institution.

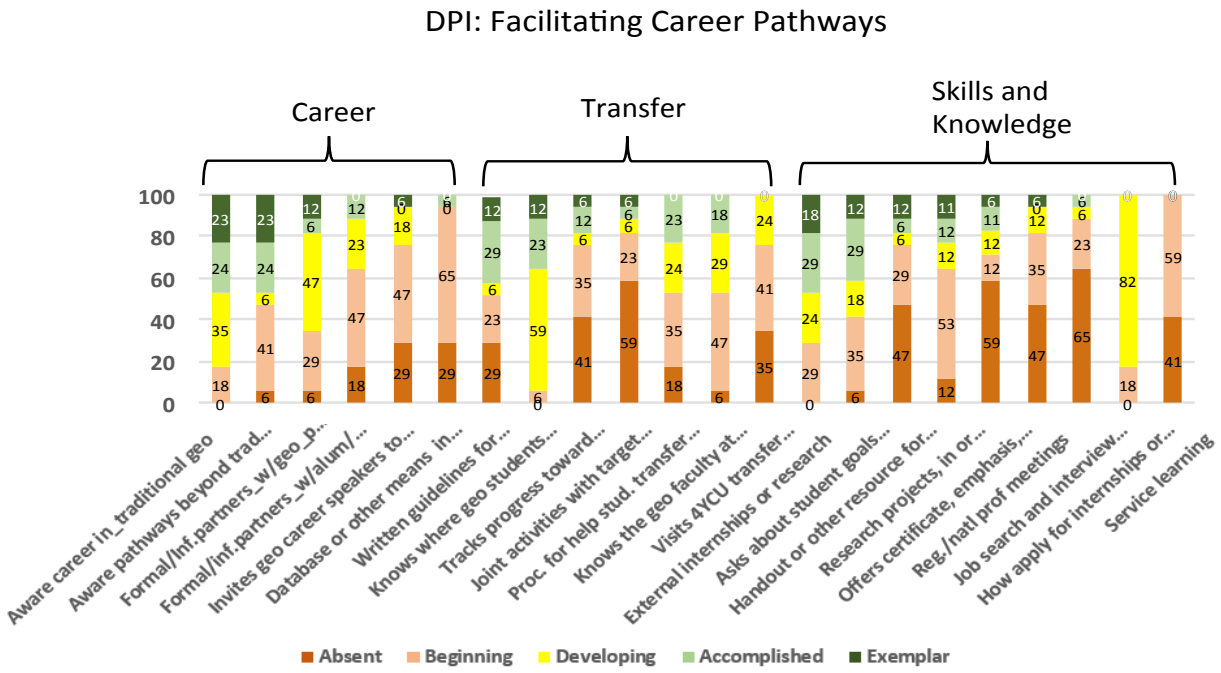

Figure 11. Cohort 1 change agent and program/departmental peer responses on the DPI items pertaining to facilitating career pathways.

Figure 12 shows responses to a question related to Community of Practice that was administered in a national survey of geoscience faculty in 2016 and to the SAGE 2YC change agents as part of the EPI, and to participants of Cohort 1 led regional workshops in 2016 and 2017. In all administrations, first respondents were asked, "To what extent do you consider yourself part of a community of geoscience educators that shares your goals, philosophy, and values for geoscience?" Then, respondents were asked "In which of the following ways do you interact with this community?" and respondents could check up to five behaviors. This figure shows these responses. The set of bars for each of the possible choices displays the percentage who selected that choice from the national survey overall, those from the national survey who participated in PD events archived by SERC, those from the national survey who were from two year colleges, and then the Cohort 1 responses followed by the total percentage from two cohort led regional workshops. The reported percentage of Change agents and participants of their regional workshops for these community of practice behaviors is higher than any of the comparable groups within the national survey response.

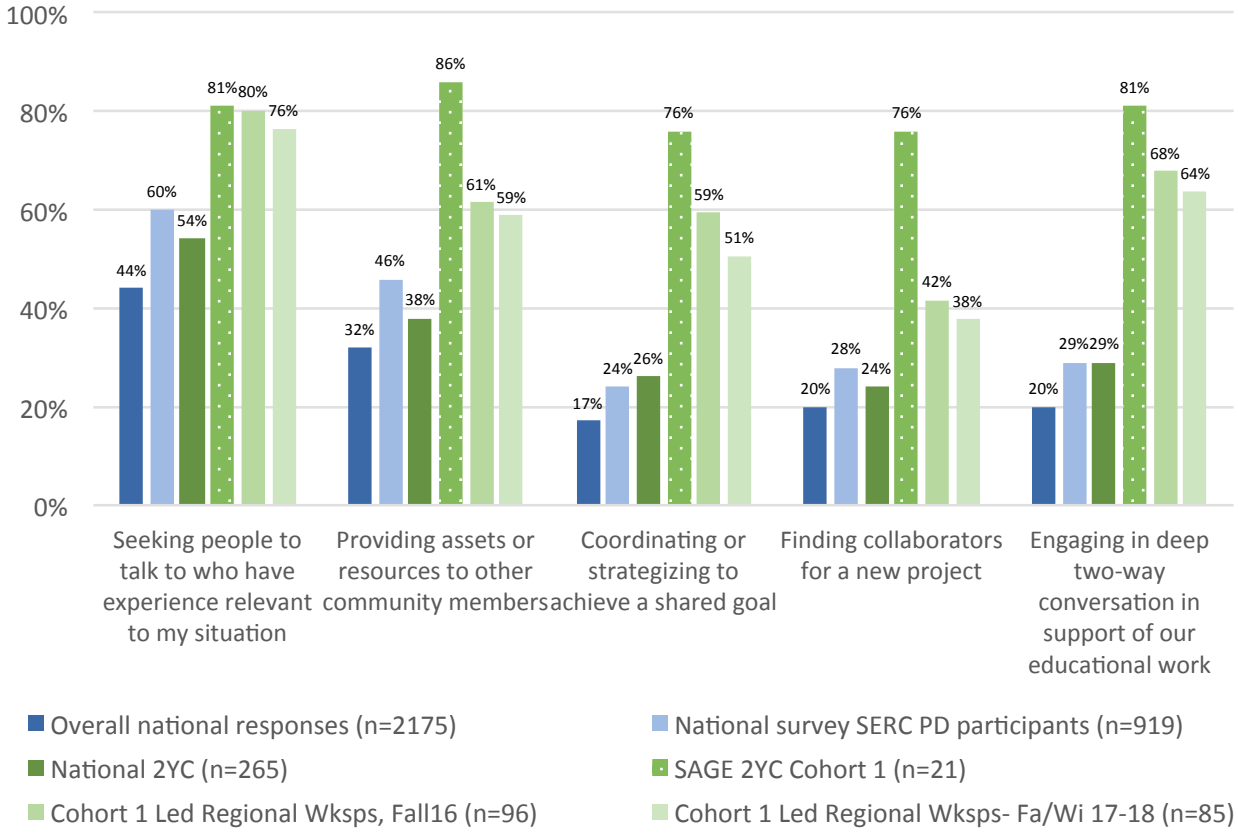

Figure 12. Cohort 1 change agent and program/departmental peer responses on the DPI items pertaining to communities of practice

Discussion of emerging findings on educational practices at the individual and organizational levels. We highlight four findings relative to these midpoint results on the EPI and DPI. First, we note that the faculty change agents report that they first modified their own classroom practices, and then some these faculty members followed up on these changes by engaging in communities of practice with other faculty on their campuses or in their regions. Some change agents enacted roles consistent with the theoretical frameworks on organizational change and leadership that we had identified at the outset of the study (based on the work of Bolman and Deal (2013), Kezar (2013), and Kotter (2014), but others did not. We discuss some of the specific aspects of changes that we are seeing change agents making in their own practices and relative to their geoscience program/department below.

- **Faculty changing their own pedagogy**. The most pervasive changes that we documented (through self-report) occurred within the geoscience classrooms of the faculty change agents. These faculty began the SAGE 2YC project by engaging in preparation, implementation, reflection, and evaluation of their day-to-day work, and these efforts have flourished and continue to evolve. Our baseline interviews provide qualitative evidence of strong faculty

commitment to the geosciences disciplines and to teaching these disciplines in the 2YC context. Most of the faculty acknowledged through the EPI and DPI, which we have supplemented with individual and focus group interviews, that they still have room to grow as geoscience instructors. However, we have documented that some change agents report taking their teaching more seriously and having greater appreciation for connecting their students to transfer pathways and the geoscience professional community and employment. Results also show most change agents have adopted new pedagogical practices in their classrooms, and they have gained experience and confidence in their teaching practice. For some faculty, this learning and growth has led to the development of organizational leadership competencies and for a few, formal leadership positions that require being a change agent for their college.

- **Faculty facilitating communities of practice.** We compared the EPI findings for the change agent faculty to responses to the 2016 National Geoscience Faculty Survey established by *On the Cutting Edge*, and these results show that SAGE 2YC respondents report being part of a community of practice comprised of geoscience educators more frequently as compared to respondents in comparable groups for the national survey. However, it is important to point out that we have gathered qualitative data suggesting some change agents have not reached this level of engagement.

- **Faculty enacting organizational change roles**. We observed first-order change [for a discussion of first- and second-order change applied to higher education, see Kezar (2013)] among a substantial number of faculty change agents so far. With respect to first-order change, site visits enabled us to observe change within the change agent's own classrooms and also in faculty peers' classrooms. Also, we observed second-order change among some but not all change agents, particularly those who sought to question their initial assumptions and widen their circle of influence. For example, according to the DPI, faculty programs/departments with higher levels of cohesion evidenced more shared practices and more connections with administrative leaders on their campuses. Faculty operating in partnership with one another recognized the strengths of their potential leadership with team members, and they built connections that illustrate aspects of individual and collective social capital (Eddy & Amey, 2014).

- **Faculty enacting other change agent roles.** Organizational leadership roles were displayed among some faculty in their enacting change roles pertaining to teaching, assessment, mentoring, and advancing students' professional identities as geoscientists; however, some faculty change agents did not exhibit these roles. We distinguish this finding from change agents changing their own instructional practice and facilitating communities of practice, including studying and conveying empirical findings and pedagogical practices to other faculty, actively encouraging and supporting pedagogical change among other faculty, and facilitating professional development designed to results in pedagogical change on their campuses and in their regions.

Cohort 2 Change Agent Activities. Whereas cohort 2 change agents have had less time to participate in the project than the cohort 1 change agents, they have learned about the three project strands and some aspects of leadership. The end-of-year online workshop conducted by the PI team in late June 2017 provided extensive opportunity for the change agent teams to share

their grant-related work with one another.

Results of those projects are displayed briefly in the bullet list below:

Cohort 2 Change Agent Activities. Whereas cohort 2 change agents have had less time to participate in the project and have not completed the EPI and DPI instruments with sufficient time to complete data analysis at this time, their accomplishments with learning and changing educational practices is substantial. The end-of-year online workshop conducted by the PI team provided extensive opportunity for the change agent teams to share their grant-related work with one another. Results of those projects are displayed briefly to give readers insights into what cohort 2 is attempting to change and improve using outcomes data (see more discussion of data below) on their own and their peers' instructional practice and geoscience programs/departments.

- Analyze student success rates by course completion and course grade for geoscience courses taught using face-to-face, online, and hybrid modalities, with the outcomes broken down by student demographics and use these results to help identify improvement strategies, including enhanced advising (faculty and staff), improved instructional and curricular approaches to online, and enhanced outreach to underrepresented students.

- Analyze geoscience course enrollment by student demographic sub-groups on credit hour attainment and use these results to identify intervention strategies, such as metacognition and enhanced faculty advising, to help students enroll in a larger number of credits per term because a higher rate of credit enrollment/attainment is associated with higher rate of college degree completion.

- Analyze courses associated with geoscience sub-fields to determine patterns of enrollment by student sub-groups that help to inform the implementation of intervention strategies, including adopting varied instructional strategies for adult learners, addressing preparedness concerns for all learners, and increasing the representation of minority groups in geoscience class and career-related materials.

- Analyze geoscience course enrollment and course completion results by racial/ethnic sub-group, gender, age, and language, and geoscience sub-fields to identify patterns of student success on grades and completion, and identify ways to align with and better utilize other campus programs and resources that focus on student success for underrepresented students (e.g., TRIO).

- Analyze geoscience course enrollment changes, especially enrollment declines, to help identify strategies to increase student enrollment, including increasing and improving marketing, communications, advising, websites, and campus visibility.

Course-Level Outcomes Assessment

During the 2016-17 grant year, the external evaluators developed a data template to gather course enrollment and outcomes data for cohort 1 and cohort 2 change agent teams, with the first data collection taking place for cohort 1 teams in spring 2017 and all teams through spring 2018.

The template gathers term-to-term data on overall and sub-group course enrollment, overall and sub-group course success (as measured by course completion with grade of C or higher), instructional practice changes, online format, and instructor of record (to designate courses taught by the change agents versus other instructors). In addition, the change agent teams are asked to identify the number of students who progress in geoscience courses on a term-to-term basis to provide a measure of pathway progression. The data template also requests the number of geoscience majors on term-to-term basis, and some but not most change agent teams are able to provide these data as well. Figure 13 presents a visual graphic representation of the three major categories of variables included in the data template. (A copy of the data template is available from the lead external evaluator, Debra Bragg, upon request.)

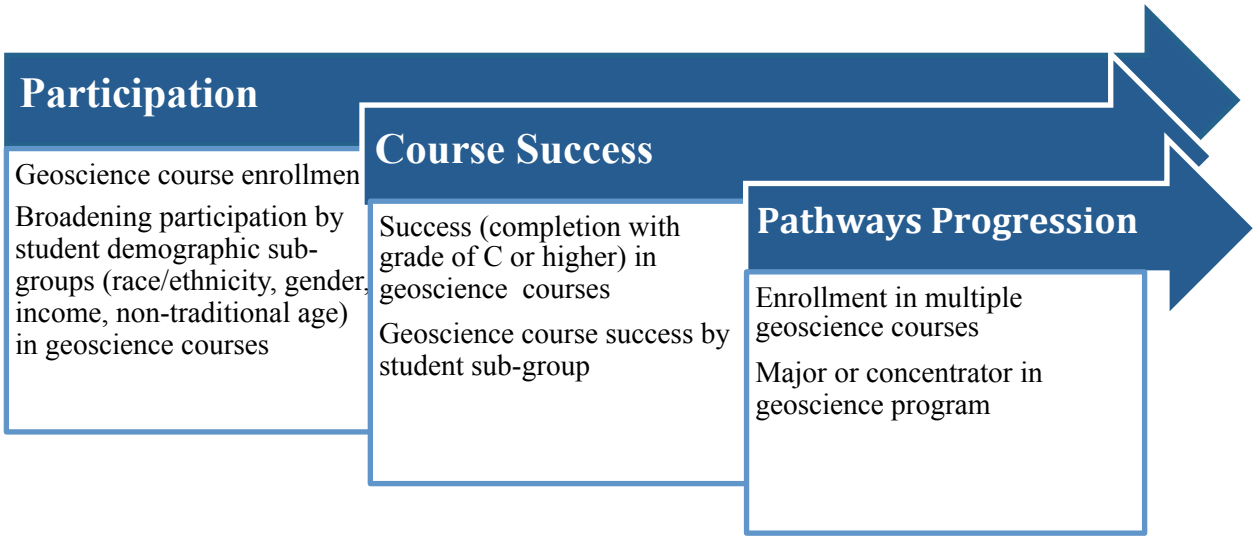

Figure 13. The three major areas of outcomes assessment for the SAGE 2YC project.

The first full complement of data was gathered using these templates for both cohort 1 and cohort 2 change agent teams in June 2018, with the majority of change agent teams providing a comprehensive response to all requested data elements. An important development during the second year of the project's focus on outcomes assessment involves deliberative efforts of members of the PI team (specifically Heather Macdonald and Eric Baer) to work with cohort 1 and cohort 2 change agents to encourage their on-going use of data to improve their educational practices particularly as relates to broadening participation and closing equity gaps. During the recent workshops (face-to-face for cohort 1 and online for cohort 2), the change agent teams were asked to consider a set of evaluation questions to guide their data analysis leading to improvement activities. These questions include:

- What are trends in overall geoscience course enrollment over time (term to term)?
- How does enrollment vary over time by geoscience course and/or section?
- How does enrollment vary over time by geoscience course and demographics?
- How does course success (grades of C or higher) vary over time geoscience course and

demographics?

- What do your progression data tell you about professional pathways?

These questions combine to set the stage for the change agents to use their data to make changes in courses and programs, including in individual and collective educational practices, to broaden participation, address equity concerns, facilitate pathway progression, and ultimately, improve student success?

In the following section of this report, we address some of the questions mentioned above to show early results on course enrollments and outcomes drawing upon data submissions from two cohort 1 and one cohort 2 change agent teams. These results represent evolving efforts by the change agent teams and should not considered final or generalizable to other change agent teams. Rather, these results are illustrative of the course enrollments and outcomes that the ER team is gathering and reporting pertaining as the SAGE 2YC grant evolves. The final results on course enrollment outcomes will be presented in the final report for SAGE 2YC.

Case 1: Cohort 1. A cohort 1 change agent team chose to analyze the course-level data to improve instructional practices and broaden participation by addressing the following questions:

- What is the overall geoscience course enrollment over time (term to term)?
- What is the term-to-term course enrollment by gender?
- What are the course success rates by gender?

This change agent team decided to focus on these questions pertaining to course enrollment and success because they align well with the change agent team's intention to increase the participation of female students while maintaining the relative high level of course success of this group.

Figure 14 shows results of this change agent team's analysis, providing term-to-term enrollment for all students as well as by gender. These results show a slight increase in overall enrollment from Spring 2017 to Fall 2017 and again Spring 2018. Males consistently outnumber females in the geoscience courses in this college but the difference in number closed to only 25 students in Spring 2018 (270 males, 235 females), with a small increase in female enrollment in the preceding Spring 2017 to Fall 2017 terms.

Figure 15 shows females course completion rates for females and males, with females consistently showing a higher success rate than males over the entire period. The completion rates were most comparable in Fall 2017 (77% course completion for females and 75% course completion rate for males), with Spring 2018 showing a higher course completion rate for females (75%) than males (70%). These findings provide useful information to help the change agent team to identify additional recruitment strategies and instructional practice changes intended to improve course completion rates for both groups.

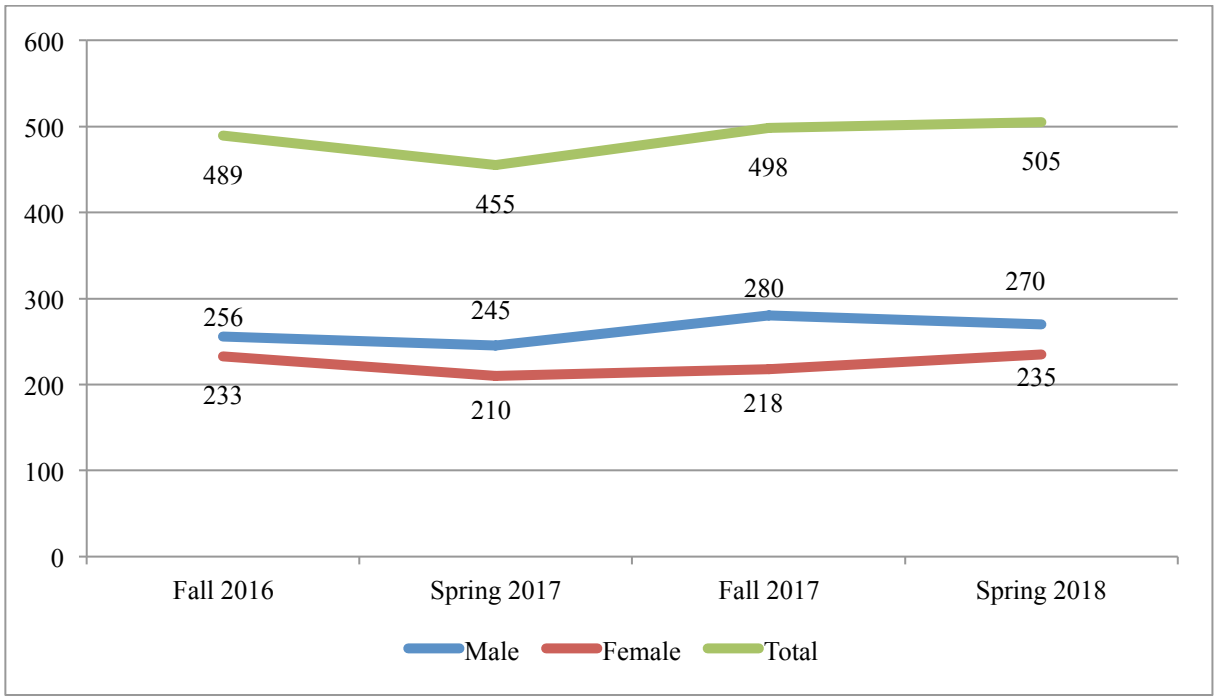

Figure 14. Case 1 geoscience course enrollment from Fall 2016 to Spring 2018.

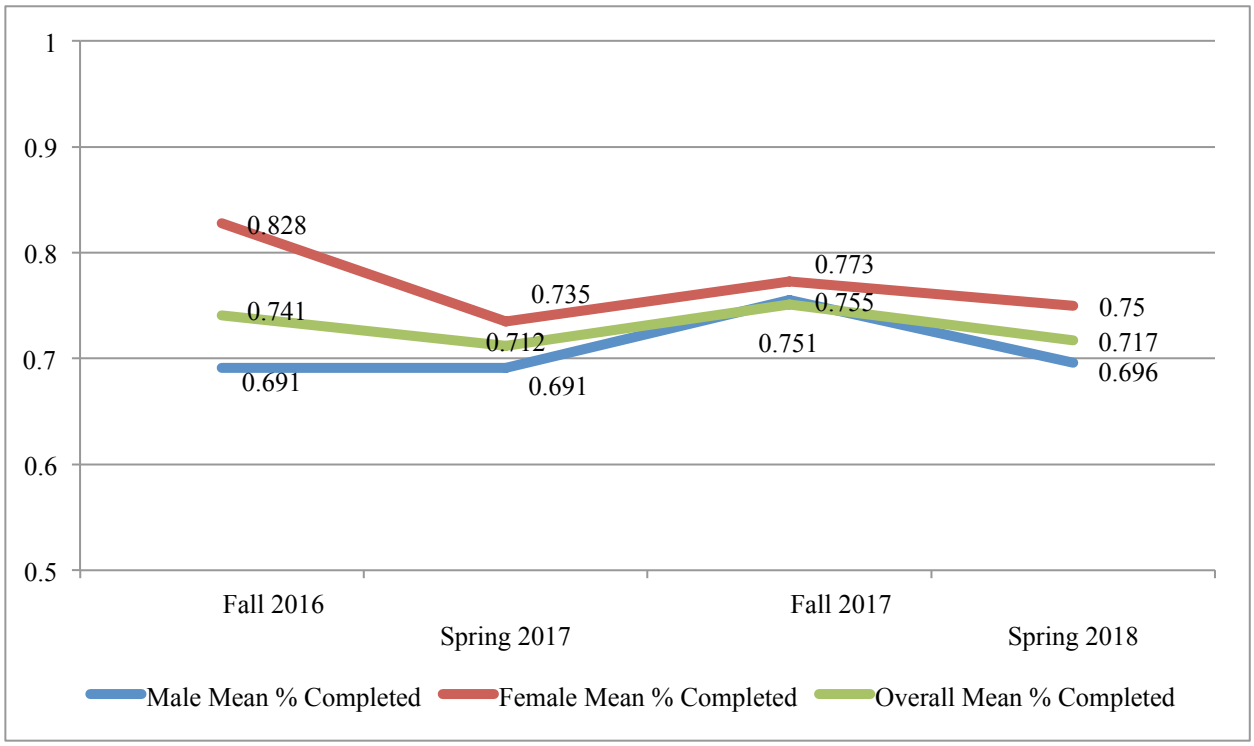

Figure 15. Case 1 geoscience course completion by gender from Fall 2016 to Spring 2018.

Case 2: Cohort 1. Another cohort 1 change agent team chose to analyze the course-level data to improve instructional practices and broaden participation to answer the following questions:

- What is the overall geoscience course enrollment over time (term to term)?
- What is the term-to-term course enrollment by race/ethnic group?
- What are the course success rates by race/ethnic group?

This change agent team has focused its efforts on the broadening participation goal since the start, including planning to increase course enrollment and completion for underserved racial/ethnic groups, particularly African Americans. To address this need, the change agent team has heightened its focus on data collection over the course of the grant, beginning with its initial submission of data in Spring 2017. At that time, the change agents reported data on their own courses only, and in this submission, they reported data for the district for the two terms of Fall 2017 and Spring 2018. This case is based on the 2017-18 data submission.

Figure 16 shows student demographics, revealing that White and Latino students are the two largest student groups enrolled in geoscience courses in the two terms of Fall 2017 and Spring 2018. Black, Asian, and Other Race make up smaller groups.

Figure 17 compares course completion rate by racial/ethnic group for the two terms of Fall 2017 and Spring 2018. The results show the highest completion rates for White students (approximately 82%) and Asian students (approximately 79%), with Latino students showing completion rates approximately 10% below the White group at about 73% and remaining consistent at this level from term to term.

Importantly, Black students increased their course completion rate from Fall 2017 to Spring 2018 by slightly over 10%, rising from 59% to nearly 70%. However, it is important to note that, over the same period, the course completion rate of students identifying as Other Race fell by about 10%, from 74% to 64%. This group and the Black student group (and other students) may benefit from changes to instructional practice and other reforms aligned to the SAGE 2YC grant, and this change agent team is planning to implement additional changes in the coming year to attempt to close the persistent equity gaps shown in these data.

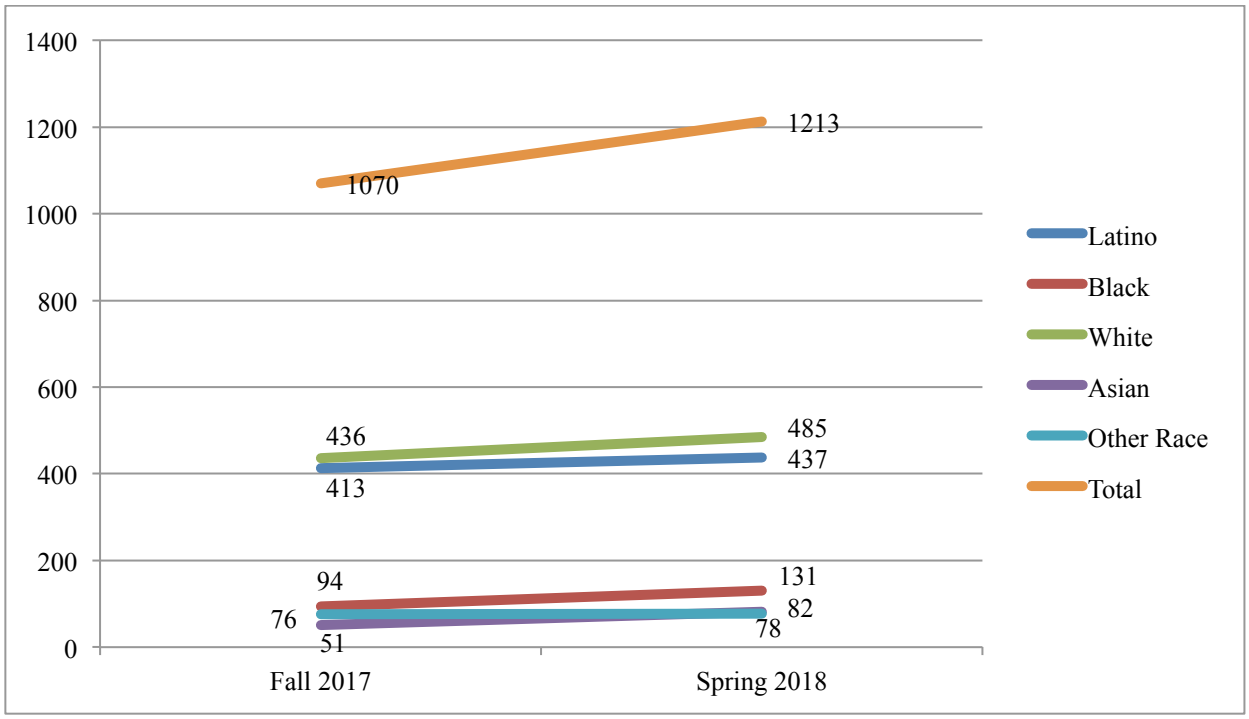

Figure 16. Case 2 geoscience course enrollment for Fall 2017 and Spring 2018.

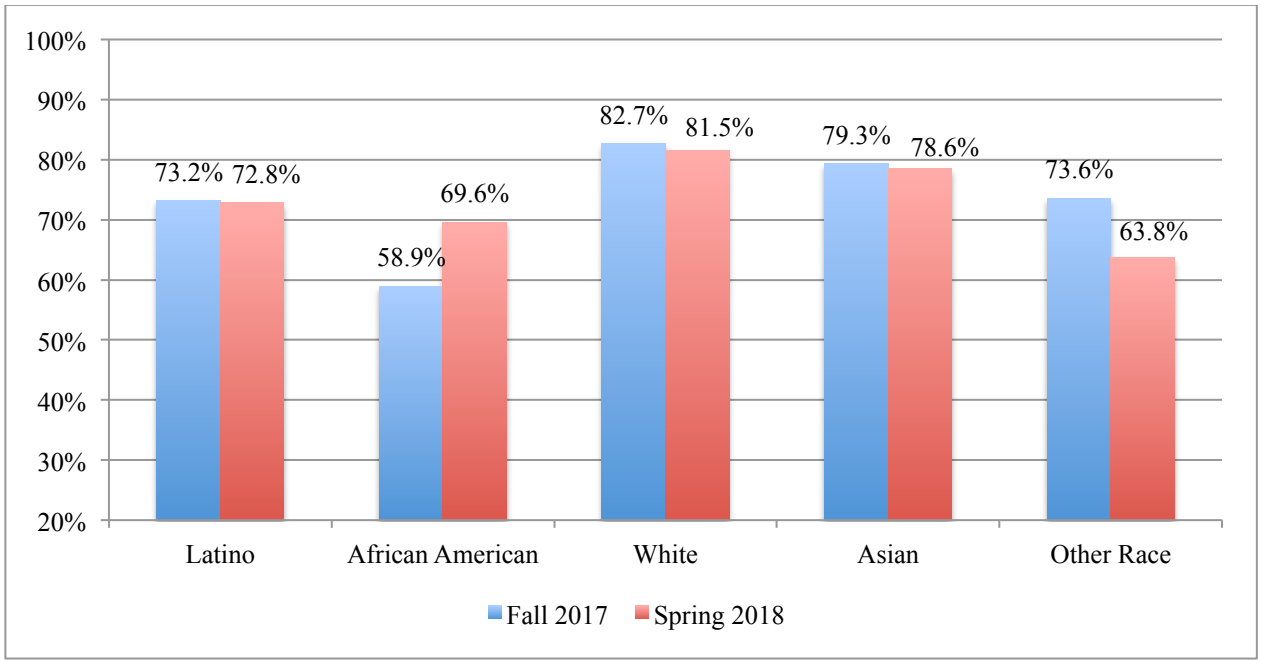

Figure 17. Case 2 geoscience course completion for Fall 2017 and Spring 2018.

Case 3: Cohort 2. A cohort 2 change agent team chose to analyze data comparing student course success rates in geoscience courses using different instructional modality (online only, hybrid, and face-to-face). The results contribute to the change agent team's efforts to improve instructional practices and the broaden participation and success for underrepresented groups who enroll in any course in the curriculum, including courses in online and hybrid formats.

Table 1 shows course completion rates for geoscience courses by online, hybrid and face-to-face format. Results show the completion rates are highest for face-to-face, then hybrid and then online courses. The completion rates for online courses are always lower than for face-to-face courses, with hybrid courses more similar to face-to-face courses than online except in one case where the course completion rate slightly exceeds face-to-face. Also, in one case the course shows a course completion rate 20% lower than the face-to-face course for both the online and hybrid formats.

These results suggest that there is a connection between course completion and format, with concerning results for several online courses and one hybrid course. The change agents are developing plans to make their online curriculum more engaging and to find solutions when students disengage in the courses midway through the term. Other analysis by this change agent team shows lower participation rates by underrepresented students and while the results on completion rates by format are not broken down by race/ethnicity, the change agent teams plans to do this analysis and address inequities by race/ethnicity and other demographics that represent differences in course enrollment and outcomes.

Table 1. Percentage Course Completion by Geoscience Course Modality

Geoscience Courses	Online Only	Hybrid	Face-to-Face	All Students
Plates, Mount.	82%	89%	95%	95%
Rocks & Min.	86%	90%	92%	88%
Rivers, Desert, Glaciers	47%	77%	NR	79%
Earth Science	76%	76%	93%	96%
Oceanography	NR	90%	NR	90%
Overall	73%	84%	93%	90%

Notes: NR = No Response (NR), indicating that there is no response for the cell due primarily to small cell size.

Social Network Analysis

We are using Social Network Analysis (SNA) to document change in connections between the change agents and the PI team over the course of the project. This analysis is important because it provides one way to assess the "cycle of innovation" associated with the grant, by which we mean change in the work of change agents interact collectively to engage in making changes to their geoscience courses and programs. SNA is a systemic means of illustrating how networks of people and organizations grow over time. Because the SAGE 2YC project envisions a "cycle of innovation" where ideas proliferate to and through change agents, who themselves form a

network of individuals and teams, it is important to understand the networking phenomenon. Knowing the structure of the network of change agents, along with the PIs and ER team members, we can see how people are connecting potentially to spread innovations. Social networks are defined by a set of relationships between network members and the implications of those relationships. Network members, or nodes, typically consist of people or organizations that represent units that may be connected to other units within the network. This approach to studying networks is known as SNA, and this methodology focuses on categorizing nodes and relationship types within a network map, as well as the structure of the network as a whole (Carrington, Scott, & Waserman, 2005).

This application of SNA utilized UCINET, which is a publicly available network analysis tool that is used widely for the purpose of analyzing and mapping social networks. The data used to create the map was obtained through an online survey that was created by the external evaluation team, with input from other members of the ER team as well as the PI team. All change agents as well as all members of the PI team and the ER team participated in the survey for the first time in June 2017, creating a map that shows 34 distinct nodes that appear in Figure 18. The data used for this SNA was gathered from an online survey created in Spring 2017 by the ER team and administered at the June 2017 workshop in Tacoma, WA. The data were entered into an excel spreadsheet to create a symmetrical matrix represent all connections between change agents, PIs, project managers (PMs) and the ER team members. To create the symmetrical matrix, any connection between individuals is recorded as a 1, so if either individual indicates a connection, then a 1 is entered into the matrix. If both individuals indicate no connection, then this is the time when a cell is coded 0, meaning neither of the individuals indicated a connection between one another.

The codes indicate the cohort, team and change agents by number. Thus, C1 means cohort 1 and C2 means cohort 2, T1 means team 1 and so forth, and –x indicates the number assigned to the members of the team, ranging from 1-3. The PIs are assigned a number of 1 to 4, the PMs are numbered 1 or 2, and the ER team members are numbers 1 to 4. These codes are kept anonymous for purposes of reporting in this annual report, but they have meaning to the SAGE 2YC grant. Results of the SNA maps have been vetted to the PI team to gather their insights into meaning for the purposes of moving the SAGE 2YC network forward.

Figure 18 shows an SNA map of cohort 1 change agents as well as the PI, PM and ER team that shows similar results to the map reported in the 2017 annual report (Bragg & McCambly, 2017). (See Appendix C for a copy of the 2017 SNA map for the cohort 1 change agents and other project team members.) This map shows most members of the PI, PM and ER team located at or near the center, with change agent teams clustering around the perimeter of the map. The map is fairly dense at the center where we can see the project leadership clustered with some members of the change agent teams who link to others who are located farther from the center. The strong representation of cohort 1 change agents in close proximity to other members of their teams may reflect the efforts of the SAGE 2YC project to engage cohort 1 change agents to work strategically within their college campuses, districts, or regions to bring about change in practice. These efforts may bring the change agent teams close to together, which is reflected in this SNA map.

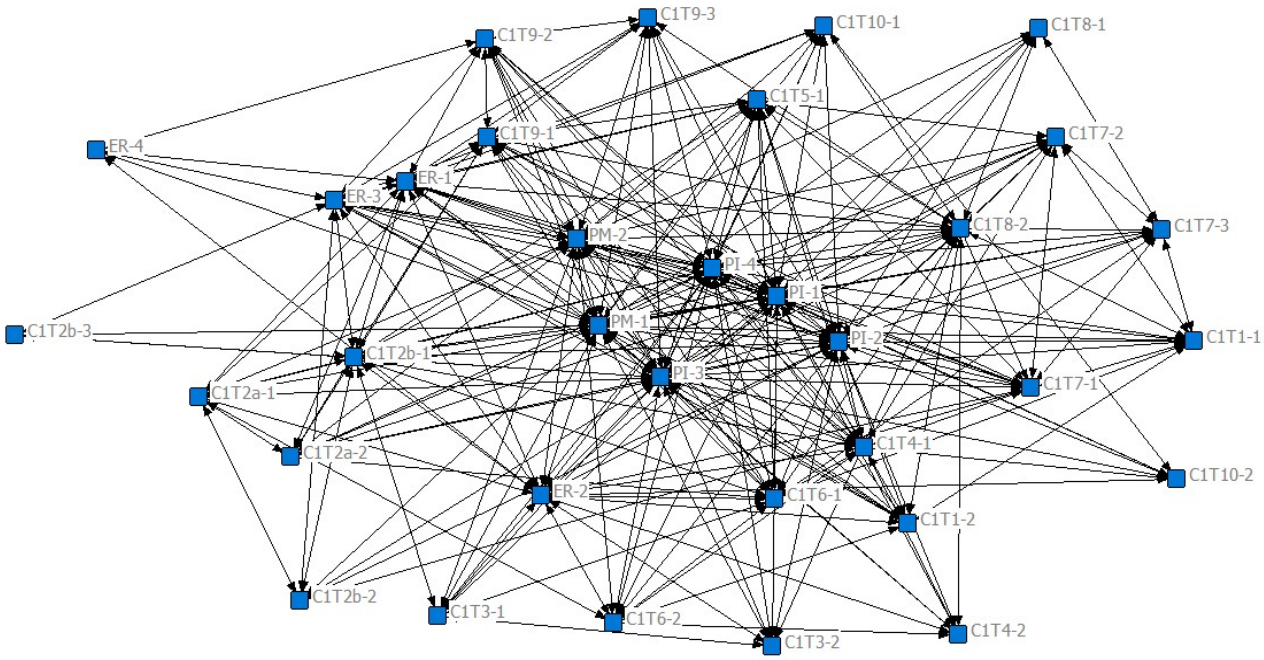

Figure 18. SNA Map for the SAGE 2YC network of cohort 1 change agents and PI, PM and ER team members, as of June 2018.

Figure 19 shows a SNA map of cohort 2 change agents as well as the PI, PM and ER team members. Similar to the SNA map shown in Figure 18, this map shows the PI, PM and ER team members located at or near the center, with change agent teams surrounding various project leaders. The map is not quite as dense as the SNA map shown in Figure 19, but still shows many individuals clustered in the middle, especially the PI, PM, and ER team members who have many ties to change agents in the network. In this map, some change agent members are located near one another but others are not. The map also shows several links between cohort 2 change agents who are not part of the same team. It seems possible that the online format used for professional development and electronic communication may be promoting ties between cohort 2 change agents who are part of different teams. Consequently, the SNA map of cohort 1 change agents and cohort 2 change agents look fairly similar until one looks more closely and sees that there is less clustering of teams in this second map. Future SNA mapping will continue to follow the location of change agents relative to one another and the ties between change agents and project leaders in order to see if the positioning shifts as people become more familiar and possibly increasingly collaborative in their work with one another.

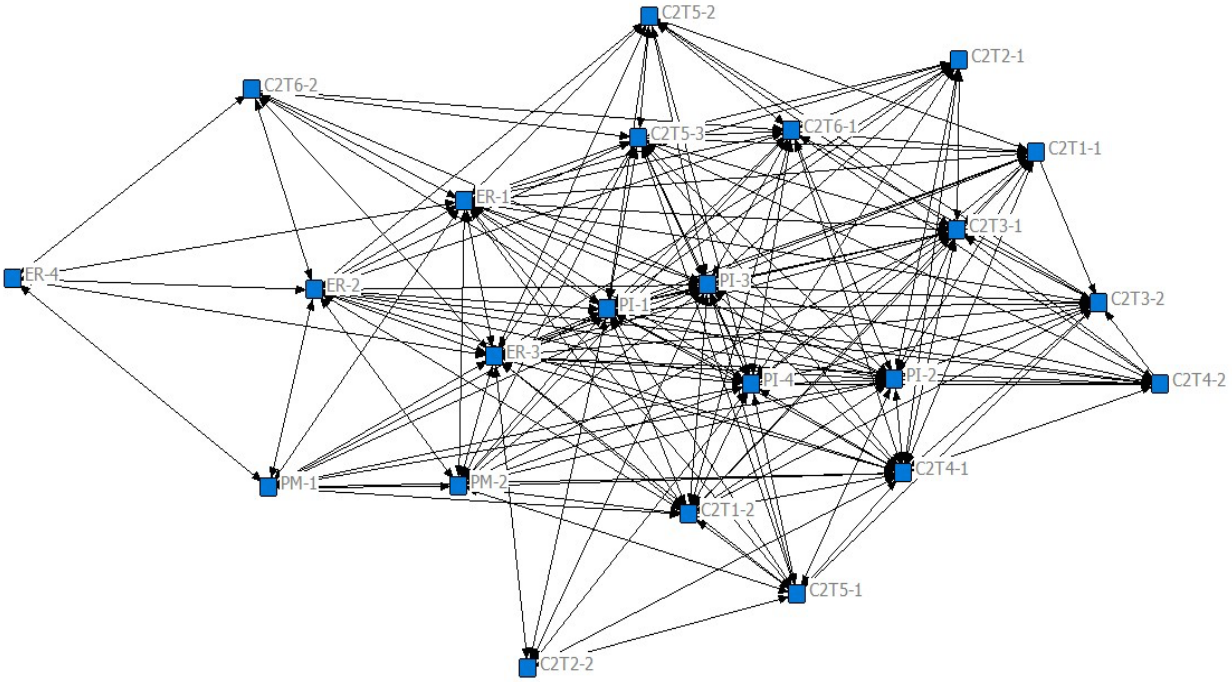

Figure 19. SNA Map for the SAGE 2YC network of cohort 2 change agents and PI, PM, and ER team members, as of June 2018.

Figure 20 shows the most comprehensive SNA map of cohort 1 and cohort 2 change agents, as well as the PI, PM and ER team members. This map is very dense, again showing the PI, PM and ER team members located at or near the center and change agents surrounding the project leaders. This last map is more similar to the first map (see Figure 18) than the second map (see Figure 19) in that, when everyone in the network is included in the map, members of the same change agent teams tend to be clustered near one another. Again, we tend to see change agent team members located in close proximity to each other and in close proximity to the SAGE 2YC project leaders (PIs, PMs, and ERs). What is uniquely important to this map that the change agent 1 teams tend to be located around the top and to the right and bottom of the map while the change agent 2 teams tend to be located in close proximity to one another in the upper left part of the map. In this comprehensive map, the cohort 2 change agent teams are located in close proximity to each other. This finding is interesting because it suggests there are ties between the cohort 2 change agent teams that exist within the larger SAGE 2YC project that may be different than when this cohort is engaging in professional development with the project leadership. We do not see this same phenomenon of dispersion among the cohort 1 change agents when their network is mapped without cohort 2. Future SNA mapping will show us whether the proximity and ties among change agents and project leaders changes over time and what potential shifts might help to inform how change is happening within colleges and across the network over time.

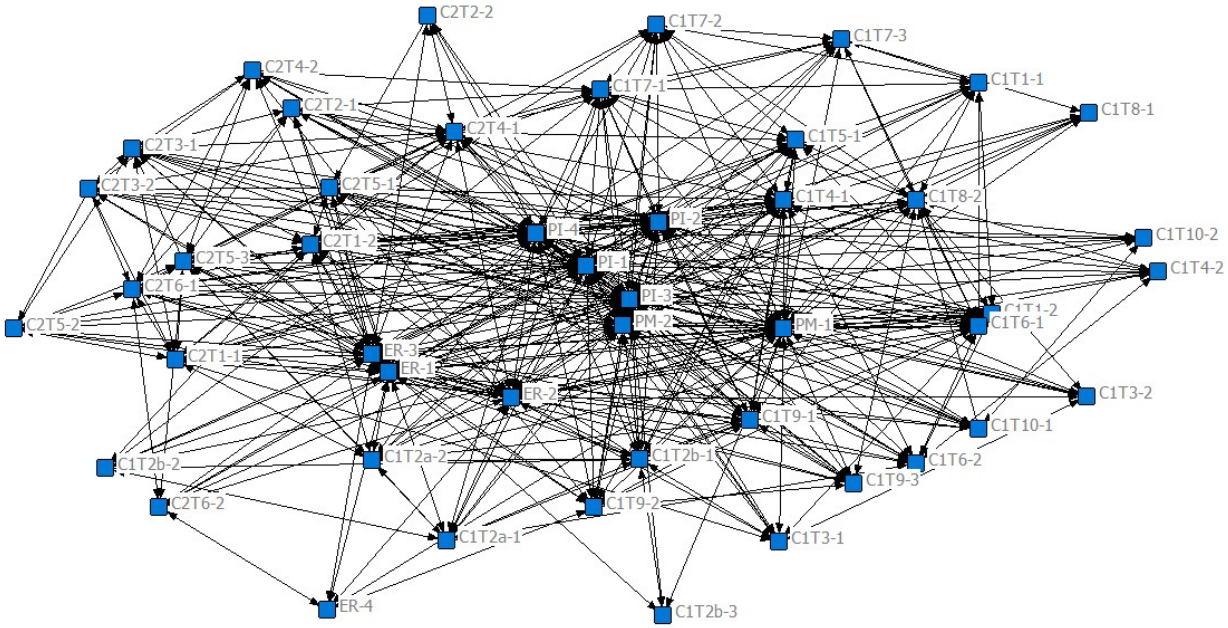

Figure 20. SNA Map for the SAGE 2YC network of cohort 1 and cohort 2 change agents and PI, PM, and ER team members, as of June 2018.

Future Research and Evaluation

Future research and evaluation activities will delve more deeply into the most interesting and potentially important findings associated with this project thus far. The ER team will work with the rest of the SAGE 2YC project team members to document the changes in practice and the outcomes related to these changes, as well as the roles that the change agents play in bringing about those changes. We are interested in organizational, programmatic, and instructional changes, and also in the roles that the change agents play in leading change. Thus far, our studies have focused fairly extensively on organizational change and these efforts will continue, but we will also focus on researching instructional leadership, which is an area that we consider under theorized in community college education. Related to this work, we will continue to study the ways in which the SAGE Y2C network and communities of practice (CoPs) are influencing change on multiple levels.

Another promising area for future research and evaluation is associated with course-related outcomes assessment activities that are spreading and deepening across the network. The data template was created and used by cohort 1 change agents for the first time in spring 2017 and now involves both cohorts of change agents. Formal reporting activities are associated with the course-related outcomes wherein the data are used to study relationships between course-related changes and outcomes for all participants and demographic sub-groups. In addition, data gathered for the project are also being used by the change agent teams to better understand changes in their own curricular and instructional practices and to use these new understandings to make additional change to improve student course access, achievement, and completion.

Another area of particular interest as the SAGE 2YC project matures has to do with efforts that the change agent teams are making to sustain positive changes that they are making to their courses and programs and also with efforts to spread the lessons learned from their change efforts to other geoscience faculty in their colleges and regions. Research and evaluation to document the spread and endurance of change is very important because it represents an important window into understanding an important aspect of the project that was evident from the beginning of SAGE 2YC. The conversation on sustainability stems part from the professional development model emerged as the ER team observes new developments and progress on course and program changes in both cohorts. We are also study the delivery methods of professional development (face-to-face, hybrid, or virtual) to understand how they may influence the changes that the change agents make on their campuses and also potentially with others in their regions. We plan to share lessons from this research with the larger higher education community and STEM educators doing similar lines of work throughout the nation.

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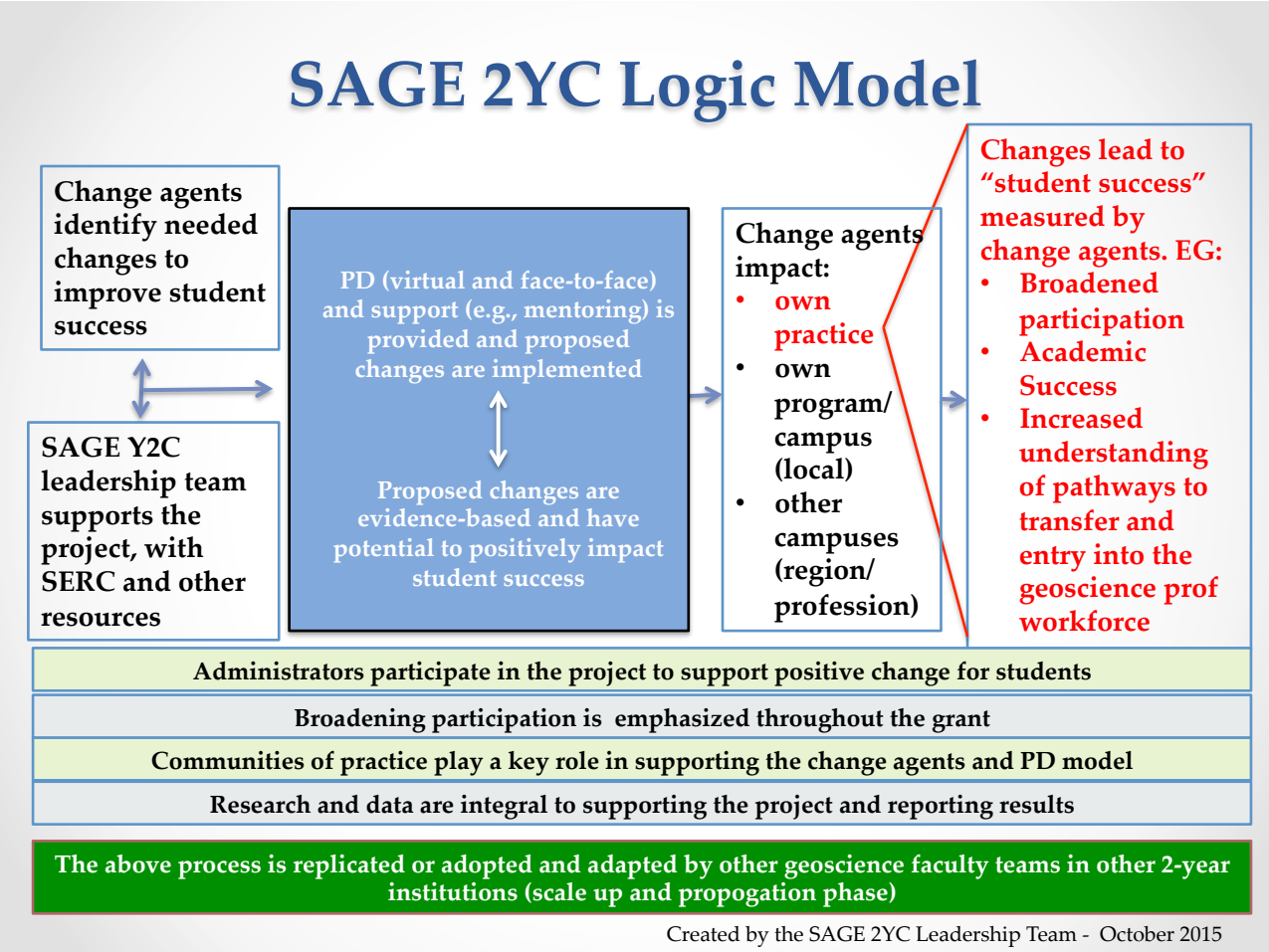
Appendix A

Original SAGE 2YC Logic Model



Appendix B

Initial Action Plans (June 2016) Compared to Updated Action Plans (June 2017)[2]

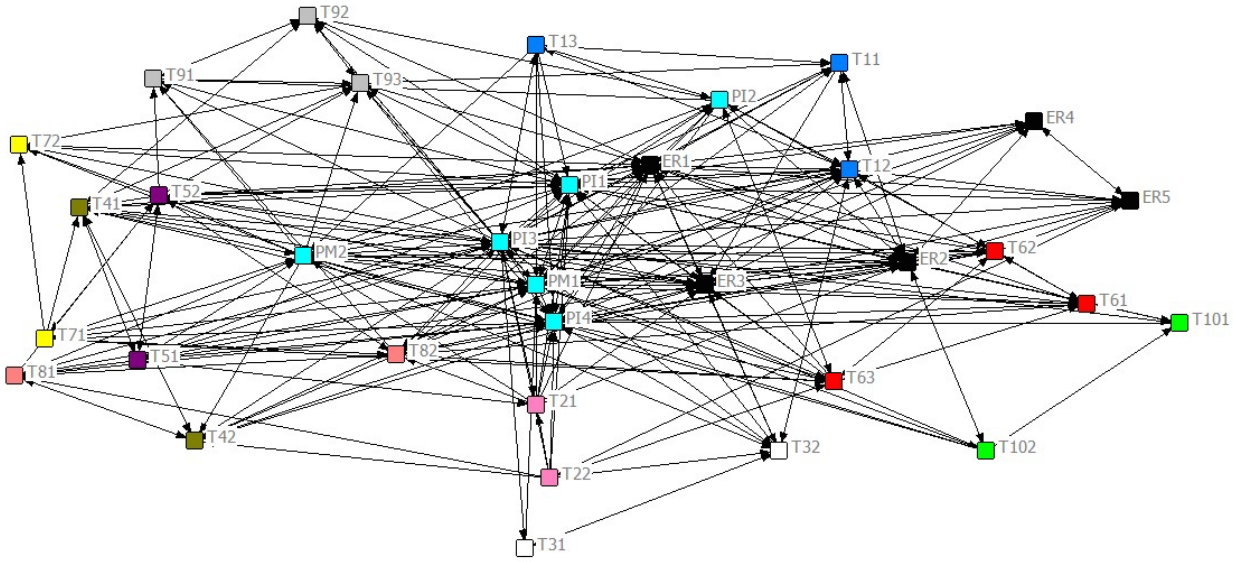
Team	Initial and Updated Plan Goal & Strategy Development	Plan Year	Instruct. Practices	Broaden Part.	Prof. Paths
1	The initial plan calling for "supportive pathways that lead to successful transfer outcomes to 4-year universities and colleges" is maintained in the new plan, but more focus is placed on collaborative teaching and learning (active learning). The updated plan also includes: 1) a larger network of colleagues and students to improve transfer, 2) "work on closing the achievement gap between targeted and non-targeted populations", and 3) champion team engagement using "frames". (Some recruitment-related tactics in the initial plan are not mentioned in the updated plan. Follow-up advised.)	Initial			
		Update			
2	The CAs of one college maintained its initial goals, with the updated plan adding: "increase student awareness of, and preparation for, academic and professional pathways attainable with a 2-year degree, 4-year degree, or certificate in geoscience." The new plan calls for using data to expand college leadership engagement and offering a CTE certificate to broaden participation. Adjunct faculty is included in delivering this instruction. The second college's CA maintained the initial goals and strategies in the updated plan, which focuses on using and disseminating instructional practices through a faculty-to-faculty approach.	Initial			
		Update			
3	Reflecting on the initial plan, this CA team noted, "We do not have strategies in place to support recruitment, enrollment, retention or completing in the geoscience pathways". In response, this college's updated plan specifies sustainable strategies to address this gap by implementing: recruitment; new orientation for geoscience majors; improved advising; undergraduate research and field courses; mentoring for student support; more active learning; monitoring of job placement; formalized transfer agreements; and improved monitoring of transfer success.	Initial			
		Update			
4	The new plan expands this college's initial goal to "increase the [student] success rate in geoscience courses as defined by a "C" grade or higher" by strengthening the focus on diversity trainings among colleagues and creating more career opportunities for students. The updated plan also specifies active learning and metacognition, noting how engaging in outcomes assessment and departmental inventory heightened their focus on this issue. The team also plans career opportunities, geoscience social events, resources for other geoscience faculty and campus groups to increase student diversity, and identify and track geoscience majors and alumni.	Initial			
		Update			

[2]Appendix B is based on the 2017 annual report for SAGE 2YC by Bragg and McCambly (2017).

Team	Initial and Updated Plan Goal & Strategy Development	Plan Year	Instruct. Practices	Broaden Part.	Prof. Paths
5	This team's updated plan sustains initial goals to address that fact that under-represented minorities (URMs) are not enrolling and succeeding in geoscience courses at rates similar to other program courses within the unit. The updated plan recognizes the CA team's experience with new strategies and use of data to create more nuanced action steps, with three tiers to 1) sustain student recruitment, 2) student support within the program, and 3) faculty development. Transfer, mentoring and proactive supports directed to all majors regardless of current enrollment in geoscience courses are added to the updated plan that calls for expanding prof. dev. for adjunct faculty (who teach proportionally more URMs).	Initial			
		Update			
6	This team shows strong and broad engagement with faculty on the initial goal of: "Students are not succeeding in the GEL 111 - Geology course due to changes brought about by new placement measures, structured pathways, and advising. We need to implement practices to support underprepared students in and out of the classroom so that they can be successful." The team tackled this goal by defining and designing a set of student learning outcomes and using high-impact practices (HIPs). Two strategies in the initial plan that continue to the new plan are to increase supports outside the classroom and HIPs within the classroom, including student support, active learning, and faculty professional development. In the updated plan, the team is also focusing on building consensus on student learning outcomes (SLOs) using backwards design.	Initial			
		Update			
7	In the updated plan, both colleges plan to continue with the initial goal to target the identified problem that "geoscience courses underrepresent campus diversity which leads to a low diversity in the geoscience workforce." Also, the updated plan of one college plans to strengthen cross-campus and cross-disciplinary collaboration to recruit and support students (e.g. mentoring, field trips, events, alumni database, and continued data use to measure impact). The updated plan drops co-requisite and focuses on broadening participation, connecting student learning to community-based case studies, and promoting REUs. The other college continues the initial plan, but with a vision modeled on the other college's goals and strategies.	Initial			
		Update			
8	This team's initial goal remains the same in that it notes: "Students are struggling to succeed on tasks in the geoscience program that require critical thinking and evaluation of scientific issues. This is affecting their success in courses and the program." However, the outcomes assessment process has brought to the fore the way URMs are affected by underrepresentation and lower success rates evident in all geoscience courses. This team noted course completion data were surprising, persuading them to continue data analysis by sub-group (given the likely link between excelling and	Initial			
		Update			

Team	Initial and Updated Plan Goal & Strategy Development	Plan Year	Instruct. Practices	Broaden Part.	Prof. Paths
	pursuing a geoscience major). The team's plan is also expanding SLOs to help align their curriculum and implement more active pedagogies in their classrooms. The team also plans to continue to prioritize collaboration with their champion team and hold meetings with admin to promote active learning among other instructors.				
9	This team's initial plan separated out the two colleges, whereas the updated plan is unified. Initially, one college identified recruitment and pathway issues, and the other focused on learning strategies. The new, unified plan focuses on instructional strategies (metacognition, backward design around program- and course-level outcomes) for the success of all students (through clarity of purpose and increased course completion), with some reference to professional pathways in the plan for the regional workshop. The updated plan also adds curriculum mapping to further clarify expectations and foster more inclusive environments through elucidating implicit rules for students. Facilitating professional pathways will be addressed in the fall 2017 regional workshop.	Initial			
		Update			
10	This team's initial plan focused exclusively on the goal of expanding course offerings, whereas the updated plan also focuses on facilitating professional pathways by improving the transferability of classes to the 4-year campuses within the system. The team wants their students to see the geosciences as a viable academic and career path, and it is incorporating active learning strategies into their courses. The team is teaching students metacognitive skills to prepare them for these academic and career paths. Lastly, the team plans to broaden participation in both number and diversity.	Initial			
		Update			

Appendix C
SNA Map of SAGE 2YC in June 2017



Appendix D

SAGE2YC Presentations and Papers

Eddy, P. L., Hao, Y., Markiewicz, C., & Iverson, E. (2018). Faculty change agents as adult learners: The power of situated learning. *Community College Journal of Research and Practice. https://www.tandfonline.com/doi/full/10.1080/10668926.2018.1507848*

Eddy, P. L., Hao, Y. H., Bragg, D., & Iverson, E. (2018, April). *The influence of mental maps on engagement in transformative change efforts.* Peer reviewed paper at the Annual Conference of the Council for the Study of Community Colleges, Dallas, TX.

Eddy, P. L., (2018, April). *Supporting and advancing geoscience education at two-year colleges (SAGE 2YC): Faculty as agents of change.* Peer reviewed symposium at the American Association for Educational Research Annual Meeting, New York, NY.

Eddy, P., Iverson, E., & Hao, Y. (2018, April). *Fostering communities of practice among community college STEM faculty: Connecting the dots.* Roundtable session at the 2018 Annual Meeting of the American Educational Research Association, New York, NY.

Eddy, P. L., Iverson, E., Hao, Y., & Markiewicz, C. (2017, November). *Change agents as adult learners: The power of situated learning.* Peer reviewed research paper at the Annual meeting of the Association for the Study of Higher Education, Houston, TX.

Eddy, P. L., Hao, Y., Iverson, E., & Bragg, D. (2017, April). *Changing teaching practices to support student success: The role of communities of practice*. Peer reviewed research paper at the Annual Conference of the Council for the Study of Community Colleges, Fort Worth, TX.

Hao, Y., Eddy, P. L., Bragg, D., & Iverson, E. (2017, April). *Becoming change agents: Geoscience faculty at two-year institutions.* Peer reviewed research paper at the Annual Conference of the Council for the Study of Community Colleges, Fort Worth, TX.

Eddy, P. L., Hao, Y., Markiewicz, C., Iverson, E., & Bragg, D. (2017, February). *Building good teaching practices in STEM: Exemplar portraits*. Peer reviewed poster at the Conference on Higher Education Pedagogy, Blacksburg, VA.

Eddy, P. L., Iverson, E., Hao, Y., & Bragg, D. (2016, November). *Focusing on teaching to promote student success: Faculty change agent roles in SAGE 2YC.* Peer reviewed roundtable at the Annual meeting of the Association for the Study of Higher Education, Columbus, OH.