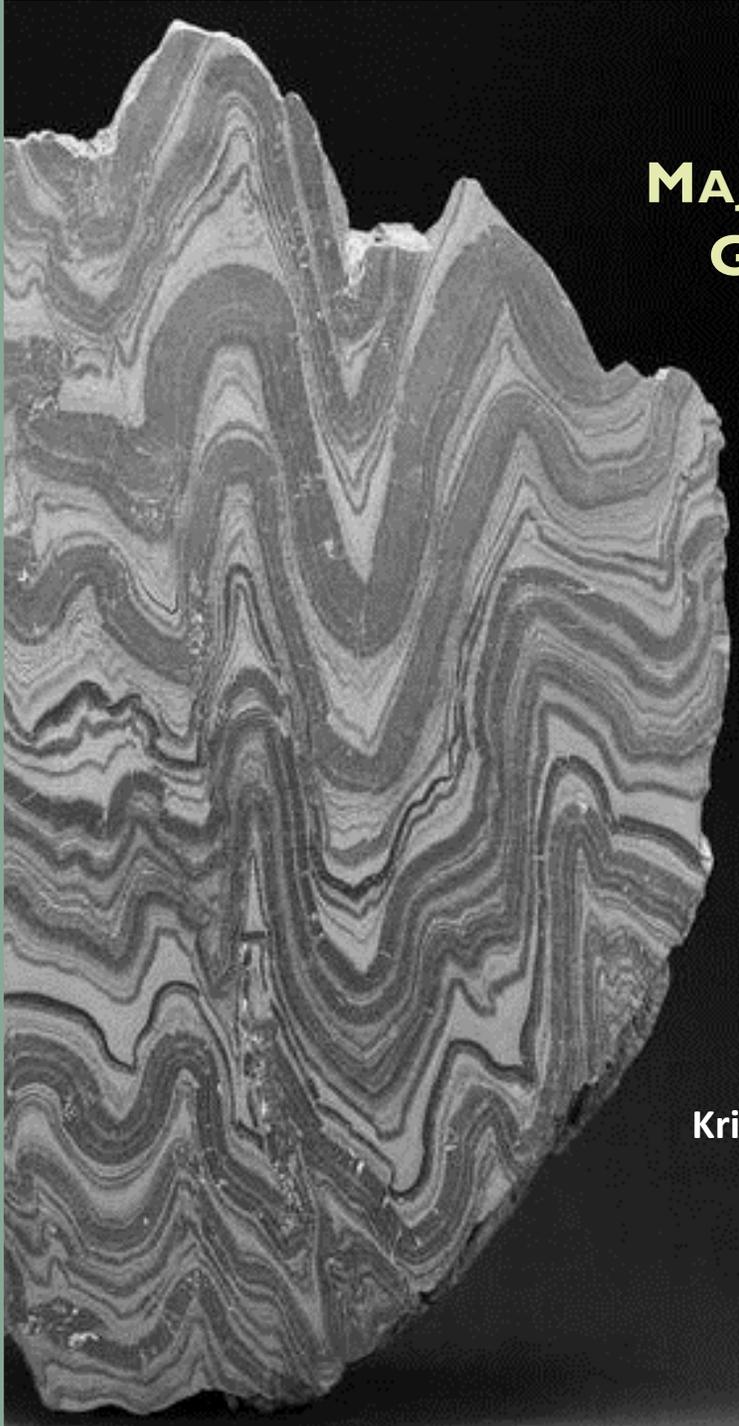# THE FINAL REPORT FOR SUPPORTING AND ADVANCING GEOSCIENCE EDUCATION IN TWO-YEAR COLLEGES (SAGE 2YC)

LESSONS FROM A MAJOR NSF INVESTMENT IN GEOSCIENCE EDUCATION

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Debra Bragg, Bragg & Associates, Inc.
Pamela Eddy, William & Mary
Ellen Iverson, SERC, Carleton College
Yi Hao, University of Virginia
**Kristin O'Connell, SERC, Carleton College**

ACKNOWLEDGEMENTS

EXECUTIVE SUMMARY

The *Supporting and Advancing Geoscience Education in Two-year Colleges: Faculty as Change Agents* (SAGE 2YC) project sought to engage faculty in changing and improving geoscience education to increase student success in community colleges. Through a strategically designed professional development (PD) model, faculty change agents (CAs) implemented change through their own efforts and through networking with other CAs to form a community of practice (CoP) dedicated to change. SAGE 2YC also focused on developing CA faculty leadership, implementing and scaling evidence-based educational practices, and building a national network of community college geoscience faculty. The three goals articulated consistently by project leaders to guide the project are:

> 1) build a sustainable national network of 2YC faculty CAs who catalyze change at multiple levels, from the micro-level of their courses to the mid-level program/departments to the macro-level of colleges and regions, as well as the profession;
>
> 2) implement high-impact practices aligned with three main areas of change (supporting student success, broadening participation, and facilitating students' professional pathways); and
>
> 3) investigate PD models for 2YC geoscience faculty that promote a reflective cycle of innovation.

In addition to developing faculty CAs, the project facilitated faculty engagement in leadership at the program, campus, and regional levels. An important element of SAGE 2YC was the engagement of campus administrators to help cultivate and scale practice changes focusing on 1) improving teaching and learning to increase student academic success, 2) broadening participation in geoscience education (as integral to improving STEM education), and 3) enhancing students' pathways to transfer and career opportunities in the geosciences or geoscience-related employment.
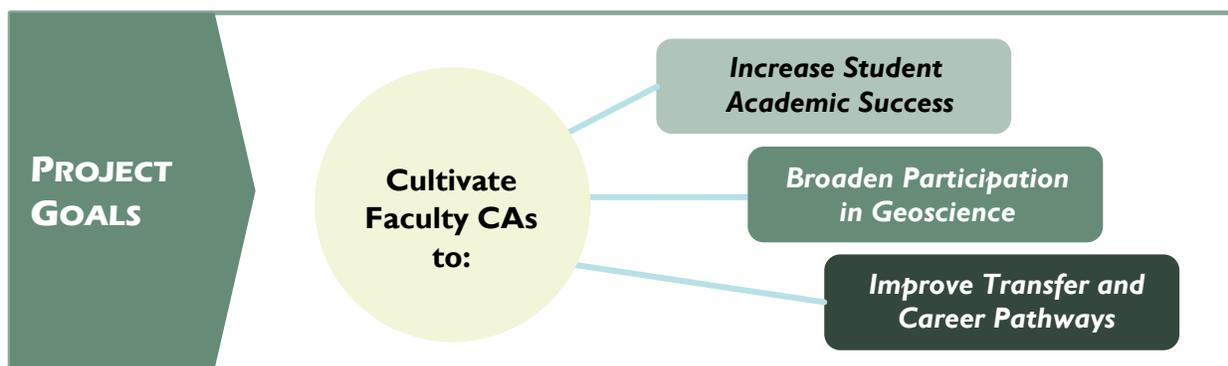
The PD model for SAGE 2YC evolved through a continuous cycle of planning, implementing, learning, and improving. This iterative process encouraged feedback loops to bring about change in practice, including scaffolding evidence-based change; promoting and supporting CoPs; forming and growing a practitioner-centered network; leading regional workshops and annual meeting workshops; gathering data and curating results on course success rates; and deliberately exemplifying and disseminating lessons learned to help scale systemic improvements to community college geoscience education.

THE FACULTY CHANGE AGENTS

Two cohorts of faculty CAs were recruited during initial funding period of the SAGE 2YC grant, with cohort 1 recruited at the beginning of the grant in 2015 (some of these individuals were identified when the proposal was written), and a second cohort recruited approximately two years later, in 2017. This recruitment strategy meant the first cohort had approximately twice the time of engagement in SAGE 2YC as cohort 2, plus the format for cohort 1 was a mix of in-person and virtual modalities while cohort 2 was primarily virtual. Since these two cohorts were formed, a third cohort was recruited through a supplementary NSF grant, but this evaluation report focuses on the first two cohorts only.

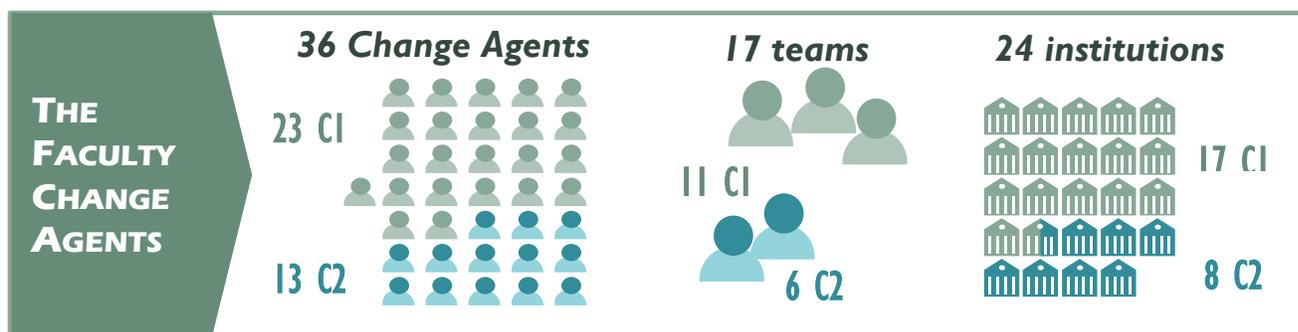The PD model for SAGE 2YC was comprehensive and multi-faceted for both cohorts, but there were some important differences between the two. Some changes were anticipated to the PD for cohort 2 from the start of the project but some emerged through lessons the project leadership team learned in working with cohort 1. This first cohort participated in PD that used face-to-face (f2f) and virtual modalities whereas the PD for cohort 2 was primarily virtual, with one f2f workshop at the end of the grant. The PD for cohort 1 included four multi-day f2f workshops (most in the summer), a culminating f2f workshop, and virtual activities (e.g., book discussions, journal clubs, and implementation groups) each fall and spring. By comparison, the PD for cohort 2 included a fall and spring virtual workshop (with both synchronous and asynchronous work) in their second year, virtual activities with cohort 1 in their year 2, and finally, the culminating f2f workshop with cohort 1 at the conclusion of their time in the grant. Campus administrators also participated in the summer f2f workshops. In addition, each year CA teams met virtually with the leader team to discuss action plans, and they had the opportunity to attend workshops offered by the SAGE 2YC grant at professional society meetings. The CAs also led one-day regional workshops that taught geoscience educators about evidence-based practices to improve student success in their settings.

WORKSHOP SESSION TOPICS	Sustainable leadership 16%	Broaden Participation 26%	Transfer and Career Pathways 29%	Student academic success 29%
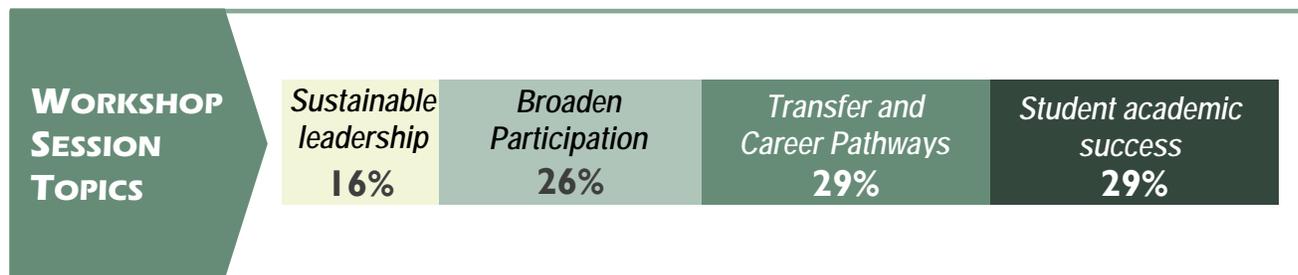
Looking at cohorts 1 and 2, we documented a total of 36 faculty CAs affiliated with 17 teams located in 24 community colleges in 12 states. Though the project experienced a modest amount of turnover when the two cohorts formed (more so with cohort 2 than cohort 1), we saw little or no turnover once the cohorts solidified. Cohort 1 was larger than cohort 2, with cohort 1 having 23 faculty CAs affiliated with 11 teams, and cohort 2 having 13 faculty CAs associated with 6 teams.

THE FACULTY CHANGE AGENTS

36 Change Agents — 23 C1, 13 C2

17 teams — 11 C1, 6 C2

24 institutions — 17 C1, 8 C2

MAJOR INTERNAL EVALUATION RESULTS

The internal evaluation focused on questions dealing with changes that CAs made in programmatic, institutional, and regional practice. This aspect of the evaluation asked how adjustments made by the CAs aligned with SAGE 2YC program themes and activities, and the extent to which CAs attributed changes to the PD and program elements associated with SAGE 2YC. What contextual adaptations were made by the CAs to bring about changes in their practice was also documented, as well as their attitudes toward those changes. The following major findings stand out as especially important to the internal evaluation.

- The CAs began the project from their own starting points, with several having backgrounds in prior PD workshops (e.g., the first SAGE 2YC grant) but some having little experience with PD or working closely with other faculty in a project like SAGE 2YC. These differences contributed to how the CAs implemented their action plans to reach their desired outcomes. Ultimately, all CAs reported making changes in their own instructional practice, and they also encouraged other geoscience faculty on their campuses or in their regions to adopt evidence-based strategies directed at increasing student success.

- Classroom observations of cohort 1 CAs using the Reformed Teacher Observation Protocol (RTOP) revealed shifts toward student-centered practice, and these findings aligned with instructional practice results reported by CAs in surveys designed by the project leaders and ERI team members. In addition, CAs from both cohorts reported higher levels of interaction with others to implement practice changes relative to their peers on the *National Geoscience Faculty Survey*.

- Changes that the CAs made to departmental and programmatic practices were well aligned to the major themes and elements of SAGE 2YC, such as integrating meta-cognition, using active learning in geoscience courses (e.g., field trips and laboratories focusing on current issues) and engagement with diverse scientists to promote enrollment. By the end of the grant, the majority of CAs reported using data to improve their practices, attributing the SAGE 2YC grant with inspiration for the adaptations they were making in their classrooms and institutional contexts.

MAJOR RESEARCH RESULTS

The research component of the SAGE 2YC project focused on two major questions. The first question asked how CAs thought of themselves as leaders of change during the SAGE 2YC grant. To this end, we sought to understand the role of context in the change process, and differences between cohort 1 and 2 in leadership development. To gain a deeper understanding of faculty development, we also studied factors that contributed to these differences. The second major question focused on influences of CoPs on CAs' attitudes, beliefs, knowledge, and practices, and how innovation was shared through CoPs associated with both cohorts. Major findings related to these research questions follow.

- Using the Bolman and Deal leadership questionnaire to gather self-report data on leadership at two points in time, with the first time being relatively early in each cohort's participation in SAGE 2YC (in spring 2016 for cohort 1 and fall 2017 for cohort 2), and the second administration being in summer 2019 near the end of the project. Comparing these two administrations, we found CAs in both cohort 1 and 2 reporting a

preference for using a multi-framed approach to leadership by the summer of 2019. In using a multi-framed approach the CAs were able to use different leadership perspectives to motivate and engage their colleagues in practice changes associated with their team's action plans.

- The CAs stated the adoption of evidence-based practices increased their confidence in sharing what they learned about working with others. These experiences contributed to their being able to see themselves grow as faculty leaders, with some CAs taking on formal assignments as department chairs or mentoring to help others learn and change their practices. The grant also contributed to increased regional and professional engagement among geoscience educators that was facilitated by the PD model. For example, the regional workshops and opportunities to participate in professional associations enabled CAs to grow CoPs that were part of the evolving SAGE 2YC network.

- Some CAs reported their understanding of community college functions and change initiatives within their colleges was strengthened through the support of campus administrators. Intentionally involving administrators in SAGE 2YC opened doors to knowledge that the CAs did not have about how their colleges work and how their contributions could be part of larger reform efforts. Interestingly, subtle differences in leadership between cohort 1 and cohort 2 emerged in this aspect of the project. More cohort 1 CAs adopted a multi-framed approach to leadership and also moved into more formally named leadership positions than cohort 2, possibly because of their longer affiliation with the grant. However, by the end, a majority of cohort 2 CAs also identified themselves as using multiple leadership frames.

- CA confidence grew in their ability to change, as well as their commitment to and sense of agency in making changes, helping them envision themselves as faculty leaders on their campuses, in the region, and among other professionals. Qualitative data confirmed some CAs engaged actively as faculty leaders on their campuses, which manifested in different ways. This type of mid-level, multi-framed leadership is increasingly important as community colleges face growing complexities, including this time when the health crisis of COVID-19 is spreading nationwde. Through SAGE 2YC, CAs were better prepared to assume leadership roles in their increasingly complex college contexts (Garza Mitchell & Amey, 2020; Iverson, Bragg & Eddy, 2020).

MAJOR EXTERNAL EVALUATION RESULTS

The last component of the ERI team's work focused on external evaluation that addressed questions dealing with implementation of the PD model, implementation of geoscience course changes and student success in changed courses, and evolution of the SAGE 2YC network. Major results pertaining to these questions include the following:

- Intentionality was present in conceiving and implementing the PD model from the beginning, but there was also considerable evolution of the model as project leaders and faculty CAs learned about evidence-based practices and deepened in their experience with implementation of reforms. Key elements such as the cohort and team structure; deliberate and consistent focus on instructional strategies, broadening participation, and pathway progression; implementation of regional workshops and

professional associations; and engagement in data-utilization were critical to the model. A high level of implementation of these elements was evident in the CAs practices and in their self-perceptions of how they were growing and changing as faculty leaders (i.e., change agents) throughout the project.

- The regional workshops drew participants from other 2YCs and educational institutions (K-12 education, universities) in their areas of the country. The majority of CA teams reported using at least one regional workshop to strengthen connections to four-year colleges and universities (4YCUs). Improving transfer and career pathways for students was an important focus of these workshops, coming later in the sequence of regional workshops that often started with evidence-based strategies to improve classroom instruction. Half of the CA teams also reported participation by industry professionals, and a smaller set of CA teams reported registrations by high school instructors that they believed helped to strengthen secondary-to-postsecondary geoscience connections.

- Nearly 300 geoscience course sections were changed on campuses associated with SAGE 2YC by the end of the grant. Almost all changes were made to course sections taught by the CAs rather than course sections taught by non-CAs (who were informed about evidence-based strategies). Changes in practice reported by the CAs included meta-cognition, active learning, group learning, career connections, and various other reforms. More course section changes were made by cohort 1 than cohort 2, probably due to their longer involvement in the SAGE 2YC project, but substantial proportions of course sections were changed by cohort 2 CAs as well. By the end of the grant, the course sections changed by the cohort 1 and 2 CAs totaled nearly 5,000 student enrollments (approximately 4,300 for cohort 1 and 700 for cohort 2).

- Results pertaining to geoscience course success rates revealed a 5% increase (68% to 73) in the geoscience course success rate (completion with C or above) from year 2 to year 4 for cohort 1. For cohort 2, the overall course success rate was substantially higher than cohort 1 from the start of the grant and this higher rate continued into the second year. In the two years cohort 2 participated in the grant, 90% of students successfully completed their course section in year 3 and 87% successfully completed their section in year 4. In the time each cohort had in the grant, the overall average course success rate for cohort 1 was 71% (over 3 years data were collected) and 88% (over 2 years of data collection) for cohort 2. The reason for this 17% difference is unknown and may have more to do with factors outside than inside the grant, and more research is needed to address this important question.

- Examining course success rates by student sub-groups revealed additional important findings. For cohort 1 from year 2 to year 4, the course success rate rose 7% for females, 12% for racially minoritized students, 9% for non-traditional age students, and 8% for Pell-eligible students. For all groups except the racially minoritized group, the average course success rate approximated or exceeded the overall course completion rate by year 4 of the grant. For the racially minoritized group, the course success rate closed to a gap of 7% by year 4 (64% for the racially minoritized group in year 4 compared to 71% for overall success).

- For cohort 2 the course success rates for females and Pell-eligible students were comparable during the two years in the grant, with both groups showing high course success rates near the overall course success rate of 87%. In addition, results for two other sub-groups are especially important to note, with data showing the success rate of racially minoritized students increasing by 8% over two years, from 82% to 90%, and for non-traditional age students increasing by 11%, from 82% to 93%. These course success rates reflect an impressive level of improvement that is important to understand on even deeper levels to continue to enhance the SAGE 2YC PD model.

- Data collected through purposefully designed and conducted student focus groups with 10 of the 17 CA teams (6 from cohort 1 and 4 from cohort 2) illuminated important themes concerning student perspectives on their geoscience courses. For example, students mentioned numerous reasons for enrolling in geoscience classes but fulfilling a science requirement to transfer was especially prevalent among their responses. Students who engaged in field trips and active learning mentioned valuing learning about science that they can readily apply in their daily lives. Students also appreciated faculty who knew their names and created welcoming classroom environments. Faculty members who expressed words of encouragement were identified as motivating students to be even more engaged in their learning processes. Concerns mentioned by some students were that advising was limited or inaccurate regarding graduate requirements and transfer options, and these concerns were sometimes attributed with lengthening time to complete a college degree and costing more money.

- Connections between CAs strengthened as the SAGE 2YC network evolved. In the beginning, the cohort 1 CAs connected mostly with members of their own team, but movement to integrate across teams was evident in later social network analysis (SNA) maps. Project leaders and managers, as well as ERI team members were integral to connecting CAs to one another and supporting these connections in a variety of ways. When cohort 2 joined the project in 2017, they were located in a specific section of the SNA map but like cohort 1, by the second administration of the SNA questionnaire, some cohort 2 CAs were integrating into the network. These quantitative results coupled to qualitative data suggest networking was beneficial to both cohorts. Nearly all CAs reported that the SAGE 2YC network was important to changing their own practice, in part by helping them see how they were part of something bigger than themselves.

LESSONS LEARNED

Looking at the totality of the SAGE 2YC project, we present six lessons learned that are supported by the comprehensive, multiple-methods research and evaluation design used by the ERI team.

Lesson #1: Intentional project leadership strengthens faculty engagement. From the beginning, the PI team envisioned major elements of the PD model (e.g., clear goals, single and multi-college teams, regional workshops) that became the backbone and connective tissue for the project. Envisioned from the start, two CA cohorts of geoscience faculty provided the test bed for additional cohorts of CAs who could learn through others' experiences, as well as their own. Coupling deliberate elements of the PD model to CA learning, leading and improving over time created momentum for even more change.

Lesson #2: Change takes time. When asked what factor made the most difference in the success of SAGE 2YC, participants pointed to a range of very meaningful factors but one factor stood out. Almost everyone said the extended length of time that they had to engage in SAGE 2YC made the most difference in their ability to change. The four years of funding that was extended to five with a no-cost extension was important to the overall accomplishments of the CAs, giving them time to execute the changes they sought to make and then seeing the fruits of their labor come to pass.

Lesson #3: No one changes alone. CoPs were integral to the CA change effort happening on and across college campuses affiliated with SAGE 2YC. The evolving SAGE 2YC network provided support for changes in practice, using collaborative learning and peer mentoring to support evidence-based reform. The PD model fostered community through virtual activities that brought the CAs together to learn, complementing in-person PD. Encouraging CAs to facilitate the learning of other geoscience faculty through regional workshops that extended social networking helped to grow impact even more widely.

Lessons #4: Learning by doing is as powerful for faculty as it is for students. SAGE 2YC project leaders practiced what they preached. They modeled evidence-based practices, and they supported CAs in engaging in similar practices. They encouraged the use of data-driven Implementation so that the CAs could know what was happening to their practice and to their students and use that knowledge to make even more improvements. Administrator involvement in the action planning of CA teams gave them a window into faculty work, which allowed CAs to see their colleges from a larger, institutional perspective. Through these experiences, faculty leadership developed and grew.

Lesson #5: Faculty leadership is developed through opportunity to practice. The SAGE 2YC PD model offered a variety of opportunities for faculty to practice leadership. Leading regional workshops gave the CAs the chance to cultivate new leadership skills (i.e., multi-framed leadership approaches), including seeing themselves as leading evidence-based practice on their campuses. These empowering experiences were instrumental to other faculty leadership changes occurring on campuses. Reflection of participants on their own leadership frames strengthened their knowledge of how to lead, and built self-efficacy that is essential to bringing about larger and more transformational change.

Lesson #6: Grounding changes in practice in the cycle of Innovation is imperative to scaling even larger change. The SAGE 2YC project was intentional about scaling change from beginning to end. Using multiple methods to achieve this goal, including team- and college-based action planning, regional workshops, professional affiliations, virtual modalities, and social media, the SAGE 2YC project kept an eye on what was happening within the project while also looking to the larger context to gain insights into what more could be done to improve 2YC geoscience education.

RECOMMENDATIONS

The ERI team offers three recommendations for practitioners, researchers, and the National Science Foundation (NSF).

1. **Focus on faculty:** The explicit, intentional and consistent focus on faculty in SAGE 2YC provides a model for how to reform community college geoscience education, and we suspect this model will work well in other areas of STEM and other disciplines as well. We begin with this recommendation about the centrality of the SAGE 2YC project's focus on faculty because it contrasts so vividly from other reform agendas associated with career, academic, and guided pathways that tend to concentrate on what administrators do more than what faculty do. SAGE 2YC provides a tangible example of change that can happen when college faculty is spotlighted, encouraged, and supported to bring about changes in practice. Other reforms of community college education would do well to examine closely the ways in with SAGE 2YC nurtured and grew faculty leaders who were instrumental to improving practice and student success on their campuses.

2. **Encourage and grow intentional change:** In SAGE 2YC, the project leadership identified a range of evidence-based practices that were introduced, modeled, scaffolded, and evaluated as they unfolded as the CAs implemented change on their campuses and in their regions of the country. Whereas many changes in practice were identified and encouraged up front, many others evolved as the CAs, as well as project leaders, learned collectively over time about what kinds of changes were being employed by CAs and how these reforms were going. Recognizing how nuanced contexts influenced the actions CAs took in their work, future reformers of geoscience education would do well to take a page from the SAGE 2YC playbook to learn how to improve practice. These lessons begin with being sure change strategies are defined clearly so they can be documented and assessed, and so they can be shared with others to promote learning and on-going improvement.

3. **Use rigorous evaluation and research designs to measure change**. The SAGE 2YC leadership introduced data-based approaches to documenting change and student success as the grant unfolded. These approaches enriched the CAs' and others' understanding of what was changing and how change was experienced by students, and it was foundational to telling the story of SAGE 2YC. Future iterations of the PD model will benefit from even more rigorous designs that enable the measurement of the impact of the SAGE 2YC PD model. Using more sophisticated designs including experimental and quasi-experimental designs will produce results on what works that others can replicate as the journey to scale change in 2YC geoscience education continues.

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1. INTRODUCTION

In September 2015, the *Supporting and Advancing Geoscience Education in Two-year Colleges: Faculty as Change Agents* project was funded by the National Science Foundation (NSF). Extending through summer 2020, the "SAGE 2YC" project sought to improve geoscience education in the community college, referred to as Two-Year College or 2YC in this project, at the individual, interpersonal, organizational, and community levels. The SAGE 2YC principal investigators endeavored to prepare geoscience full- and part-time faculty to act as change agents to implement evidence-based reforms on these multiple levels. These faculty change agents (CAs) would apply this new knowledge to their instructional practice and leadership endeavors to improve geoscience education and increase student success on their own campuses and other colleges and universities in their regions of the country.

HOW COMMUNITY COLLEGES ARE CHANGING

Community colleges enroll a substantial proportion of undergraduate students in higher education in the United States. Currently representing 41% all undergraduates in the country [American Association of Community Colleges (AACC, 2020)], community colleges enroll more diverse student populations than most public universities, including enrolling the preponderance of historically underserved student groups in the nation. Among all undergraduates in the U.S., community colleges enroll 57% of all Native American students, 52% of all Latinx students, 42% of all African American students, and 39% of all Asian American students (AACC, 2020). To meet these learners' needs, community colleges are prioritizing diversity, equity and inclusion in academic and non-academic programs and services, resulting in more structured efforts to close equity gaps (Bensimon, 2018; Bragg, Wetzstein, & Bauman, 2020; Smith, 2018). Because of their instructional relationship with students, community college or "2YC" faculty are favorably positioned to act as change agents to increase student success.

Walter Bumphus, President of the American Association of Community Colleges (AACC) called upon 2YCs to place a "laser focus" on improving student success, arguing "success will only truly be realized when all of our students achieve equity in educational outcomes that provide relevant credentials for economic mobility and family-sustaining wage employment" (Dembicki, 2018, n.p.). Echoing Bumphus's call to emphasize equity in strategies to increase student success, McNair, Albertine, Cooper, McDonald, and Major (2016) recommended that community colleges transform from the historic expectation of teaching "college-ready students" to being "student-ready colleges" (p. 1). In their argument for change, McNair et al. explain colleges expect students to enter higher education having all the knowledge and skills they need to be ready to learn. However, as college attendance has become more universal, policies and practices that perpetuate inequities in college preparedness have become increasingly problematic (see, for example, Malin, Bragg & Hackmann, 2017). To ensure America's diverse collegiate population achieves success, advocacy for colleges to be "student-ready" are growing.

Currently, community colleges engage in many reforms to improve student success. Propelled to take action to improve completion by President Obama (2014, n.p.), community colleges undertake reforms to improve pathways to certificates and associates degrees that lead to transfer and/or employment. Reforms associated with "career pathways" and "guided pathways" are advanced in community colleges across the country, including recommendations to improve teaching and learning in classroom, online and hybrid modalities; provide holistic student supports, including enhanced academic and career advising; implement learning outcomes assessment, including alternative assessments; and engage community, education and employer partners who are committed to student success (see, for example, Bailey, Jaggars, & Jenkins, 2015; Jenkins, 2018; McClenney, 2019).

As part of reform of community colleges, geoscience education is an important focus of the National Science Foundation (NSF). Already, the NSF funded the *On the Cutting Edge Professional Development for Geoscience Faculty (*known widely as *Cutting Edge)* project led by R. Heather Macdonald, other geoscience faculty PIs, and including researchers from the Science Education Research Center (SERC) (see, for example, Kastens & Manduca, 2018; Misener, 2019, *On the Cutting Edge*, 2017). Though focused on improving geoscience teaching and learning broadly, Macdonald (cited in Misener) advised that future improvements to geoscience education would benefit from increased focus on diversity, echoing the words of AACC President Walter Bumphus. She observed, "diversity, equity, access, and inclusion initiatives would be essential to a healthy future for the discipline, and the individuals who comprise—or could comprise— its community" (p. 23). Implicit in her comments is recognition that 2YC geoscience faculty do not tend to reflect the demographic composition of their students (Gonzales & Keane, 2011; Huntoon & Lane, 2007), particularly their racial and ethnic identities. Her leadership of *On the Cutting Edge* was foundational to the subsequent SAGE 2YC project focus on improving teaching and learning with a deliberative focus on diversity, equity and student academic success. Coupling this understanding to the NSF's long-standing priority for "broadening participation" created an opportune environment for improving geoscience curriculum and increasing student success through SAGE 2YC.

Other factors contribute to the need to improve geoscience education, as noted in the SAGE 2YC proposal, including the distinct community college context in which faculty teach. These factors include the large number of part-time instructors who supplement the instructional capacity of full-time faculty, a circumstance that is especially prevalent in the geosciences. Many community colleges offer their geoscience curriculum with one or two full-time faculty whose instruction is bolstered by one, two or more part-time (or adjunct) instructors, depending on the size of the 2YC campus. Given the relatively heavy teaching loads of community college faculty compared to their university counterparts, typically offering approximately 15-credits of instruction (Cohen, Brawer, & Kisker, 2013), part-time faculty are essential to the delivery of high-quality community college geoscience education. Knowing this, the principal investigators for SAGE 2YC were committed to scaling professional development (PD) to meet the needs of all geoscience faculty.

Improving geoscience education in 2YCs is also important because of the larger environmental, economic, social, and health crises that are impacting our planet at this time. Geoscience educators play an important role in helping students and their larger communities to understand the critical role that natural resources and hazards, including climate change, play in global health, safety, and economic security. Though unforeseen when this project began, geoscience education is integral to advancing a science-based response to COVID-19. Indeed, the need to cultivate science-literate students as part of a well-informed public is urgent. As concerns about following the science grow relative to the pandemic (Harris, 2020), SAGE 2YC's focus on improving geoscience education also grows. Lessons learned from this NSF investment have the potential to contribute to geoscience education reforms in community colleges for years to come.

PURPOSE AND GOALS OF SAGE 2YC

The focus of this project is on the strategic efforts of two-year college (2YC) faculty to change and improve geoscience education. These individuals are the faculty change agents, or simply change agents (CAs), who implement and lead change through their own efforts and networking with other CAs. Since the project began in 2015, three CA cohorts have been selected to participate in SAGE 2YC, with this evaluation focusing on the first two cohorts. Leading SAGE 2YC is an experienced project leadership team of geoscience educators working in collaboration with an evaluation team, and through their combined forces, the two CA cohorts create action plans to bring about change in their classrooms and

on their college campuses. Lessons about what and how to change are then shared with other 2YC geoscience educators who participate in regional workshops or other dissemination activities. Through this cycle of innovation, the SAGE 2YC model of professional development (PD) becomes a vehicle for learning, leading and scaling improved 2YC geoscience education.

The SAGE 2YC project had multiple goals that focused on developing CA faculty leadership, implementing and scaling evidence-based educational practices, and building a network of 2YC college geoscience faculty who would capitalize on enriched community of practice (CoPs) to accomplish their work. Specific to this overall purpose are three goals:

1) build a sustainable national network of 2YC faculty CAs who catalyze change at multiple levels, from the micro level of their courses to the mid-level program/departments to the macro-level of colleges and regions, as well as the profession;

2) implement high-impact practices aligned with three main areas of change (broadening participation, supporting student success, and improving pathways); and

3) investigate PD models for 2YC geoscience faculty that promote a reflective cycle of innovation.

The SAGE 2YC project theorized improvements incorporating evidence-based educational reform (or innovation) would require highly effective PD, including PD focusing on faculty leadership development and community (professional) service. The principal investigators (PIs) strived to promote and support dialogue within and between CA teams and cohorts, and also between CAs and campus administrators. This deliberate engagement of college administrators in SAGE 2YC was designed to cultivate supportive relationships that would facilitate pedagogical reform, as well as faculty leadership endeavors focused on student success at the classroom, program and campus levels.

Three themes cut across the project's goals, and they are to: 1) increase student academic success, 2) broaden participation in geoscience education (as integral to STEM education) and 3) enhance students' pathways to transfer and career opportunities in the geosciences, all of which inform the larger STEM education community on ways to improve student success (Figure 1-1). The SAGE 2YC leadership team intentionally nurtured connections among these themes to help deepen the understanding of the CAs to innovate and improve in ways they might not otherwise undertake. These synergistic activities work together to increase student success.

Figure 1-1 Synergistic Themes Undergirding the SAGE 2YC Project
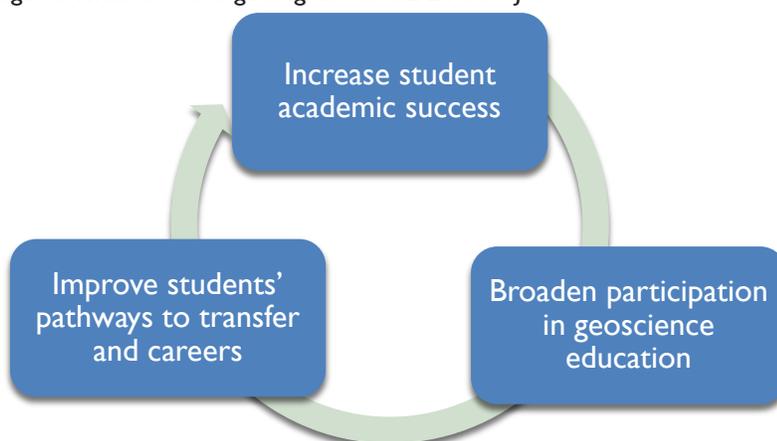
THE PROJECT LEADERSHIP TEAM

The SAGE 2YC project leadership team is comprised of four geoscience faculty leaders on their own 2YC and 4YC campuses. The principal investigators are two 4YC faculty, Dr. Heather Macdonald, Chancellor Professor in the Geology Department at William & Mary in Williamsburg, VA and Dr. Jan Hodder, Senior Lecturer at University of Oregon in Eugene, OR; and two 2YC faculty, Dr. Norlene Emerson, Professor in Geology/Geography at the University of Wisconsin-Richland in Richland, WI and Dr. Eric Baer, Instructor in Geology, Highline College in Des Moines, Washington.

In addition to the PI team, Dr. Carol Ormand and Mr. John McDaris who are employed at the Science Education Resource Center (SERC) at Carleton College provide project leadership support in the areas of communications including the website, PD, and numerous other functions required of the project.

The project team also includes a group of researchers and evaluators led by Dr. Pamela Eddy, Professor of Higher Education at William & Mary, Dr. Ellen Iverson, Director of Evaluation for SERC, Carleton College; Dr. Debra Bragg, President of Bragg & Associates; Dr. Yi Hao, Graduate School at University of Virginia; and Ms. Kristin O'Connell, Evaluation and Education Specialist at SERC, Carleton College.

PRACTICES OF CHANGE

Complementing the notion of a "theory of change" that we introduce in the next section, we use the concept of "practices of change" (Arensman, Waegenigh, & Wessell, 2018) to convey the importance of decisions and actions taken by the project leaders of SAGE 2YC. By "practices of change", we refer to the strategies that individuals undertake to make changes in their larger contextual environment and that they also advocate for others to make. Rather than seeing change as a fixed set of activities directed by authorities outside their realm of influence, practices of change evolve through the leadership and advocacy of individuals who operate as change agents in their efforts to help others change. These "dynamic practices" (Arenson et al., p. 222) are conducted individually and collaboratively to stimulate and sustain improvement over time.

Looking at the deliberate yet evolving approach that the SAGE 2YC project leaders took to engaging with the CAs and supporting their actions to change, we can better understand their efforts to instill competence and confidence in "practices of change". The comprehensive approach that the project leaders took to assisting CAs to improve geoscience education on multiple levels (classroom, departments, colleges, and the profession) was complex and demanding throughout the grant. Table 1-1

provides a high level overview of program activities written into the original NSF proposal (column 1), and the program activities enacted in the grant (column 2). Our purpose for including this information is to provide a baseline description of the project from its initial conceptualization compared to how it evolved over time, including the fact that some changes were made during the negotiation period between NSF and the PIs before the SAGE 2YC project began. Subsequent sections of this report provide detailed description of results to document what actually happened during the grant.

Table 1-1: High Level Proposed and Enacted Activities

Activities in NSF Proposal	Enacted Activities
Support of the Growth of CAs	**Support of the Growth of CAs**
• Four 3-day in-person leadership team workshops	• Cohort 1: Two annual 3-day in-person workshops for CAs in the first year; subsequent annual in-person workshops held each summer (Cohort 1) • Annual virtual workshop (year 1), in-person workshop (year 2) Cohort 2
• Coaching by PIs and project managers	• Coaching by PIs and project managers, including meetings with individual teams to review action plans and share ideas; also responses to discussion threads.
• Virtual PD and other activities (journal clubs, webinars, informal discussion and implementation groups)	• Virtual PD meetings (synchronous and asynchronous) and virtual activities (journal clubs, webinars, informal discussions, implementation groups, and book clubs)
• Resources on evidence-based, high-impact practices	• Resources on evidence-based, high impact practices using the project website, webinars, virtual discussions and other media
• "Pay-attention" lists, rubrics and other online tools	• Extensive set of online tools accessible o the project website (e.g., SAGE Musings and bi-weekly blog; Educational Practices Inventory (EPI) and Geoscience Departmental/Program Inventory (DPI) instruments developed and administered.
CA Activities	**CA Activities**
• Action plans	• Action plans
• Assess the impact of changes, including relevant student outcomes to be measured each year using baseline instrumentation	• Course-level outcomes assessment using a custom-designed template to measure aggregated and disaggregated course success outcomes
• Administrative workshops (first focusing on institutional change, second focusing on geoscience program change)	• Administrators included in annual workshops with the CAs.

Activities in NSF Proposal	Enacted Activities
• Assess the impact of changes	• Course-level outcomes assessment
• Two administrative leader workshops (first focusing on institutional change, second focusing on geoscience program change)	• Meetings with administrators
• Plan local workshops and follow-on activities	• Annual regional workshops
Scale-Up	**Scale-Up**
• Open virtual workshops for others	• Second faculty CA cohort
• Engage a second faculty CA cohort and provide virtual support	• Virtual support for cohort 1, plus participation in culminating face-to-face workshop for cohort 2
• Two workshops at professional society meetings in years 3 and 4; financial support for 70 at each event	• Financial support for faculty to attend workshops at professional society meetings
• Year 4 hold a summative propagation workshop for 100 participants (22-25 teams of two faculty and one administrator)	Culminating workshop including all cohort 1 and cohort 2 CAs and their administrators substituted for the summative propagation workshop. This was a deliberate choice to advance the goals of the grant.

Summarizing the practices of change proposed and enacted by the project leadership team in association with the CAs, we highlight key components of the SAGE 2YC PD model that are described in this final report:

- Organizing **CA teams** into two cohorts within states located in different regions of the country
- Guiding CA teams in developing and implementing **action plans** to improve their geoscience, programs or departments, and community colleges
- Collecting and analyzing **course-level outcomes data** to inform the reform of 2YC geoscience education curriculum
- Meeting with community college **administrators** to support the implementation of action plans
- Designing and leading annual **regional workshops** that address project themes with neighboring 2YCs (and other organizations)
- Forming and growing a **network** of CAs committed to reforming geoscience education in 2YCs

The project promoted a cycle of collegial dialogue, improvement of practices, and critical reflection centered on supporting student success, broadening participation, and transfer and career pathways happening over five or more years. This multi-year sustained engagement also promotes CA leadership development to foster the diffusion of change that results in improved student success.

SIGNIFICANCE OF THE PROJECT

The SAGE 2YC project builds on the foundation of geoscience faculty development that emerged from the national movement toward reforming undergraduate instruction in the sciences (National Science Board, 1986; NSF, 1996) and specifically in geoscience education (Ireton, Mogk, & Manduca, 1996). One particularly influential project, the *On the Cutting Edge* PD program, sponsored by the National Association of Geoscience Teachers (NAGT), promotes evidence-based teaching practices to an expanding a community of geoscience educators through in-person workshops, virtual activities, and a comprehensive website. As part of its PD it included leadership development to sustain future PD efforts (Manduca, Macdonald, Mogk, & Tewksbury, 2004).

The *On the Cutting Edge* program capitalized and leveraged the expertise of participants with a PD model to promote active learning, dialogue, and community learning; Evidence-based practices were modeled and embedded in this PD program. The earlier SAGE 2YC project (2011 to 2015) developed its own national workshop program and website that adopted the practices of this earlier project with an eye to meeting the substantial challenges that 2YC faculty face without adequate resources and limited opportunities for geoscience PD. During this same period the 2YC Division of the NAGT offered community support, activities, and resources aimed specifically for 2YC geoscience faculty (https://nagt.org/nagt/divisions/2yc/index.html). The current SAGE 2YC project encompasses these principles and practices but adds new program elements, including faculty cohorts of teams sustained and supported in their efforts to change practices over time, administrator involvement with these teams, a completely virtual PD program, and new hybrid models of PD to encourage student-centered instruction.

ORGANIZATION OF THIS REPORT

This final report is organized into discrete sections to provide the reader with easy access to the comprehensive set of findings. Following this introduction, we present the theory of change developed by the ERI team to reflect the logic undergirding the SAGE 2YC project, followed by sections on the study's mixed methods design and the SAGE 2YC PD model. Subsequent sections describe the CAs (Cohort 1 and 2), including who they are and what they accomplished as CAs in SAGE 2YC, as well as the community college administrators who were involved in the project. The last sections offer analysis and interpretation of key "practices of change" associated with SAGE 2YC, including the course changes, regional workshops, and the SAGE 2YC network. Lessons learned from the project are documented at the conclusion of the report, including recommendations to assist educators and researchers to better understand, document and advocate for faculty to act as change agents to improve geoscience education and student success.

2. THEORY OF CHANGE

The SAGE 2YC program is a complex and dynamic social system designed to deliver evidence-based teaching and student support practices in a way that is actionable in each CA's distinctive context. The program was designed by the project leadership team, rooted in their extensive prior experience teaching geosciences, and leadership of large-scale PD programs (see Introduction). Chen (1990) would describe this as the normative theory, or the way leaders' conceptualize and design the program to achieve the desired outcomes rooted in their experience.

To complement the normative theory, data and observations of the program implementation gathered by the ERI team were used to construct a "causative" theory reflective of the emergent activities employed by the project leadership team relative to the CAs. This theory of change is also grounded in social and education literature to help situate the SAGE 2YC program in the larger landscape of educational interventions and social change theories. The Theory of Action (e.g., Funnell & Rogers, 2011), also referred to as "practices of change", provides a practical view of key activities the program took to activate the theory of change (see again the Introduction, Section 1).

Like a single geologic landscape can simultaneously include anthropogenic, hydrologic, sedimentologic, tectonic, and geochemical influences, a social system is equally dynamic and multifaceted. Through observations of the SAGE 2YC program and evaluation of its participants, the emerging theory of change draws on aspects of adult learning theory, CoPs and transformation, readiness for change, diffusion of innovation, situated cognition, adaptive leadership, organizational change, and more to build a holistic picture of how the system operates and where it fits in the landscape of existing PD programs.

In the original proposal (Macdonald et al., 2015) the eight-step change model conceived by Kotter (2014) was anticipated to underpin the theory of change. Yet, as the program unfolded, it became clear that Kotter's focus on positional leaders envisioning and administering organizational change did not align well with the change processes employed by 2YC faculty, which is sometimes called "leading-in-place". Finding theories about leadership specific to higher education by Kezar (2014) more relevant to SAGE 2YC, our theory of change shifted to viewing faculty leadership as a means of advancing change initiatives on college campuses in a more authentic and contextually appropriate manner.

THEORETICAL FRAMEWORK

Our theory of change proposes that Change Agents (CAs) engage in a cycle of innovation through PD and practice, resulting in the incremental development of leadership skills and evidence-based teaching practices. The changes are manageable with the support of the SAGE 2YC community, program, resources, and ongoing opportunities for discussion, reflection, planning, and practicing. Engaging in practices within and beyond the classroom amplifies the individual CA changes to improve student academic success (see course changes, Section 9), support colleagues in changing their practices and programs/departments (see DPI, Section 6), engage in leadership endeavors (see administrators Section 8), and create regional communities (see regional workshops, Section 11).

Figure 2-1 shows the generalized theory of change that includes the many scales at which SAGE 2YC program operates, and Figure 2-2 shows examples of how SAGE 2YC enacted that theory.

The theory of change also recognizes that each faculty member enters the program with different readiness for change. This readiness to change (Armenakis, Harris, & Mossholder, 1993) includes

individual-level backgrounds, beliefs, and experiences; interpersonal relationships, social networks, and leadership orientations; organizational contexts that in this case include very small departments or programs, limited PD opportunities, and high teaching loads; and distinct department, institutional, and regional cultures (Condon, 2016). Austin (2011) describes the system in which a faculty resides as essential to understanding how change does or does not occur, as the "levers" of change vary from one system to the next and influence faculty members' choices about their teaching practices and the level of innovation they are willing and able to employ. The SAGE 2YC approach attempts to meet faculty where they are at by providing practical and actionable ways to improve practice, while scaffolding in opportunities to reflect and learn about their broader student, institution, and regional landscapes. Baseline evaluation measures document individual starting points and act as part of the intervention, where CA's learn and reflect about their leadership orientations, their practices (as measured by the EPI, RTOP), and their department culture (as measured by the DPI) (see Section 6).

How the theory of change works for Change Agents

Recognizing CAs enter SAGE 2YC having varying levels of readiness for change, our theory of change for SAGE 2YC purports faculty join a CoP (Wenger-Trayner & Wenger-Trayner, 2015) with a common purpose to increase evidence-based practices and cultivate faculty leadership and agency to enact new practices and advocate for implementing changed practices with their colleagues. Members of the CoP find a shared purpose to broaden student participation in their programs, support academic success of all students, and facilitate students' professional pathways. The common purpose provides individual motivation, shared engagement, and professional relevance that is the backbone of the CoP. Through the anchoring practice of PD (meet, discuss, plan, reflect), practice, and incremental change, faculty gain knowledge and experience while an adaptive support system is designed to ease the uncertainty and risk associated with implementing new practices. Synchronous PD opportunities are designed and offered to the CAs to model the process of learning, reflection, and practice that they are encouraged to integrate into their professional practice.

Gehrke and Kezar (2016) define this particular type of CoP as a Community of Transformation (CoT), as the shared purpose involves making deep and meaningful changes to their practices and cultures, the program philosophy is embedded throughout the PD, and the relationships provide ongoing support through change. The SAGE 2YC model goes a step further than the CoT's as described by Gehrke and Kezar (2016), where local support of teams and administrators who potentially act as "site champions" is intentionally incorporated. This local support helps to grow knowledge of the system and context that is reflected in action plans that guide the CAs in bridging the gap between theory and practice. By incorporating ideas gained and shared through PD (including brainstorming, and reflection), the CAs hone their practice to address local contexts.

In this intentionally designed safe and social PD setting, the CAs exchange ideas and receive feedback, learn new strategies to build on their own experience, and plan together about next steps. In this way, the process of learning is both individual and collective. Building in reflection on their own practice allows the CAs to assess change adoption, while interactions with other community members illuminate colleagues' various approaches. Unlike the top-down knowledge transmission of the train-the-trainer approach that expects replication, CAs learn from each other to gain insights and ideas and are encouraged to make changes that are meaningful to their local context (Macdonald et al., 2019) and therefore increase the likelihood of sustained long-term change.

Leadership development is embedded throughout, as the CAs situate their own practices in local and

broader contexts. For example, engaging administrators who are champions for change on their campuses allows the CAs to view their work through a wider lens that includes a broader landscape. For example, the CAs' leadership of regional workshops connects them to both 2YCs and 4YCUs. This cycle is underpinned by situated learning theory, in which opportunities to practice and reflect with a network of colleagues may help faculty adopt their newly acquired knowledge into on-going professional practice (Lave & Wenger, 1991). Scaffolded and repeated opportunities to practice and reflect (both individually and with colleagues) enable faculty to make incremental improvements to their practice, as well as the confidence and experience needed to engage in larger scale change over time.

SUMMARY

The change model of faculty learning and leading through practice provides a mechanism for individual faculty members to reflect on what they are learning, to meet with colleagues to discuss and investigate together, and apply what they are learning and experiencing by intentionally changing to refine their practice. This reinforcing process also aligns with organizational learning (Dee & Leišytė, 2016) in which feedback loops constantly allow for adjustment to practice. Understanding better how PD for 2YC faculty members builds and reinforces learning and leading for professional practice is reflected in our theory of change. By researching how change works in the SAGE 2YC project, we document how PD can be a lever for change to faculty practice, in their classrooms and on their campuses, as well as in conjunction with faculty at other 2YCs and 4YCUs.

Figure 2-1: Generalized Theory of Change. Faculty Lead and Learn Through Supported Practice

COMMON PURPOSE

Increase evidence based practices

Cultivate faculty leaders
Leading in place, agency, advocacy

ANCHORING PRACTICE

Meet, Discuss, Plan, Reflect
Relevant, active, social, collegial, challenges assumptions, evaluated

Incremental Changes
Iterative, enact changes based on new experience and knowledge

Change Agent Pathway
Unique, continuing, supported, social, authentic

Community

Organizational

Interpersonal

Individual

CA's enter with differing social-ecological contexts & readiness for change

Practice
Manageable increments, mutually strengthening

Profession

Region

Institution

Classroom

Program/ Department

Support Network
Program, peers, and administrators

ADAPTIVE SUPPORT SYSTEM

Resources
Relevant, actionable, evidence based

Figure 2-2: SAGE Enactment of Theory of Change

COMMON PURPOSE

Increase evidence based practices
*Broaden participation in geoscience
*Support academic success of all students
*Facilitate students' professional path

Cultivate faculty leaders
*Agency to engage colleagues
*Advocate for all students
*Lead regional workshops

ANCHORING PRACTICE

Meet, Discuss, Plan, Reflect
PD (in person or virtual), team and individual action plans, feedback from peers & leaders, critical reflection opportunities

Incremental Changes
Iterative, enact changes based on new experience and knowledge

Change Agent Pathway
Unique, continuing, supported, social, authentic

Regional context
Institutional structure
Peer relationships
Individual

CA's enter with differing social-ecological contexts & readiness for change

Practice
Teaches and learns from students & colleagues

Profession
Opportunities to attend regional and national conferences

Region
Plan and run regional workshops spreads effect

Institution
Meet w/ site champions situates efforts in broader context

Classroom
Trial new practices
Learn from students
Evaluate what works

Program/ Department
Discussion of teaching & learning & student support

Support Network
Teams, CAs, Project, Site Champions
(e.g. admins)

ADAPTIVE SUPPORT SYSTEM

Resources
Practical & actionable strategies & examples, website w/ resources & workspace

12 | P a g e

3. MIXED METHODS DESIGN

The SAGE 2YC project used a mixed-methods design to address questions for the internal evaluation, research, and external evaluation components of the project. These questions were created by the ERI team and revised over the course of the project with guidance from the project leadership team. Also, once the CAs were introduced to the SAGE 2YC project, including practices of change that they were encouraged to adopt, the CAs were invited to advise the ERI team on their research questions and also on their reactions to emerging findings. The theory of change was also reviewed to help the ERI team refine the graphic and textual representations of the SAGE 2YC project. This reciprocal relationship between the SAGE project activities and evaluation and research functions is consistent with "developmental evaluation" that advocates for data-informed, active learning about how change is happening to ensure meaningful system change (Patton, 2011).

In conducting evaluation and research on SAGE 2YC the project leadership designed a synergistic approach involving internal evaluation, research and external evaluation. Though these three data-oriented approaches to inquiry are related, each took on a distinctive focus in this project. With respect to internal evaluation, the ERI team members focused on the changes the CAs made and how those changes related to the practices of change advocated by project leadership. The research component of the project focused on CA leadership development over the course of the project, as well as the formation and influence of CoPs. Finally, the external evaluation gathered data to inform the meaning and merits of the SAGE 2YC PD model from the perspective of two major project components: course outcomes and networking.

THE MIXED METHODS APPROACH

The ERI team used qualitative and quantitative methods to gather numeric and textual data to address the questions posed for the internal evaluation, research external evaluation. From the time of notification of funding, a plan was developed and executed to use qualitative and quantitative methods to ensure a comprehensive approach to studying the SAGE 2YC project and informing the PIs and CAs on data gathered to help guide the evolution of the project. Recognizing that embedded in the theory of change for SAGE 2YC was the notion that practices of change would be dynamic and evolve of time meant the research design and data collection also required a comprehensive, multi-layered approach.

As noted, the choice of a mixed methods approach was deliberate. Because of the many goals and complex dimensions of SAGE 2YC, the project leadership team understood the need to gather data using multiple perspectives, multiple methods, and multiple data sources. Mixed methods designs encourage multiple world views (post-posivitism, pragmatism, constructivism) and they value the importance of collaborative relationships between project implementers and researchers (Creswell & Clark, 2007) as was the case with SAGE 2YC. Mixed methods also contribute to problem-solving because of the contextualized nature of the qualitative and quantitative data that are gathered, typically on an on-going basis from start to end. Possibly most important, mixed methods yield information that is meaningful to diverse audiences, understanding that quantitative and qualitative data resonate with different people and groups in meaningful ways.

Table 3.1 summarizes the key questions and methods for major parts of the overall study. As noted in this table, the qualitative methods focus quite extensively on interviews of PIs and CAs at key intervals in the project, often associated with the annual workshop and annual reporting to the NSF. Also, more in-depth case studies were conducted at numerous CA colleges (cohort 1 and 2), involving multi-day visits wherein ERI team members (typically two) reviewed materials created by CAs; conducted personal

interviews with CAs and administrators and focus groups with students; and carried out classroom observations.

Table 3-1: Evaluation and Research Foci, Questions, and Mixed Methods

Evaluation & Research Foci	Questions	Methods
Internal Evaluation	• What changes (attitudes/efficacy, practice, programmatic, institutional, regional) do CAs make over the time of the SAGE 2YC grant? • How do those adjustments align with SAGE 2YC program themes and activities? • To what extent do program participants attribute changes to SAGE 2YC program elements? • What contextual adaptations are evident in what the faculty CAs do?	Analysis and synthesis of data collected from individual CA and teams including classroom observations, interviews, focus groups, survey responses, action plans, PD artifacts (such as posters or presentations).

Research	• How do CAs perceive of themselves as leaders of change over the time of the SAGE 2YC grant?
	    o What is the role of context in the change process?
	    o What are the differences between cohort 1 and 2 in terms of leadership development?
	    o What factors contribute to these differences?
	• What influence does the CoP developed in the project have on the CAs regarding attitudes, beliefs, knowledge, and practices?
	    o How is change and innovation shared in the CoP?
	    o What contributed to the differences between cohort 1 and cohort 2 based on their distinctive starting points?
		Analysis and synthesis from data collected through site visits and workshops from CAs and administrators, including interviews, focus groups, project communications and web pages, and responses to survey instruments such as the Bolman and Deal questionnaire and workshop related forms.

External Evaluation	• How was the PD model implemented by the PIs and CAs (cohorts 1 & 2), and what factors influenced implementation of the PD model and its associated practices of change by each cohort? • What are the course outcomes associated with the instructional practices of the CAs (cohorts 1 & 2), and how do they relate to the PD model? • How does the CA network form and change over time, and how do those changes relate to the PD model?	Analyze and synthesis of qualitative and qualitative data gathered for the project. Quantitative outcomes assessment method conducted using a data collection method and template created for SAGE 2YC. Quantitative survey used to conduct Social Network Analysis (SNA), complimented with open-ended survey questions to elicit qualitative data

In addition to these qualitative methods, the ERI team administered well-known instrumentation to measure instructional reform and individual leadership, including the Reformed Teacher Observation Protocol (RTOP) and the Bolman and Deal leadership frames. These instruments yielded quantitative data near the beginning of the project and again near the end. In addition, two instruments were designed by the ERI team and PIs specifically for the SAGE 2YC project, called the Educational Practices Inventory (EPI) and Department/Program Practices Inventory (DPI); site visits where classroom observations and faculty and student interviews; social network analysis (SNA): and thematic content analysis of faculty journals, the SAGE 2YC webpages and musings (blog posts) hosted on the SERC website, webinars, email exchanges, and online discussion groups. In addition, the external evaluation/research team engaged all CA teams in gathering data on the courses the CAs have taught and changed as a result of the grant, including documenting the types of changes made, as well as course student demographics and course success defined as completion with a grade of C or above.

Over the entire course of the SAGE 2YC project an enormous amount of data was gathered, analyzed, and reported in numerous ways (i.e., in textual reports and online via blogs, electronic newsletters and websites). In addition, the ERI team maintained a spreadsheet of conference presentations and academic publications completed by the PIs and other project leadership team members, and to the extent possible, also the publications and presentations of faculty CAs. Appendix A provides a complete list of publications and presentations involving ERI team members thus far, with more anticipated to the end of the grant and beyond.

LIMITATIONS

The evaluation and research design for SAGE 2YC had strengths but also limitations. Funded by the SAGE 2YC grant, the ERI team members worked in partnership with the project leaders. With the clear focus of SAGE 2YC on improving geoscience PD, the ERI team understood that its role was to support the project by gathering data that could be used to further the project's improvement agenda. As such, the study design and methods for SAGE 2YC were fluid in that they evolved as the core project functions progressed, with ERI team members taking care not to disrupt the intentional decisions and actions of project leadership and CA teams. This approach enabled the project leaders to maximize the internal validity of the project in being able to work closely with the CAs to help them translate their learning into practices of change without being impeded by the ERI team's efforts. Enormously advantageous for promoting change in practice, this design introduced complications to the ERI's team to conduct research and evaluation designs that could measure impact of the overall project, or key components of the model using the most rigorous research designs (i.e., experimental or quasi-experimental). Without consistency in interventions and associated documentation, it was not possible for the ERI team to measure the impact of those interventions. This is not to say the rich descriptive qualitative and quantitative data did not yield useful information about the SAGE 2YC project but simply to caution readers on the extent to which this report can speak to "what works" in a highly rigorous way. In the end, we believe this ERI team's research and evaluation process makes an important contribution to the literature on improving community college geoscience education and deepening understanding of how the SAGE 2YC PD model contributes to evolving practice in the field.

4. THE SAGE 2YC PROFESSIONAL DEVELOPMENT MODEL

The SAGE 2YC project set out to support faculty CAs through "a national program of professional development, leadership development, and community support." The project intended to provide the CAs with collaborative experience using a learning community to ultimately support a cycle of innovation. Two cohorts of faculty were envisioned within the project. Cohort 1 would engage over a four-year period and attend face-to-face PD sessions, supplemented by virtual sessions, whereas cohort 2 would receive virtual PD over a shorter two-year cycle. CAs from both cohorts would participate in a final propagation workshop.

Synthesizing data gathered to research and evaluation the entire SAGE 2YC project, we dedicate this section to addressing the following primary questions:

- What aspects of the SAGE 2YC PD model engage the faculty CAs in making changes to their practice, and how does this engagement happen?
- How does the enacted PD model align with the theory of change for SAGE 2YC?
- What are CA perceptions of strategies that the SAGE 2YC PD model advances to help them change practice?

METHODS

This section reports on data reported from CAs and collected from PD programming artifacts. The methods include:

Workshop forms and surveys: CAs completed registration forms, formative "roadcheck" surveys, and end of event surveys as part of their participation in PD events. Registration forms collected current contact information and information related to programmatic choices. Formative "roadcheck" surveys were administered daily for face-to-face events or in the early weeks of virtual events. These formative surveys collected data on what participants found useful and what could be improved with the workshop program in real time. End of event surveys collected data about participants' overall satisfaction, their impressions of what could be improved, what they learned and what valued about the PD and the overall CA experience.

Web pages of PD agenda of activities and relevant materials: All face-to-face and virtual activities included a set of web pages that delineated the schedule, lead facilitators, description of format and types of activities, and links to relevant materials (e.g., books, PowerPoint slides, handouts), and discussion lists (for asynchronous activities).

Educational Practices Inventory (EPI) survey: The survey was developed by the SAGE 2YC project (see section 6 What and How Change Agents Change). In addition to collecting data on CAs reported practices, the survey also measured CAs reported engagement in a CoP (Wenger, 2011).

BACKGROUND OF THE SAGE 2YC PROFESSIONAL DEVELOPMENT MODEL

To understand what the CAs gained due to the professional development (PD) model, it is important to understand the delivery of the PD. The modality for delivery of the PD used synchronous involvement of the CAs in either face-to-face (f2f) sessions or virtual sessions. Asynchronous work conducted by the CAs via discussion boards, which provided a chance to review materials prior to workshop sessions. Table 4.1 summarizes the total number of CAs at each workshop, recognizing there was some movement of CAs

coming into and leaving the project over the four-year timeframe.

This section presents information on participation of the CAs in the workshops over the course of the project, describes the role of the principal investigators (PIs) in delivery of the PD, and reviews the content of the overarching PD. Differentiation by cohort 1 and 2 occurs to align with the different modalities of PD delivery.

PD Format by Cohort

Table 4.1 shows CA participation levels for both cohorts. Cohort 1 received PD predominately in a f2f format, with CAs attending five f2f workshops over the course of their involvement from 2016 to 2019. Cohort 1 CAs also took part in virtual PD in each semester of the project in the form of book clubs and sessions on topics aligned with the project. Of the 23 CAs in cohort 1, 19 attended all five workshops. In 2016, cohort 1 CA teams led their first regional workshop, ultimately conducting four f2f regional workshops over the course of the project. In 2017 several of the CA teams offered virtual regional workshops to follow up on the fall f2f regional sessions (for more detail see Regional Workshop, Section 11). Also, some of the CAs from Cohort 1 and 2 attended one or more professional association workshops over the course of the grant, consequently these CAs received additional PD beyond that provided by the SAGE 2YC grant.

Cohort 2 received PD predominately in a virtual format. In fall 2017, they participated in a series of virtual sessions on the various strands of the project (see content section below for details). Of the 14 CAs engaged in fall 2017, three attended all the synchronous sessions and participated in all the asynchronous activities. On average, 11 of the 14 CAs were involved in the synchronous sessions, and 9 in the asynchronous activities. These levels of participation were influenced by the fact that three CAs were involved for only part of the year, either leaving or starting the project mid-semester; one of the CAs had a class conflict for the times when the synchronous sessions were offered.

Table 4-2 summarizes cohort 2 participation in PD in fall 2017. In spring of 2018, members of this cohort took part in book clubs and another series of workshops that focused on the development of the team action plans. In June 2018, these CAs participated in a summer virtual workshop, followed in the fall by another set of virtual PD sessions and in the spring of 2019 with virtual book clubs and support sessions. The CAs also hosted regional workshops in 2018 and 2019.

Members of both cohorts participated in a culminating workshop in June 2019, to which their administrators were also invited.

Table 4-1: CA Workshop Participation by Cohort

Cohort	March 2016	June 2016	June 2017	June 2018	June 2019
1	22	24	22	22 (f2f)	22
Cohort		Fall 2018	Spring 2018	June 2018	June 2019
2		13 (virtual)	13 (virtual)	13 (virtual)	11

Table 4-2: Cohort 2 Fall 2017 Participation

Number participating (14)	S	A	S	A	S	A	S	A	S
	13	10	10	10	11	9	11	6	11

*S=synchronous session; A=asynchronous session

Role of PIs

The bulk of the PD sessions was delivered by the PIs, with invited speakers on topics that addressed each of the project strands, e.g., broadening participation, implicit bias, equity, transfer, course design, and metacognition. Administrators attending these sessions noted how much they enjoyed learning about practices on other campuses. The PIs were very connected and well-known to the CAs in cohort 1 as these CA faculty members were identified in the original grant and were included in SAGE 2YC based on past participation in past projects with the PIs.

Figure 4.1 and 4.2 show the number of sessions offered in each workshop and who led the sessions. Over time, the PI role of leading sessions was balanced with more CA-led sessions, poster presentations and work on action plans/website development (grey in the figures below). For example, in the summer 2018 workshop, cohort 1 CAs led sessions on a range of topics and presented information relative to their campus-based action plans. When the CAs were working on their action plans or presenting at the workshops, the PIs maintained active involvement by providing ongoing feedback. Over the course of the project, the amount of time for data gathering for the project evaluation increased in the in-person workshops, and the ERI team also presented ongoing findings over the course of the project in addition to conducting data gathering focus groups, lightning interviews, and individual interviews.

Figure 4-1: Percentage of Sessions by Roles (Cohort 1)
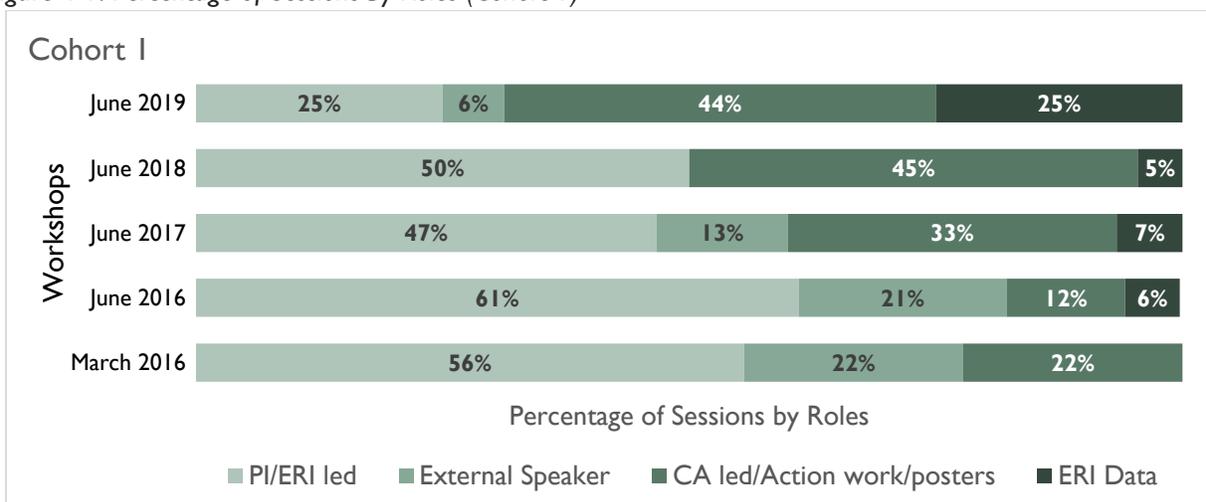
Figure 4-2: Percentage of Sessions by Roles (Cohort 2)
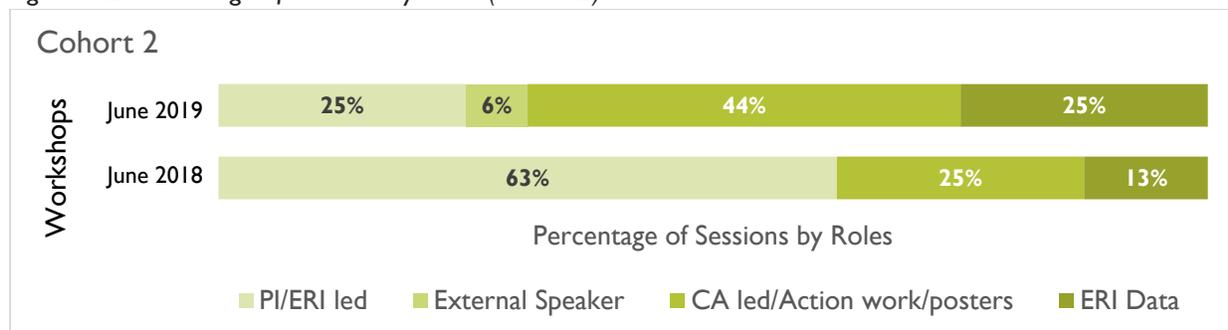
PD Content

The PD content had four main components for both cohorts of CAs. Figure 4.3 highlights each of these. The PIs curated research-based strategies that provided the material for the workshop sessions and for virtual PD sessions for which each PI was responsible. These strategies sought to support the three strands of the project [supporting student academic success, broadening participation, facilitating career and transfer pathways]. Another component of the PD sessions addressed leadership development and change theory to support knowledge growth for the CAs. The CAs also developed their own materials as part of their individual and team action plans and in the delivery of their regional workshops. A scan of the titles of the regional sessions highlights the range of topics covered by the CAs (see the Regional Workshop, Section 11 of this report). They also capitalized on material provided to them as part of their own PD in the project, including website, registration and evaluation support for regional workshops.

Figure 4-3: PD Content Areas

Evidence Based Strategies
- Active learning
- Inclusive pedagogy
- Career and transfer pathways
- Course outcomes (aggregate and disaggregated)

Regional Teams
- Regional workshops
- College and region context-based implementation
- Communities of Practice (CoP)

Leadership Development
- Faculty leadership
- Leading in place
- Change theory
- Working with administrators
- Communities of Practice (CoP)

Action Plans
- Team- and individual-based planning
- Authentic learning by doing
- Course-level outcomes data
- Deliberate college/program/course linked changes

Evidence-based Strategies

A review of the PD content for cohort 1 for 2016, 2017, 2018, and 2019 is shown in Table 4.3 by session and project theme. In 2016, the virtual sessions for cohort 1 included a book club that discussed Saundra McGuire's *Teach Students How to Learn* and sessions on implementing active learning strategies into courses. In Fall 2017, the virtual sessions included a book club on James Lang's *Small Teaching* and a teaching circle on teaching geoscience in an online or hybrid format. In Spring 2018, the virtual activities included a book club on *Whistling Vivaldi: How Stereotypes Affect Us and What We Can Do* by Claude Steele, plus sessions on developing your students' science identity. In Fall 2018, virtual activities that were open to both cohort 1 and 2 CAs included: working for change at the program and institutional

level; supporting transfer; fostering a sense of belonging; and revising a historical geology course. The Summer 2019 meeting was also attended by both cohorts, providing cohort 2 CAs their first opportunity to meet in-person at an annual SAGE 2YC workshop.

Table 4-3: Hours of PD by Theme Topic in F2F Workshops

F2F Workshop	Major Themes	Hours
March 2016	Support Academic Success of all Students	2
	Broaden Participation in Geosciences	2.75
	Facilitate Professional Pathways	2.5
	Build Sustainable Leadership (includes action plans/regional workshop planning)	4
June 2016	Support Academic Success of all Students	3.75
	Broaden Participation in Geosciences	4.75
	Facilitate Professional Pathways	3.5
	Build Sustainable Leadership (includes action plans/regional workshop planning)	9.75
June 2017	Support Academic Success of all Students	2.5
	Broaden Participation in Geosciences	3.75
	Facilitate Professional Pathways	.5
	Build Sustainable Leadership (includes action plans/regional workshop planning)	9.5
June 2018	Support Academic Success of all Students	1
	Broaden Participation in Geosciences	3.5
	Facilitate Professional Pathways	1
	Build Sustainable Leadership (includes action plans/regional workshop planning)	11.25
June 2019	Support Academic Success of all Students	4
	Broaden Participation in Geosciences	4
	Facilitate Professional Pathways	1.5
	Build Sustainable Leadership (includes action plans/regional workshop planning	5.5
Total	Support Academic Success of all Students	13.25
	Broaden Participation in Geosciences	17.75
	Facilitate Professional Pathways	9
	Build Sustainable Leadership (includes action plans/regional workshop planning)	40

Cohort 2 participated in 12 activities in 2017, consisting of both asynchronous work and synchronous online work; no in-person PD was conducted with this cohort until summer 2019 when these CAs

attended the last major in-person PD workshop. The asynchronous meetings were typically one-hour in duration. In the first and second activities, the CAs learned about one another and the SAGE 2YC project, and they received training on online collaboration tools. Activities 3, 4, and 5 focused on supporting the academic success for all students (e.g. pedagogies to support student success, active learning, metacognition, reflective practice, and developing science identity). Activities 6 and 7 provided PD on facilitating students' professional pathways, and began to introduce the role of broadening participation in these pathways. The topic of broadening participation was the focus of Activity 8. Activities 9, 10, and 11 focused on the development of individual action plans. The final activity, Activity 12, involved individual team meetings with project leaders.

In spring 2018, cohort 2 participated in an additional 10 activities, in asynchronous and synchronous formats. Activities 1 and 2 included supporting the transfer of students to four-year colleges and universities. Activity 3 involved the CAs conducting the Geoscience Department/Program Practices Inventory with colleagues at their institution, with a follow-up in activity 4 focused on identification of program strengths and opportunities, providing background on activities 5 and 6 involving action plans. Activity 7 involved the CAs meeting with their administrator to work on their action plan, and activity 8 delved into questions of their plans based on institutional context. Activity 9 provided the CAs time to revise their action plans, and activity 10 included individual team meetings with the PIs.

Session Themes for All Face-to-Face PD Workshops

Table 4-4 summarizes the number of sessions aligned to each of the three themes of the project, as well as leadership development. A review of culminating webpages of the CAs highlights how they applied these strands to their own practice. Many CAs noted their use of active learning strategies, scientist spotlights, metacognition, partner engagement to support transfer and careers, and data-use to help focus their work to broaden participation.

Table 4-4: Number of Sessions By Major Theme

Sessions	Support Academic Success for all Students	Broaden Participation in the Geosciences	Facilitate Professional Pathways	Leadership Development
Cohort 1-March 2016	1	2	1	1
Cohort 1-June 2016	4	2	4	1
Cohort 1-June 2017	3	2	1	1
Cohort 1-June 2018	1	1	1	1
Cohort 2-June 2018	1	1	1	1
Cohorts 1 & 2 -June 2019	1	2	3	1
Total	11	10	11	6

Figure 4.4 shows the number of sessions that were dedicated to four themes that were delivered during the face-to-face workshops, including the three themes designated as central to the project's mission: student academic success, broadening participation, and professional pathways over the five years of the grant. The figure shows there were slightly more sessions on student academic success over the course of the grant, but broadening participation and professional pathways were

also a major focus. Sustainable leadership had the smallest number of sessions but it was delivered consistently throughout the grant, with one session offered per year. Also noteworthy in Table 4.4 is that all four themes were addressed on some level in every PD workshop delivered during the grant. Some workshops emphasized some themes more prominently.

Figure 4-4: Number PD Sessions by Major Theme Over the Four Years of the Grant
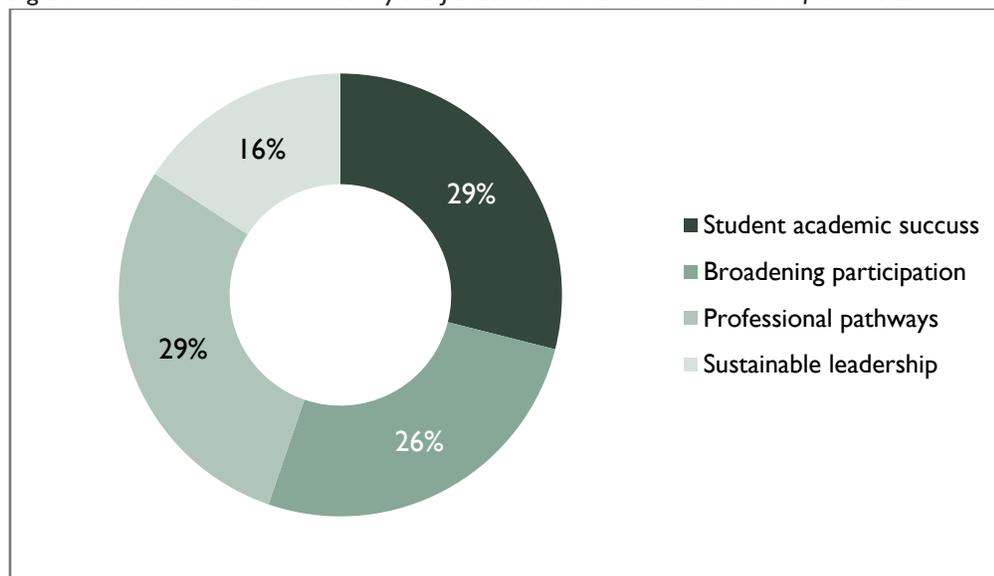
CONNECTIONS OF PD TO THE THEORY OF CHANGE

This section also discusses the role of reflection and situated cognition that occurred in the PD model, as both of these elements contribute to the theory of change and learning for the CAs. The aforementioned information on the PD content provides a backdrop for opportunities where CAs could meet together as a group to discuss new strategies they were learning, develop action plans, and see practices modeled by the PIs and external speakers. An important part of the practice for the CAs involved testing out new strategies in their own classes and then reflecting on what worked, what needed refinement, and what else they needed to know to make strategies long-lasting. The CAs also put into practice what they learned when they led regional workshops. In explaining strategies to others, they had to comprehend the strategies well enough to explain them to others and they had to consider the ways in which they engaged with and integrated the strategies into their own practice. This experience with reflective practice, gave them knowledge and perspective that was valued by other faculty who were learning from them. Using this inquiry mindset over time, the CAs were able to continue to reflect on their work to make longer lasting changes.

Reflective Practice

Reflective journal prompts were provided for CAs throughout the project to provide them with opportunities to use metacognition on a personal level to think about their own thinking. Brookfield (2017) argues that as adults, critical reflection provides a mechanism for individuals to question the assumptions about how best to help students learn. By reflecting on what they learned in the PD, the CAs had opportunities to surface their assumptions and make changes to their teaching practice as a result of this reflective learning. These prompts focused on ways the CAs felt they were learning about new strategies for their work and how they were planning for the future. As part of the theory of

change, this level of reflection was critical to understanding the starting places of the CAs. It contributed to the feedback loops for them in their learning as well. The final team pages provide evidence of the final reflective artifact of the project for the CAs. Here, they focused on the ways their practice changed over the course of the project and identified particular sources within the project that helped support this change (e.g., active learning strategies, metacognition, networking).

Situated Cognition

The theory of change focuses on the role of faculty learning, the opportunity to practice new concepts, and the ability to use this new learning more than once over time. Situated cognition involves the opportunity to learn within context and through social interactions. In the SAGE 2YC project the learning in context involved PD activities occurring with peers in similar situations (i.e., teaching geoscience at community colleges). The ability to practice strategies modeled by the PIs and invited speakers without fear of judgment was valuable to the CAs. The similar disciplinary backgrounds also provided the CAs with a shared language for applying this new knowledge and skills. This carefully constructed learning space contrasts with high-risk classroom environments where faculty try a new strategy and receive unvarnished student feedback . The opportunities SAGE 2YC provided for CAs to practice individual, group, and team assignments with different partners and in different formats was also invaluable.

Community of Practice

A feature of the theory of change is an adaptive support system, to include a network comprised of team members, other CAs, and allies and champions on campus. The project asked about the CAs' perspectives on their CoPs (Wenger, 2011). Figures 4.5 highlights the extent to which the CAs felt a part of a CoP, revealing that the number of CAs from both cohorts who felt a part of a CoP increased. Figure 4.6 highlights a comparison of the CAs to others responding to the same prompts in the *National Geoscience Faculty Survey* regarding the ways in which interactions occur. Across all the prompts, CAs from both cohorts reported higher levels of interaction relative to their national peers. The reasons this finding occurred may relate to the team structure in which CAs worked together with others in their region on team action plans, through interactions with other CAs from around the country (that allowed for cross-cohort interactions; see Section 11 on Regional Workshops and Section 12 on Social Network Analysis), and with their campus administrators (see Section 8 on Community College Administrator Support).

Figure 4-5: Cohort 1 and Cohort 2 Faculty CA Responses on the EPI Items Pertaining to CoP

To what extent do you consider yourself part of a community of geoscience educators that shares your goals, philosophy, and values for geoscience education?

- Cohort 1 EPI-Winter 2016-2017 (n=21)
- Cohort 1 EPI-Winter2018-2019 (n=22)
- Cohort 2 EPI-Fall 2017 (n=9)
- Cohort 2 EPI-Winter 2018-2019 (n=9)
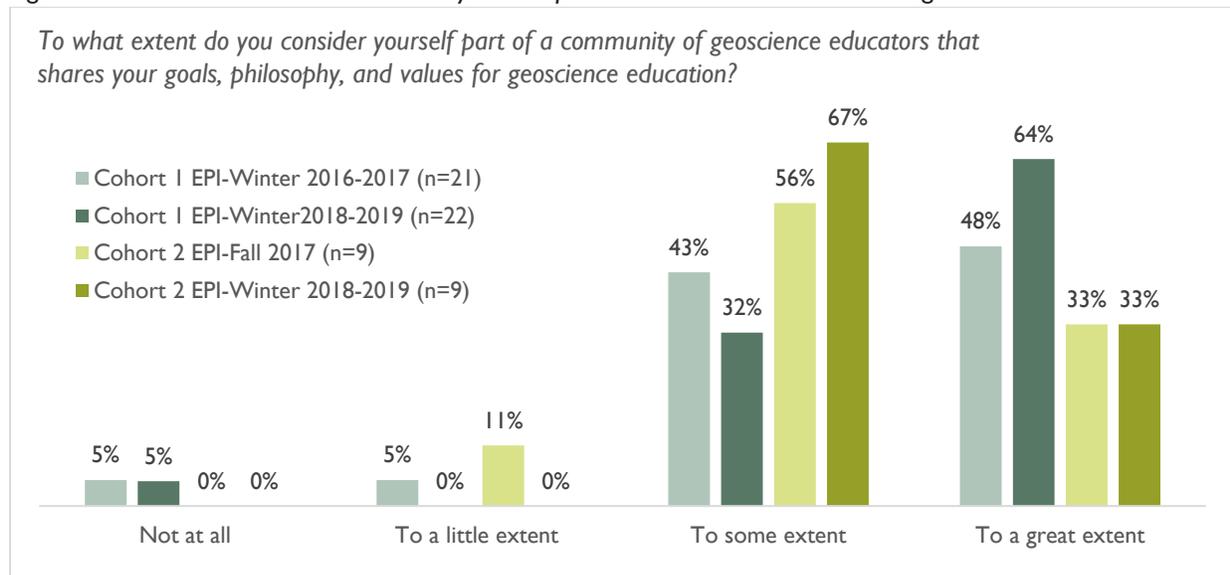
Figure 4-6: Comparison of SAGE 2YC CAs to 2016 National Geoscience Faculty Survey

In which of the following ways do you interact with this community? (select all that apply)

- Overall national responses (n=2175)
- National survey PD participants (n=919)
- National 2YC (n=265)
- Cohort 1 EPI-Winter 2018-2019 (n=22)
- Cohort 2 EPI-Winter 2018-2019 (n=9)
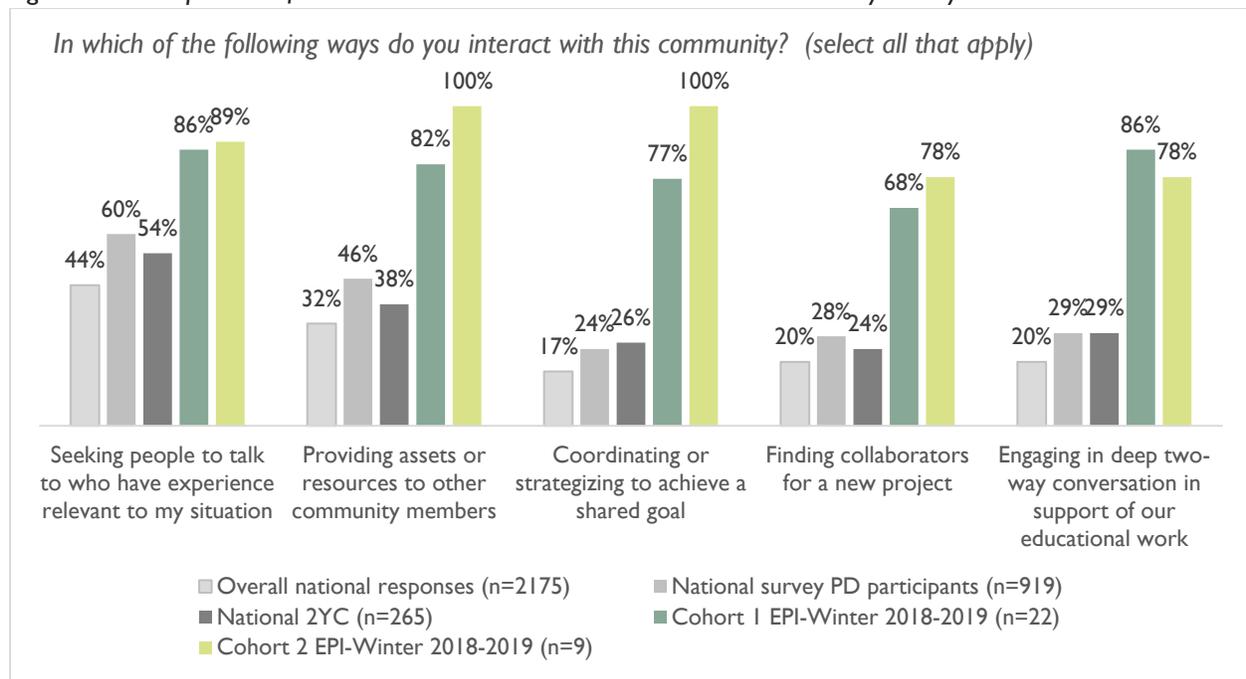
Changes over Time

The PD process evolved over time based on feedback gathered on the process while building the CAs' foundational knowledge. How speakers delivered PD changed over time as feedback from the annual workshops showed more and less effective presentation approaches. For example, one of the early invited guest speakers used a lecture format to present content on broadening participation that was not viewed as especially effective. As CAs learned more about active learning themselves, the PIs prepped the invited guests to employ similar strategies and made such sessions more interactive. Not only did the CAs use feedback loops over time to deepen their learning, so too did the PIs. The PIs held regular meetings throughout the project to plan for upcoming sessions and to debrief on prior sessions.

This learning by the project leaders influenced how the PD was assembled for cohort 2, with adjustments to the content, ordering, and flow of the virtual activities benefiting from what the PIs learned worked due to leading cohort 1. The difference in modality of delivery of the PD for cohort 2 also meant that the PIs had to learn and deepen their own knowledge on how to effectively deliver virtual PD. For the CAs, as time progressed in the project, they were able to know what to expect in workshops and sessions, which helped prime them for learning. For example, prompts or activities required CAs to identify examples from their own practice, presentation of strategies set up a range of examples for the CAs to learn about, and time to practice implementing in active learning activities allowed the CAs a way to try out the new strategies. Equally, by the conclusion of the workshops, CAs had tried out the new strategies in their own classes, conferred with colleagues and PIs about their experience, and reflected on what worked and what did not.

CA PERCEPTIONS OF STRATEGIES TO CHANGE PRACTICE

A review of the End-of-Workshop evaluations for the workshops indicates a high level of satisfaction for the material presented (see Table 4.5). Of note for both cohort 1 and 2 is how their satisfaction remained high with the project and showed slight increases over time. The workshops made use of daily "roadcheck" surveys for both the f2f and virtual events. These responses provided formative feedback to the PD leaders, allowing them to address issues in real-time related to participants' perceptions and satisfaction. In addition, as CAs understood expectations and requirements associated with the PD model, as they learned what to expect from the workshops, they became more involved and confident in delivering their own regional workshops. This latter experience provided an opportunity to appreciate more fully what it means to host a workshop compared to being a participant.

Table 4-5: Overall Cohort Satisfaction (on scale of 1-10)

Cohort	March 2016	June 2016	June 2017	June 2018	June 2019
1	9.23	9.04	9.32	9.73	9.61
2				9.11	

The following **comments** reflect a sample of perspectives from each cohort's first workshop and culminating workshop:

First Workshop Cohort 1-March 2016

This was an excellent workshop and I look forward to working with everyone over the next four years.

Everything was wonderful! I learned a lot, and was never at one point of the workshop bored. Quite the opposite! Thank-you so much!

This was one of the best workshops I have attended! I feel clear-headed leaving the workshop with a clear plan of what I need to do in the short-term. The long-term is a bit fuzzier but I like that I know what to do when I get home.

Overall it was great, just need more time to digest. Enjoyed meeting everyone, the team is very delightful and inspiring.

I wasn't in a good place during this meeting, so that's on me. Despite being distracted and disengaged at times, I did get concrete benefits from attending the meeting and met a few people who I didn't know previously and I think will be good to work with. I appreciate everyone working so hard to put the workshop together.

First Synthesis Workshop Cohort 2-June 2018

The following quotes come from cohort 2 CAs who participated in virtual workshop held in June 2018 that was fairly closely aligned with the traditional cohort 1 June workshop than the prior PD workshops.

I can now see the path we need to take to get our workshop started and this was a great way to sort of force us to start a detailed look at what we want to accomplish and how to get there.

Not enough time to digest info

Very useful, good use of time (efficient). Left feeling very connected with the cohort and the project leaders. Wish I could have that group's input on all the changes I work on!

Again, my disadvantage was my job. I could not feel completely engaged since I could only hear people (rather than see them). I didn't realize how crucial or helpful that would have been until the workshop.

Culminating Workshop-June 2019 (Cohort 1 and Cohort 2)

Excellent Job. You have provided a positive and safe space for all participants.

It has been an exceptional experience overall and the culminating workshop was spectacular.

Some of the sessions were a waste of time, and the lack of time to complete items. There were constant interruptions which were difficult to deal with.

I always leave the summer workshop with new energy, new information, and new ideas. Thank you for all you have done for me and for us.

This is probably the most useful professional development experience I have ever had. I am coming away with greater confidence, a larger network, and real do-able plans for the future. I am always inspired by PD, but can't recall any situation where I've been able to make a list like this as an "action plan" on the last day!

What a wonderful group of people! Life-long professional friendships have been made through this project!

Based on our analysis of all comments, only one CA of the 33 attending the culminating workshop in June 2019 had a negative experience: *Good content, great interaction, but the overt favoritism displayed by some project leaders really destroyed any pleasure I gained from the workshop. It has been a painful experience.* Though unclear, we believe this comment may reflect a particular concern of the CA team about a culminating workshop presentation, and the attempt by PIs to provide guidance that was not well received by all the CA team members.

Also evident in workshop evaluation data was CA identification on what was **most valuable and least valuable** in the range of topics and delivery approaches to the workshop content. Results highlighting what each CA cohort found most compelling in their first workshop and culminating workshop appear below.

First Workshop Cohort 1-March 2016
Most Valuable:

1. Networking and learning more about the project (17 of 24 mentioned)

   Opportunities to discuss ideas with colleagues.

   Meeting new people & networking w/ other Geoscience teachers all across the country!!!

   I have enjoyed the opportunity to get time to work with my team--we all have busy schedules and are not on the same campus so having some time to start planning was much appreciated.

2. Active learning and teaching strategies (10 of 24 mentioned)

   Active learning strategies. I can implement them immediately in my class. I am in control of them!

   I really enjoyed the portion on active learning. Although I currently employ a few of the techniques there are few I have never used that i think would be very helpful to my students and my course prep.

   Modeling of how to run a meeting with time for active participation and individual reflection.

3. Diversity (5 of 24 mentioned)

   Discussions on Diversity were very insightful.

   [First name of speaker]'s session- don't get to see URM role models often.

   [First name of speaker]'s presentation and her being available for more discussion was very helpful, as her input will be invaluable for one of my action plans. I hope to be able to contact her in the future, as the project continues.

Least Valuable:

1. Review of information already knew (6 of 24 mentioned)

   Teaching techniques--not new information and took up quite a bit of workshop time.

   Reviewing active teaching strategies- this was a review.

   For me personally - I've been to many of your wonderful workshops and have already learned about the active learning activities and ideas. So, it's not that this is an overall negative, it's just something I learned from our "On the Cutting Edge workshop" MANY years ago, many of which I use in my classes.

2. Diversity presentation (6 of 24 mentioned)

   The broadening pathways session was least useful, it had good information but was not as interactive as I would have liked.

   The Broadening Participation portion was premature, at least in the detail we received. I believe that we should have worked harder to move along our other parts of planning and

developing our duties as change agents before focusing so strongly on this topic. Please don't misunderstand, this was essential information and will be an important component in whatever we create, but it would be better left to a later date.

I think [External speaker's] presentation could have been shortened. It was essentially 3 hours of mostly listening to her speak.

3. Rushed for time (5 of 24 mentioned)

I felt like there were several parts that got rushed to the point that partial gains may never be recovered. Providing a little more time and trying to cover less may mean more progress towards the end goal/s.

Longer breaks to walk around and get fresh air. I know we had a lot to do in a short time but it would have been nice.

The only one that I can think of, maybe, is the cutting off of discussion because of time. I realize if we do not cut off discussion we would be here for days or would not cover the information that was planned. Sticking to a schedule is necessary for that. But, it would have been nice to make discussion time last longer.

First Workshop Cohort 2-June 2018

Most Valuable:

1. Planning time for workshop and action plans (8 of the 9 mentioned)

Getting a chance to begin planning with my team member. I was very intimidated by some of the workshop planning and was able to move past it with the useful activities and sharing!

The act of drafting a workshop description (even if we end up not using any of it) really made all of this feel real- it made me feel like we took 100 steps in a day, which I needed.

2. Collaborative learning and sharing with others (4 of the 9 mentioned)

I think the ability to bounce ideas off each other and to hear other peoples' points of view on our projects helps a lot when we are trying to formulate a plan. It's also nice to get to know the other people on the project and be able to get a sense of their personality and school culture.

Seeing data from various campuses (student population, success rates...). Showed me how we compare to other campuses. What makes us unique and how we are facing potentially similar challenges.

3. Well organized workshop (2 of the 9 mentioned)

All of it was useful. The team leading it were all excellent. I have a lot to think about.

Zoom technology went great.

What could be improved?

1. Time/breaks (5 of the 9 mentioned)

I just began to scratch the surface of what we will do to plan our workshop. I will need to spend more time with my team member to accomplish this.

My only issue with the workshop is that as an adjunct, I have a full-time job. The need to have the workshop and participate in it was clear, but that doesn't negate the responsibilities of my job. With that said, the team did make every effort to break up the workshop over multiple days to avoid overburdening the participants. Thank you.

This may (and very likely is on me) but I would have liked to have known a little bit more about the type of activities to expect each day. It was also difficult to not have all team members present.

2. More connecting (2 of the 9 mentioned)

Our virtual meeting time was shorter than the time one would spend with others in a face-to-face meeting. Maybe a zoom lunch/coffee break chat room to continue conversations after the formal meeting time?

I thought the first day was a bit rough, but it was okay!

Culminating Workshop 2019—Cohort 1 and Cohort 2

Most Valuable

1. Sharing resources/networking (22 of the 33 mentioned)

Absolutely loved the 3 minute slideshows summarizing our work...like [CA] said, "Holy cow we've done A LOT of cool stuff!"

Bringing together both cohorts was valuable. There is so much energy and expertise from the change agents to infuse each of us with ideas and contacts to further develop those ideas outside of the project's timeline.

Hearing from other change agents on specific strategies, which left me with a multitude of ideas to choose from and an understanding of where those ideas occurred. Time to connect outside of structured sessions to follow up and connect with individuals.

2. Working with administrator (15 of the 33 mentioned)

Working with our administrator was valuable. We do not usually take the time when we are at home to sit down and go over what we need and how he could help. We need to learn from how well this works and attempt to make it happen more on our own.

Although I found everything valuable as usual, the most valuable was spending time with my administrator. I feel that sharing this project and my goals with her will make it more likely that I will be able to reach those goals and that I will do so more efficiently.

Including administrators and having a space away from our campus where we could have a conversation was critical and very valuable. We would have been unlikely to converse in this way (and in a very productive way) without it.

3. Learning about equity and diversity (4 of the 33 mentioned)

I am excited to have heard about equity, and plan to propose her (keynote speaker) to speak at my campus.

(Keynote speaker's) discussion was very evocative and led me to consider the importance of role models, how I take that for advantage, and ways in which I might be able to help, or provide students with a variety of role models.

Least Valuable

1. Rushed/Confused on rationale (11 of the 33 mentioned)

Some sessions and gallery walks, specifically on the second day of the workshop were rushed. I needed more time. I loved [final session on sustainability] talk (Friday), but I felt like I needed more time to digest it to make is applicable.

The lack of time to reflect this time around. Everything seemed a lot more rushed than usual.

Working on the web pages was a little confusing, especially when we started pulling up references from the SERC website which seemed to cover what we were doing, it kind of felt like we were needlessly recycling web content.

2. Less salience in administrator interactions/Session topics (10 of the 33 mentioned)

(Keynoter) Equity presentation was more of a reminder than getting a lot out of it.

I didn't think that our poster was all that significant in terms of showing our administrator what we've been doing. However, it was a starting point for conversation.

The time with the administrator was the least valuable part of the workshop for me. The plan prior to that session was that our administrator would split his time between our team and the other team (both from the same institution.) However, our administrator approached my partner and I and expressed a preference for sitting with both teams together, so we went with that model.

3. Repetition of material (3 of the 33 mentioned)

Several of the scheduled sessions seemed to me to rehash material that we had already covered - Material on how to interact with administrators and colleagues was not only unnecessary, but a little condescending.

Some parts near the end seemed a bit redundant.

Follow up interviews and reflections by CAs indicate that the elements they found compelling in the workshops were put into practice. A focus on teaching strategies emerged as most salient to the CAs after their first workshops. A few representative examples follow:

- C1: I focus on challenges students face in the classroom to decide on the type of strategies to use.
- C1: If it is relevant to my teaching, then I prioritize it. This is also what I understand better (teaching rather than networks or outcomes assessment).

- C1: I always come back to doing right by my students. Whatever strand of the project, I always try to keep that in mind. What's the driver within the strands.

- C2: I used to do a few think-pair-share and other small group projects but since the fall workshop, I reorganized my class structure to reduce the amount that I lecture and make room for more group discussions and quick writes. I'm still working on the perfecting jigsaws and plan to do a test wrapper in the fall.

- C2: One of the earlier provided PPTs, which summarized active learning strategies, was a great resource. I experimented with collaborative quizzes for the first time this past semester and both, students and I, loved them. Students were teaching each other a lot during those quizzes.

- C2: I shared the active learning posters and other tools with colleagues on campus. I discussed metacognition during department meeting and to the department chairs (math, science, and technology).

Virtual PD Sessions—Cohort 1 and Cohort 2

Topic-specific virtual PD provided an opportunity to delve into book readings, teaching strategies, and broadening participation beyond workshops and the core virtual PD for cohort 2. Regarding the virtual format, a CA offered: *Zoom is excellent. It can be used with varying formats giving us options when we have several commitments*

A few comments for improvement were made:

The discussion board wasn't particularly valuable for me, personally. Because we were required to post, the board was a bunch of individual responses, rather than a discussion. Which is fine, just not an actual discussion. I felt personally like since I was required to respond to other people's posts, I felt like I was going through the motions for some of those responses.

The zoom discussions with the whole group was frustrating and dominated by a few of the participants.

Following are examples of what the CAs took from these virtual PD sessions:

Fall 2017-Cohort 1 (Blooming your Course/Book club for "Whistling Vivaldi")

The Blooming your Course activity inspired me to re-evaluate my course exams to ensure they cover a range of levels. Additionally, this increased my familiarity and comfort with Bloom's taxonomy, so I started to share this more explicitly with students, helping to use this model as a way to more clearly/directly articulate my expectations of their work. It is my hope that this will lead to students doing better, academically, tying into improving student success.

I found the Blooming your Course one of the best virtual activities to date. It was very well organized. We had simple instructions and meaningful feedback. This activity will serve as a model for me on how to run an impactful, yet simple workshop/webinar.

Seeing our colleagues via the zoom format and sharing ideas, feedback, frustrations, etc., is a huge benefit to carry us throughout the year until we meet in the summer. This group of

colleagues has similar values and goals which is a great boost when my colleagues on campus aren't interested in developing new ideas or teaching techniques. Connecting personally through the virtual meetings strengthens my resolve to improve my courses and other student outreach.

Becoming exposed to the research presented in the book Whistling Vivaldi really opened my eyes further to the topics of bias, identity threat, stereotypes, etc. on a topic that I thought I was already well versed in. That exposure was the most valuable to me because it has opened my mind a lot further in regards to my students.

I really enjoyed submitting questions that the reading provoked and I also enjoyed seeing what others had questions about. It really surprised me how similar a lot of our questions were. I also really enjoyed having the web meetings and seeing one another and getting the chance to talk to each other. It really energizes my teaching and gives me new ideas.

Spring 2018—Cohort 1 (Scientist Identity/ Book club for "Whistling Vivaldi")

The meetings engaged me in active learning related to its goals.

I plan to incorporate the scientist spotlights into my courses in some way. I have many ideas, such as posters of scientists that rotate as I change topics, a screen that continuously rolls through videos of scientists, and somehow making links to my current career project.

I gained some new ideas that I am excited to incorporate into my online teaching environment that I hope will allow my students to increase their science identity.

Listening to others' ideas and thinking of ways to implement them in my classes/program.

I will describe a more diverse array of researchers when I introduce various topics of discussion. I will add an assignment where students must interview scientists, including questions about the process by which the researcher came into the field. I will have students share their results with each other.

I'm looking at adding some of the recommendations from the book to help my students succeed in my class so that they can get where they want to be in school and employment.

As a result of this series I have been adjusting my responses on student assignments to provide more substantive feedback and advice on how to improve answers. I've also been trying to improve departmental displays to be more inclusive of underrepresented populations by displaying student research and providing information regarding interdisciplinary student groups and activities. I also had a nice conversation with my VP about these issues and what we are doing in our department to increase participation, and the success(es) and difficulties we have had. I also shared the book with our VP and assistant chair.

Fall 2017-Cohort 2 (Included asynchronous and synchronous as part of the PD)

The asynchronous work pushed me to think about how I was going to use the tools being provided. Too often we are given 'tools' but never really implement them because we are too busy or too focused on other things. These assignments forced me (in a good way) to try to use these tools or at bare minimum think about how I would

I am very happy with all the new resources provided by everyone involved. Specific exercises that work to include diversity among scientists. We've been given many resources I'd like to know what works, I want my students to see themselves as scientists.

The combination of asynchronous and synchronous work is a great format. The asynchronous work made me prepare for a productive synchronous meeting.

The space to talk and reflect on my own teaching practices as well as being able to share my ideas and get feedback about my ideas from other instructors in my field

I thought the assigned readings and resources for the asynchronous work were really well-chosen; some of the early resources were things I knew about but they were excellent, accessible introductions to a variety of strategies

Information rich resources. The posters and PowerPoints were made to be short and dense and very practical. I know I will go back to them again and again

I really liked that material had been pre-picked for us. Such great resources. There is so much information out there and one gets lost (and loses so much time) when starting from scratch to find info.

For me, part of what has been so valuable about SAGE 2YC is having an opportunity to build relationships with other 2YC faculty

Summary

The CAs began the project at different starting points, with several having backgrounds in prior PD projects (e.g., *On the Cutting Edge*), and some having little experience with working with others in a targeted and collaborative way. These differences in starting points influenced how CAs began the project but as time went on, the CAs engaged in different ways, at different paces, and to somewhat different ends. All engaged at some level with collaborative and active learning strategies via the team-based structure of the project, with the PD sessions providing examples that the CAs could use with their students. A network of CoPs was nurtured throughout the project, with data from CAs confirming the merits of their engagement in community. CAs from both cohort 1 and 2 reported CoP behaviors at a higher frequency than the *2016 National Geoscience Faculty Survey*.

Bringing together cohort 1 and 2 CAs through the virtual activities in 2018-2019 provided a forum for broadening the SAGE 2YC network, focusing on topics of interest to their local context and using the format of book clubs, journal clubs or implementation groups (see Table 4.6).

Table 4-6: Topics of Interest to Local Contexts

Virtual Activity	Number participating from Cohort 1	Number participating from Cohort 2
Working for Change at the Program and Institutional Level	6	4
Supporting Transfer	2	2
Fostering a Sense of Belonging	6	5
Revising a Historical Geology Course	10	2

The final culminating workshops provided the opportunity for virtual relationships to deepen among CAs. The ability to learn with peers helped strengthen the PD process (see the SAGE 2YC Network, Section 12 to visualize changes in connections among cohort 1 and 2 between 2018 and 2019).

Also embedded throughout the PD was a leadership development focus (see Faculty Change Leadership, Section 7 on this aspect of the PD model). The cultivation of faculty leadership was evident in the increased confidence that the CAs gained in their abilities, addressing the imposter syndrome that many felt at the beginning of the project. When asked about how knowing about their leadership orientation would influence them In the future, one cohort 2 CA commented: *The most striking moment was being in the same-frame group (in the workshop activity) and asking each other "What do you mean there are other solutions?", then hearing from the other groups and seeing the dramatically different approaches. It's given me some clarity on what I see/look for and what I don't think about. IF I can remember to ask myself about my colleague's frames AND design strategies that incorporate all frames, I think I will be more successful. This helps me understand the source of many barriers in group efforts."* This example shows how CAs saw themselves as better prepared to take on new leadership roles as some CAs did during the project, including CAs becoming department chair, accreditation lead, chair of campus committees, leader of campus teaching and learning, etc.

5. THE FACULTY CHANGE AGENTS (COHORTS 1 & 2)

In the SAGE 2YC project, the CAs are 2YC faculty who teach geoscience (e.g., geology, meteorology, oceanography, and physical geography) or another STEM area that is aligned within their campus unit (e.g., chemistry). With the goals of increasing students' academic success, broadening participation, and enhancing transfer and career pathways, the CAs are encouraged to engage in "anchoring practices" (see again Section 2 on the Theory of Change) that include time to "meet, discuss, plan, and practice" "reflect," and "iterate" on their own practice and in association with other faculty and staff on their campuses, as well as their geographic region. The CAs are supported in improving their instructional practices, using course-level student outcomes data, and working to strengthen their program and develop new leadership skills. These changes may also be adapted by other faculty on their own campuses and on other campuses in the same geographic region of the country.

This section addresses the following questions about CAs in cohorts 1 and 2:

- How was each cohort selected?
- Who are the change agents/change agent teams?
- What experiences and expectations do they bring to the project?

Findings to these questions reflect areas in the theory of change, and also provide a baseline for observations later in this report about CA growth during their participation of the SAGE 2YC project.

METHODS

This section reports on results of qualitative interviews conducted by the ERI team to document how the CAs' initial beliefs, values, and perspectives, as well as their different backgrounds, professional profiles, institutional engagements, and classroom teaching experiences influenced changes in practice over the the SAGE 2YC project. During year one, the ERI team conducted telephone interviews using a faculty-centered lens to understand changes courses, departments, institutions, and disciplines as the CAs starting on their SAGE 2YC journey. Operating individually but also as part of a team within designated cohorts, the intentional structure of the project provided support for CAs working to change practices in their classrooms and departments, on their campuses, and also at other colleges in their region. The website maintained by SERC coupled with correspondence between the PIs and ERI team was used to track personnel changes in CA teams.

In addition to the initial telephone interviews, individual interviews with the CAs were conducted by the ERI team in years one and three to delve more deeply into how practices were changing, how the CAs understood geoscience education was changing in their colleges, and what it meant to them to participate in the SAGE 2YC project. For cohort 1, these baseline data were gathered before the first face-to-face workshop in 2016; for cohort 2, these interviews were conducted before the first in-person, virtual workshop in 2018.

CAs by Cohort

The two cohorts recruited and selected during the main four years of the SAGE 2YC grant include a total of 36 CAs in 17 teams. Table 5-1 summarizes the CAs at the conclusion of the grant in summer 2019 when the final PD workshop was held. Except in one case where attrition early in the grant resulted in a team having one CA in cohort 1, all other teams had two or three members, mostly two (see Table 5.1 for the states where the 17 teams are located). The project experienced a modest amount of turnover of faculty CAs. In cohort 1, five CAs from three teams left the project, with four new CAs replacing them. In cohort 2, eight CA's from four teams left the project, with two new CAs joining. Three of the departing cohort 2 CAs came from a single team, eliminating that location from the project.

Table 5-1: Summary of Faculty Change Agents, Teams, Colleges, and States

Cohort	Number of Faculty Change Agent Teams	Number of Faculty Change Agents	Number of 2YCs	Number of States
1	11	23	17	9
2	6	13	8	5
Total	17	36	24[1]	12[2]

Note: [1]One 2YC has a faculty CA team in both cohorts. [2]Three states have faculty CA teams in both cohorts.

Selection of the Faculty CAs and Initial Professional Engagement

The SAGE 2YC project sought to develop "a national community of practice of 2YC geoscience faculty who will increase their knowledge of and ability to apply evidence-based instructional practices" and to this end, qualitative data revealed important information about the two cohorts. We delve into findings for each cohort below.

Cohort 1

At the start of the project, nearly all (21 of 24) of the first CA cohort stated that they had had some involvement with previous PD, either through national professional association meetings (e.g., GSA, AGU, IAGD, NASA, COSEE), regional meetings (e.g., NAGT), or other workshops (e.g., previous SAGE 2YC, *On the Cutting Edge*). Just over half of cohort 1 had led one or two workshops locally or at professional meetings prior to SAGE 2YC. As a result, cohort 1 came into the project having participated in disciplinary PD, with many having led a workshop. Nineteen of 24 of the first cohort identified a leading role that they had taken in a past workshop aimed at improving instructional practices.

Cohort 2

The second cohort was selected after publicizing the SAGE 2YC project through various geoscience lists (e.g., an email list of ~ 600 members composed of mainly geoscience community college faculty, a list of faculty who had participated past SAGE 2YC workshops, the NAGT GEO2YC division), and other relevant announcement mechanisms of professional organizations (e.g., American Meteorological Society, Center for Ocean Sciences Education Excellence), as well as targeted invitations to other 2YC faculty members. Completed applications were received from seven team, including 18 faculty from nine colleges, and all were accepted.

Faculty CA Teams

As noted most CAs were members of teams comprised of two or three members, mostly two. The teams associated with each cohort are described below. (Appendix B provides a list of cohort teams by state or regional location as well as by specific 2YCs included in each team).

Cohort 1

Cohort 1 is composed of 11 teams: a total of three teams in California (two teams in Southern California and one in Northern California), and one team each in Florida, Illinois, New York, North Carolina, Oregon, Texas, Virginia, and Wisconsin. Most team members in cohort 1 already knew each other before joining the SAGE 2YC project having had prior collegial connections or acquaintance in past professional activities. However, some CAs in cohort 1 became acquainted when they decided to apply together as a regional team, and in these cases, SAGE 2YC acted as the vehicle to establish new professional connections. In terms of relationships within teams, most team members operated as peer companions on equal footing but a few teams functioned in mentor-mentee relationships wherein one team member who had more experience with SAGE 2YC (or a similar PD project) provided guidance and support for other team members. .

Cohort 2

Cohort 2 consisted of six teams: Washington, D.C. metropolitan area, Massachusetts, Michigan, Oregon, and Southern California. These CAs did not have as many prior collegial connections as cohort 1. Nevertheless, many were connected to other 2YCs and 4YCs in their regions through a variety of initiatives. These connections included improving transfer and articulation agreements and helping students from rural areas to access college. Two teams reported that their institutions had connections to cohort 1 teams: one from the same institution and one in the same geographic region. Some had been in contact with the SAGE 2YC PIs or cohort 1 CAs through interactions in the same professional societies or other PD in the geoscience community.

Geographic Location of CA Teams

Figure 5.1 shows the location of the CA teams by state and cohort ("1" in dark green, "2" in yellow, and both "1 and 2" in pale blue). Seven CA teams (four with cohort 1 and three with cohort 2) are located on the west coast, and four cohort 1 teams and two cohort 2 teams are situated on the east coast. The middle of the country also has four teams, three cohort 1 teams in Illinois, Texas and Michigan, and one cohort 2 team in Michigan. Also evident in the map is that some states have more than one team in cohort 1 and/or 2, and some states have only one team in either cohort 1 or 2. The map also reveals regions of the country without teams including a large swath of states in the Great Plains and Rocky Mountain regions of the country.

Figure 5-1: United States Map Showing States having One or More Faculty CA Cohorts

State with Cohort 1 team

State with Cohort 2 team

State with Cohort 1 and 2 teams
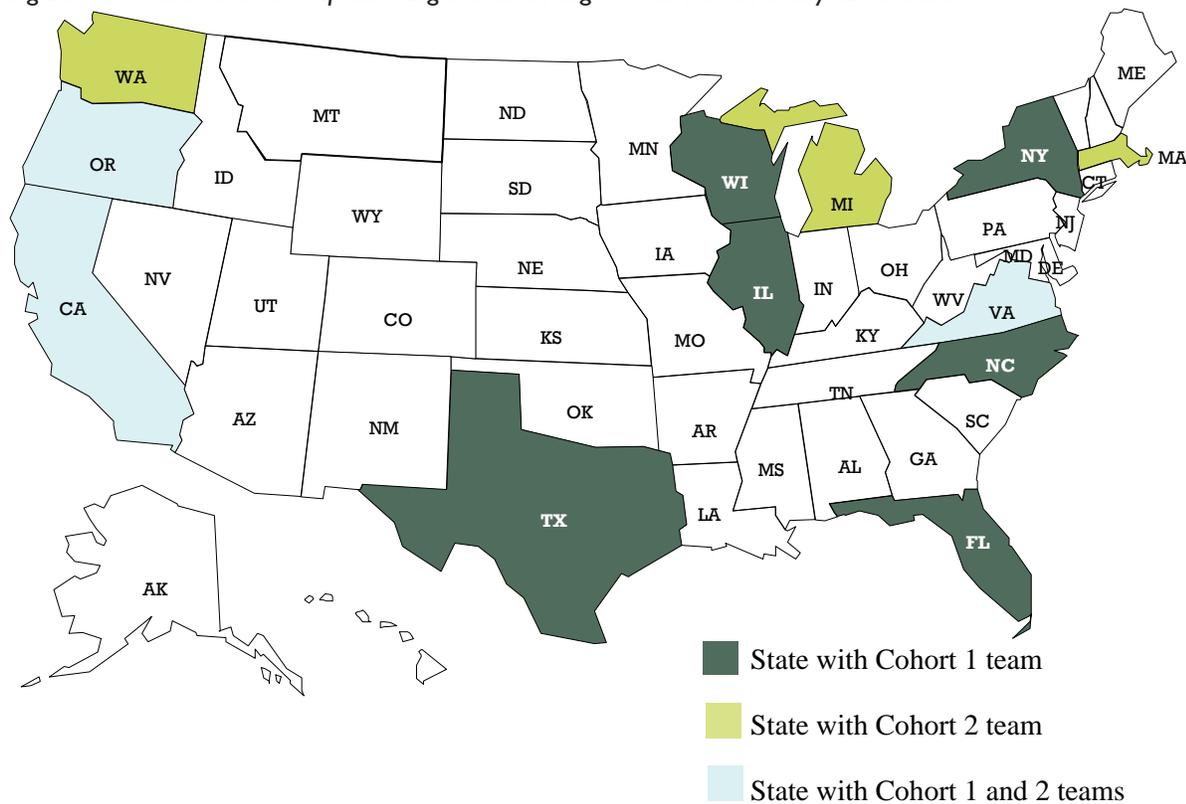
THE FACULTY CHANGE AGENTS AT THE BEGINNING OF THE PROJECT: TEACHING PRACTICES, INSTITUTIONAL CONTEXTS, AND EXPECTATIONS

Cohort 1

Our analysis found that CAs from cohort 1 used a range of pedagogical approaches from the start of the SAGE 2YC project, with teacher-centered practices dominating their teaching practice. Specifically, a higher percentage of cohort 1 CAs devoted class time to lecture, with a smaller percentage using student-centered practices more extensively than lecture (also see Section 6, on *What and How Change Agents Change* for results on the RTOP). All CAs espoused a commitment to teaching and student learning, but some lacked knowledge in active learning approaches with their students. More years in teaching often created higher levels of comfort in the classroom but did not translate into using student-centered practices.

Most CAs reported that they knew their students well, with many describing various academic challenges their students face (e.g., quantitative skills, writing, or use of data). Most CAs sought to convey a passion for geoscience to their students through their active engagement in the classroom. Many expressed a general desire to help their students persevere by helping them to learn strategies to move forward in geoscience or other STEM disciplines. Some CAs stated they saw connections between broadening participation and pedagogical practice, and some reported they had a systematic way to look at student performance broken out by demographic sub-groups. The quality of transfer and articulation arrangements varied across CA institutions, with some reporting using strategies to support students' professional pathways, such as cooperation with other STEM areas to form pathways, along

with other strategies. These include sharing stories of professionals having a diversity of demographic backgrounds and experiences with students, alums working in related careers, partnerships within institutions with departments, such as career services; and relationships with geoscience 4YCU faculty in the region.

Cohort 2

The initial data collection about changing practices involved six teams, including 8 of 14 faculty had participated in disciplinary PD prior to SAGE 2YC. In their initial interviews, the cohort 2 CAs described using a spectrum of teaching practices ranging from traditional lecture to more active learning strategies such as small group in-class activities, gallery walks, or think-pair-share. These CA teams came with specific plans, such as developing new courses and building curriculum, redesigning labs, and implementing a quantitative literacy initiative.

Also, most cohort 2 CAs reported on specific supports their institution provided for students but they described themselves as lacking knowledgeable about strategies they could employ to broaden participation or facilitate transfer and career pathways. Several of these CAs expressed interest in working with specific student demographics, such as underserved students, English language learners, women, and those from rural backgrounds. Our analysis suggests there faculty perspectives were stated more explicitly among the cohort 2 CAs than the cohort 1 CAs, possibly creating a potential difference in intentions and engagement in SAGE 2YC between the two groups.

Summary

As noted above, we found some differences in the two cohorts in terms of their experience with PD strategies advocated by SAGE 2YC as well as the intended uses of what the CAs learned in the project, but we also found common themes. In looking at the qualitative results for both cohorts we find three themes transcend cohort 1 and 2 CA, reflecting the CAs' experiences with teaching, institutional context, and self-expectations, as well as their aspirations to change.

Teaching

- Utilizing a range of teaching strategies
- Leveraging their own experiences as learners to design classrooms suitable for learners
- Always looking for ways to improve their teaching
- Have established ways to work with students through learning materials and assessments, such as providing immediate feedback and collecting summative assessment through various ways
- Many acknowledging the lack of knowledge of educational assessment and how to use and understand student outcomes data

Institutional context

- Serving as the only or one of the few full-time faculty with no disciplinary colleagues or with several adjunct faculty
- Being away from the main campus and other science faculty and often located on the satellite campus
- Less familiar with or lack institutional resources in student services such as tutors specific for geoscience and writing

- Little interaction with administrative units or functions outside of geoscience

- Submitting data to meet requirements yet do not have access to data or receive feedback on how data are being used

- Struggling with program size compared to other sciences and fewer students interested in geoscience

- Focusing on greater science literacy or quantitative reasoning to support students in their experiences at community colleges and possibly advance to science majors

CA expectations for themselves

- Finding time in busy schedules to learn

- Excited to try ideas they have heard of or new to them and to improve their teaching

- Hoping to use this opportunity to address issues at the programmatic level

6. WHAT AND HOW CHANGE AGENTS CHANGE

The SAGE 2YC theory of change provides a framework to examine how faculty learn in ways that support change, what they change, and how they make change happen in themselves as individuals and as change agents leading through practice.

 The questions this section addresses are:

- What changes in terms of practices and associated attitudes/efficacy surrounding those practices do CAs make in their teaching and courses, programs, and institutions over the time of the SAGE 2YC grant?

- How do CAs attribute and report these adjustments in relation to the SAGE 2YC program?

METHODS

This section reports on data collected from CA or reported by CAs across the years of the project. The methods include:

Reformed Teacher Observation Protocol (RTOP; MacIsaac & Falconer, 2002)**:** This protocol was used to conduct classroom visits for cohort 1 CAs in 2016 and then again 2018-2019 by observers trained by the *NSF-funded Cutting Edge Classroom Observation* project, including the *SAGE 2YC* internal evaluator. The *Reformed Teaching Observation Protocol (RTOP)* was developed by the NSF-funded *Arizona Collaborative for Excellence in the Preparation of Teachers* (ACEPT) as an observation instrument to provide a standardized means for detecting the degree to which K-20 classroom instruction in mathematics or science is reformed. The 25 items included in RTOP are divided equally into five categories: 1) Lesson Design and Implementation, 2) Content: Propositional Pedagogic Knowledge, 3) Content: Procedural Pedagogic Knowledge, 4) Classroom Culture: Communicative Interactions, and 5) Classroom Culture. Originally conceived as a tool to improve science and mathematics instruction of pre-service teachers, the RTOP developers did not assume that reformed teaching is necessarily quality instruction. Rather, they suggested the RTOP should be tested across various instructional settings to determine whether changes in instruction are associated with changes in quality (as measured in various ways including student learning). Additional information about RTOP is available at:
http://physicsed.buffalostate.edu/AZTEC/RTOP/RTOP_full/about_RTOP.html.

Educational Practices Inventory (EPI): The EPI survey was developed jointly by members of the ERI team and other members of the project leadership team. This survey was administered to CAs early in their project involvement and then again in the spring of 2019. The EPI measures the self-reported individual practices related to success for all students, information sharing, and engagement in a CoP (Wenger, 2011). Teaching practices are reported on a frequency scale: nearly every session, *weekly, several times a term, once or twice a term, or never.* Classroom strategies are reported on a frequency scale: *all or nearly all of my courses, some of my courses, rarely, or never.* Information sharing strategies are reported on a scale related to the numbers of students who received the information: *I told all of my students in my courses, I told some of the students in my courses, I didn't tell students in my courses about these, I had no information to share on this topic.* Student support strategies were reported as present (yes), absent (no), or not applicable. The CoP items report to what extent the individual perceives belonging, followed by a number of open-ended questions relating to the composition, defining goals, ways of interacting, and potential impediments related to the CoP.

Geoscience Department/Program Practices Inventory (DPI)**:** The DPI survey was developed jointly by members of the ERI Team and the project leadership team, with the intention of using these data for the project evaluation and also as a roadmap for CAs to adopt evidence-based practices in their action plans and self-assessments. It was designed to help characterize and trace the evolution of departmental/program practices and reflect on what CAs' departments or programs had been doing and what they might do in the future. Some items in the DPI were influenced by the PULSE (Partnership for Undergraduate Life Sciences Education) Vision and Change Rubrics 2.0 (2016). Items in the DPI are aligned with reporting practices and behaviors in support of the three strands of the project: supporting student success, broadening participation, and facilitating career and transfer pathways. This survey was administered to CAs early in their project involvement and then again in Spring 2019, just prior to the culminating workshop in June 2019. The two DPI administrations are not comparable as a pre- and post-measure.

In terms of how the DPI survey was completed, we found variability in how the cohort 1 CAs consulted with others in their department/program for the initial DPI responses but greater emphasis on seeking department program input in the subsequent administration. For cohort 2, the initial DPI was integral to the virtual PD activities, whereas the subsequent administration was independent of the PD activities. Results of the DPI reveal scaled responses on adoption saturation in a department or program, with the project interpretation indicated in parenthesis using the following scale: *None of the faculty (absent), A few faculty (beginning), Some faculty members (developing), A majority of faculty members (accomplished), and Nearly all faculty members (exemplary).*

Interviews and focus groups: The ERI team conducted interviews with CAs at the start of the project, in lightning interviews at workshops in 2017 and 2018, and through individual interviews during site visits. Focus group interviews were conducted as part of in-person workshops.

CA team action plans: Action plans were developed using a project template and revised by CA teams throughout their involvement in the project.

PD artifacts and surveys: As part of the virtual and in-person surveys were administered to ascertain CAs' perception of their PD experience. In addition, PD activities included artifacts such as CA produced posters, presentations, and other activities, such as gallery walks.

Site visits: Site visits were conducted for a purposive sample of CA teams. During the site visits, classroom observations were conducted, administrators were interviewed individually, and in many cases, student focus groups were conducted.

CHANGES TO TEACHING AND LEARNING PRACTICES

The first PD activities included workshop and virtual sessions across all three project themes but particularly focused on instructional practices that fostered an active exchange of ideas. Changes in practices were measured through analysis of action plans, surveys, and independent observations of teaching. In cohort 1 action plans in the initial and second years of SAGE 2YC, CAs reported making changes primarily to their own instructional practices. Many CA teams wrote into their action plans a range of strategies discussed during CA PD activities. These action plans focus on instructional practices that were found to align closely with CA reported changes and ERI-team observed changes. Initial and repeated observations of teaching practices were collected from the majority of the cohort 1 CAs using the RTOP. The difference in RTOP scores between the initial and later observations for many of the CAs

corroborate changes in instructional practice that they self-reported in later surveys and interviews (see Figure 6.1).

Delving into RTOP results, initial observations conducted during the first year of the project in 2016 showed eight faculty CAs with practices dominated by teacher-centered lecture practices (scores below 30), 10 using transitional practices that integrated some aspects of active lecture strategies (31 to 49), and two employing student-centered practices that include extensive use of active learning pedagogies (50 or above).

Observations conducted toward the end of the grant during the 2018-2019 academic year involved 16 of 19 faculty CAs, omitting four faculty who were not able to be scheduled for the second, later observation. RTOP results on the second observation revealed higher scores than in 2016 for most CAs, in some cases substantially higher scores reflecting movement toward student-centered instruction. Of the 16 faculty CAs observed, only two remained in the teacher-centered range. Also, one other faculty CA who showed a decline in student-centered instruction had communicated prior to the RTOP observation that the session observed was planned as a review lecture prior to examination, raising questions about the timing of this observation.

Changes in teaching practice were also measured through EPI survey responses that measured self-reported individual practices related to success for all students, information sharing, and engagement in a CoP. The EPI was administered to cohort 1 at the end of 2016 and at the beginning of 2019, and cohort 2 in the fall of 2017 and again in 2019. Data from the forced-choice questions were analyzed using descriptive statistics, on the average responses, by cohort.

Figure 6-1: Differences Between Initial and Later RTOP Observations for Cohort 1

RTOP Scores from **initial** to **final**
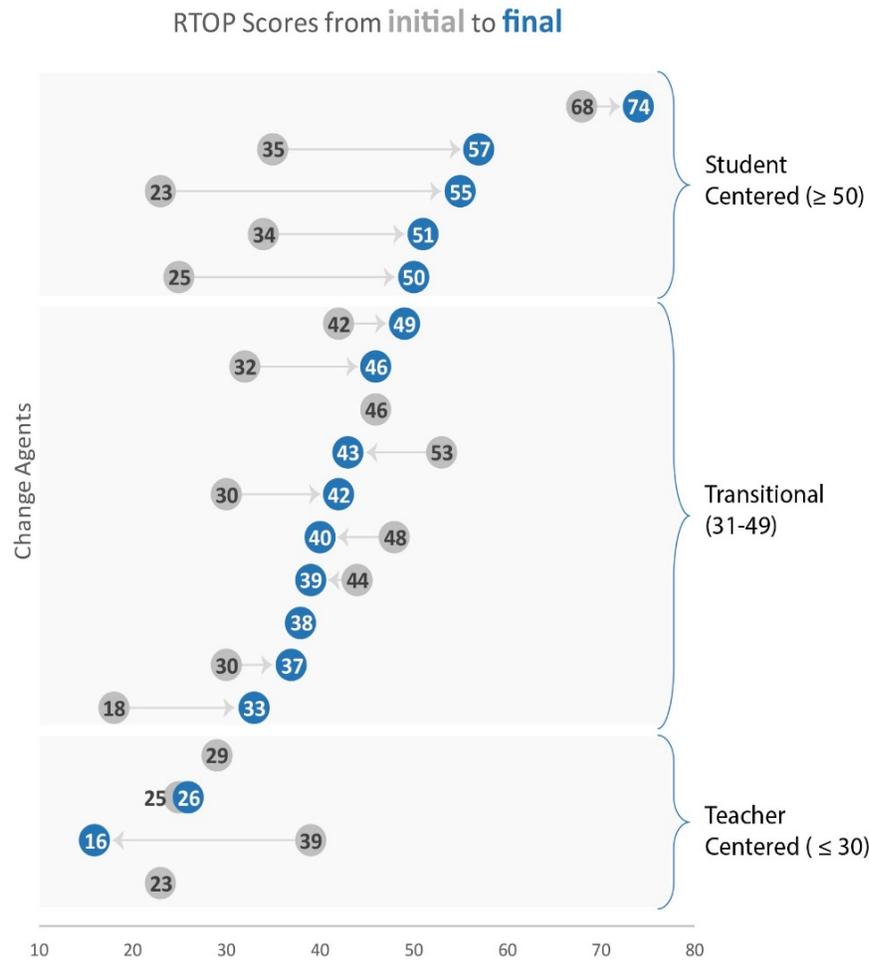
Responses to the EPI underscore the pedagogical changes made during SAGE 2YC, with CAs from both cohorts more frequently reporting implementing active pedagogy compared to other student success strategies. It is also noteworthy that the CAs' responses to the EPI aligned with RTOP sub-categories related to student-to-student interactions, student-to-instructor interactions, inquiry-learning, cooperative learning, and metacognition. Figures 6.2 through 6.5 show these responses with the top box presenting results for cohort 1 in 2016 and again in 2018-2019, and the bottom box showing results for cohort 2. The stacked bars represent the aggregate percentage of faculty CAs by frequency of implementing the educational practices, using the scale of no response, never, 1-2 times per term, several times per term, and every session. The figures show bars associated with educational practices most fully implemented toward the left of the graph and less frequently implemented toward the right of the graph.

Responses to the EPI reveal lecture is consistently reported by CAs to be used for instructional delivery. Yet, it also shows that CAs more frequently report implementing active pedagogy and self-efficacy strategies than strategies related to relevance (e.g., connect to geoscience careers) or strategies associated with virtual availability. Interestingly, there was some decline in the percentage of cohort 2 faculty CAs on self-efficacy and relevance strategies, though this group is small (n=9) so very modest changes can give the appearance of major change. Also, the cohort 2 faculty who responded to the EPI were different between the two administrations.

Figure 6-2: Cohort 1 Faculty CA Responses on EPI Items Pertaining to Student Success (response rate range of n=21 to n=23)

Support Academic Success of All Students
How frequently you incorporated the following strategies within the course(s) that you taught last year.
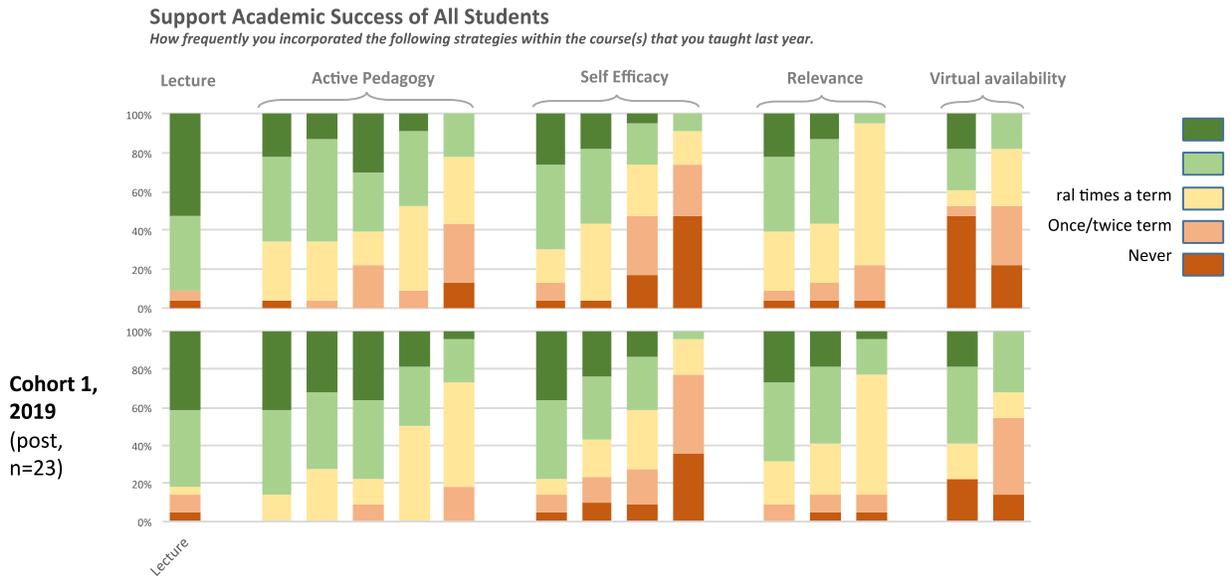
Figure 6-3: Cohort 2 Faculty CA Responses on EPI Items Pertaining to Student Success (responses rate range of n=9 to n=11)

Support Academic Success of All Students
How frequently you incorporated the following strategies within the course(s) that you taught last year.

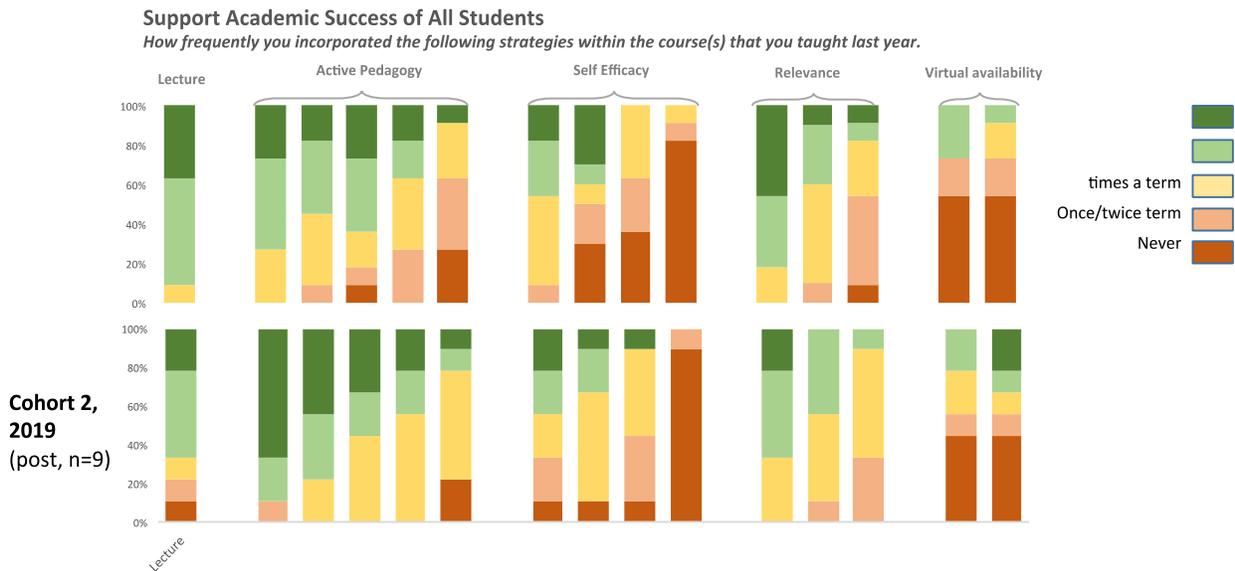*Figure 6-4: Cohort 1 Faculty CA Responses on EPI Items Pertaining to Teaching Strategies*
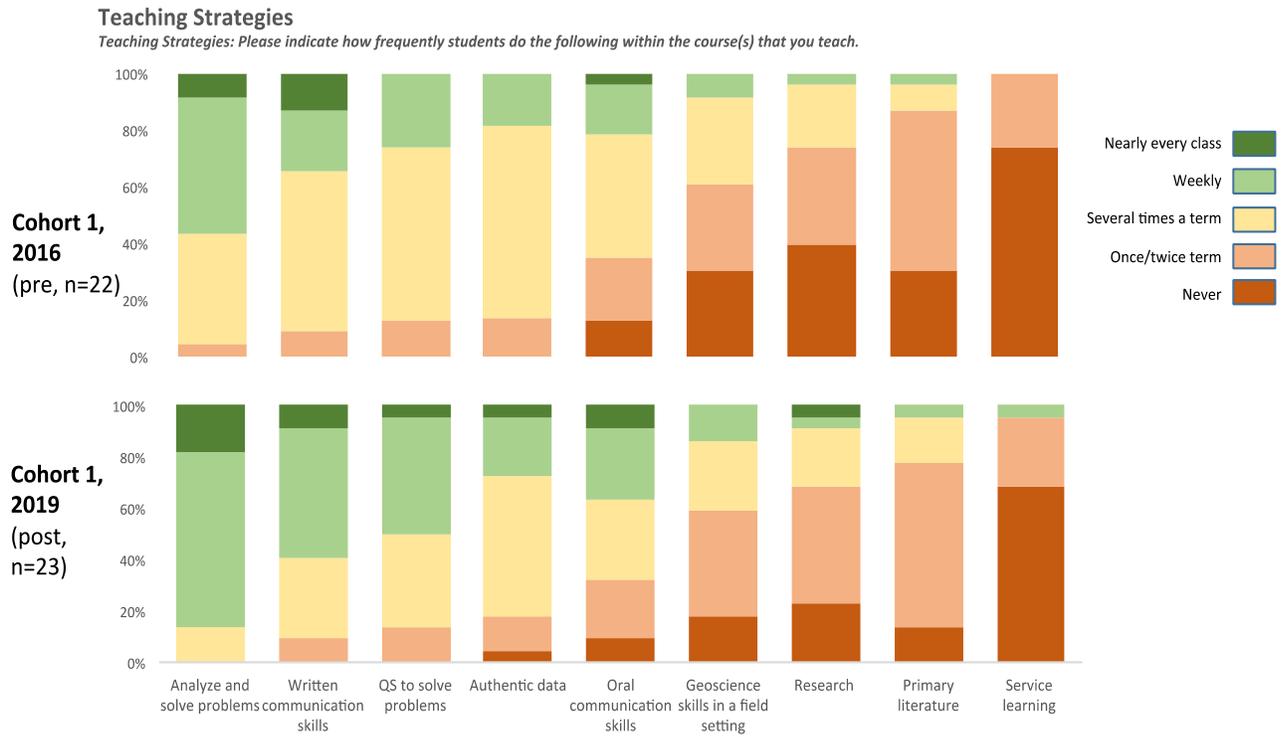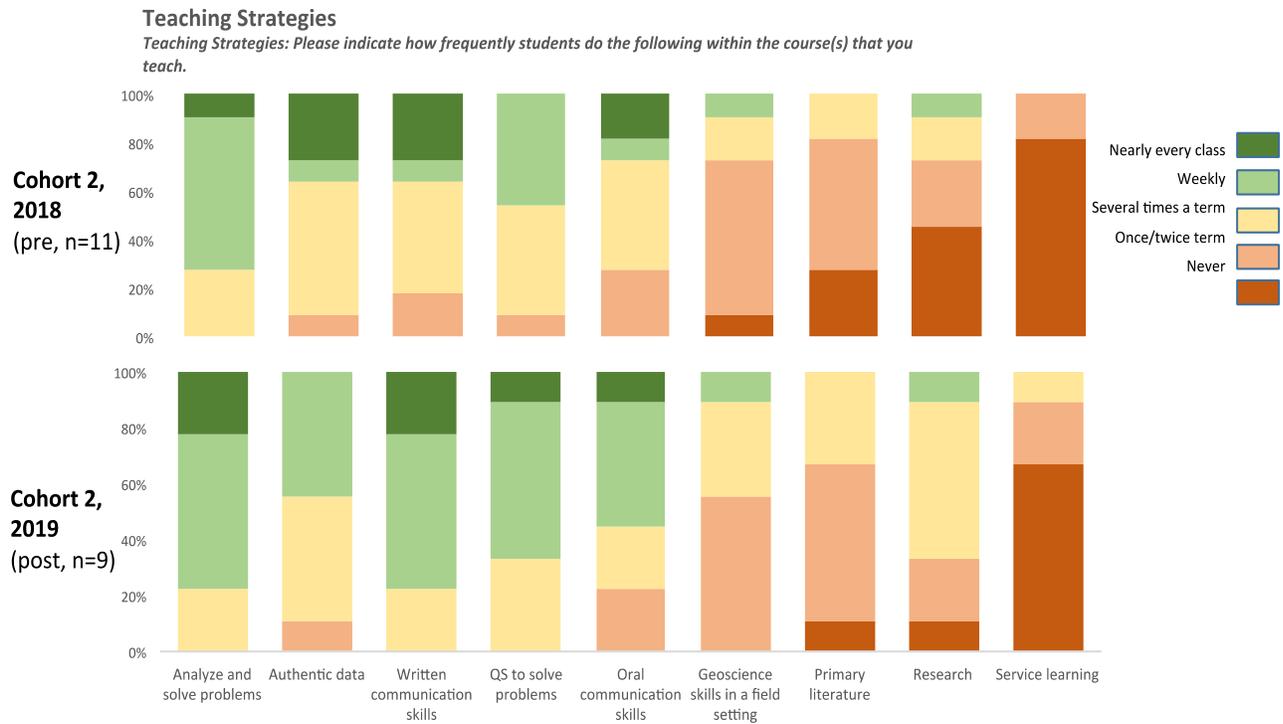

Figure 6-5: Cohort 2 Faculty CA Responses on EPI Items Pertaining to Teaching Strategies

CAs also reported more frequent use of teaching strategies related to supporting student learning such as problem-solving, writing, quantitative skills related to problems, and the use of authentic data (see again EPI responses shown in Figures 6.4 and 6.5). These changes in frequency of teaching strategies correspond to areas of focus that CAs described as academic challenges during their initial interviews.

Using Data

At the beginning of their SAGE 2YC experience, a few CAs reported during interviews that they had previous experience using data to inform changes to practice, primarily through experience with the student learning outcomes assessment implemented at their institution. The project aimed to build a spirit of inquiry in the CAs, including using the PD to build CA capacity to use data to inform practices. When asked during the culminating June 2019 end of workshop survey how the CAs used data (if at all) to inform changes they made to improve practices, the majority of respondents (25 of 33) stated at least one way that they used data to inform their practices, with a larger percentage of the smaller cohort 2 CAs reporting on at least one type of use. To supplement these survey findings, qualitative responses were coded as to whether the CAs reported using data to inform practices and if so, by themes describing how those practices were data-informed. Specifically, eight of 15 cohort 1 CAs and 9 of 10 cohort 2 CAs who responded to the survey stated that they used some form of data to improve their practices. Nearly all of the total group of CAs (23 of 25) who reported that they used data, stated they used data to inform their teaching, including comparing exam scores and retention numbers between years, collecting short informal feedback from students, or assessing student learning outcomes data to see whether changes they made in their teaching were making a difference in ways they envisioned. In addition, nearly half of these CAs (12 of 25; 7 from cohort 1 and 5 from cohort 2) described how data helped them in evaluating broadening participation practices and reported on data strategies such as assessing success rates by demographic groups and comparing trends in enrollment by demographics across their department. A few also described ways they used data in advising students or reported on ways they used data to support faculty learning circles or connecting with institutional initiatives such as "Guided Pathways for Success" (Bailey, 2015).

The following quotes from interviews and the culminating workshop survey illustrate the range of CAs' perspectives on using data to inform their practices.

> I feel like cohort 1 CAs might have a more robust answer for this question, but that I am only getting started using institutional data sources. It's certainly rich and deep, a powerful potential tool.

> Data we've been asked to (and also data I've been collecting on my own from students) have been huge in informing changes to my teaching practices. It may be the biggest driver to some changes, such as strategies supporting the whole student and self-efficacy.

> This is an aspect of this project that I want to do more often and more effectively. Other than grades, and the overall data I can get from IR, I don't have any specific data that I look at in a systematic way to make changes.

> My new department is barely established but I kinda semi-volunteered for a new assessment program that will include several things that we're going over here [in Madison] with SAGE 2YC. I thought, you could turn it down, but I've already done all this work on it… It's a risky thing but I'm excited.

> Our campus does not put very much in the way of resources into supporting that aspect of our work [using data to inform teaching]. We haven't had very good faculty development

opportunities centered on assessment. We haven't had good guidance in doing that kind of work. There's very little support for closing the assessment loop. People overall are very frustrated with it.

We are getting to analyze data, so that's the one thing I think, because of getting to do the data side on this [the SAGE 2YC project] I wanted to do more and we had to say why we were here and what we hoped to get out of it and I said because I have been working with data for a few years and am no longer chair . . . I still want to have data in my life.

The data was very important to me. My student comments are always good to excellent but after looking at data (granted, for only two semesters) the success rate was surprisingly low so I have and will still make changes to increase that for all student.

In addition to individual CA practices, the project also developed and administered the DPI survey. In the DPI results from 2019, nearly all CAs indicated their program had at least some faculty members involved in analyzing success data across all classes in their department or program (see Table 6.6). cohort 1 CA responses indicated the following range of involvement by faculty members in their department/program: some faculty members (developing: 35%, n=3), a majority of faculty members (accomplished: 55%, n=5), and nearly all faculty members (exemplar: 10%, n=1). Cohort 2 CA results on the scaled responses were distributed as follows: a few faculty members from department/program involved (beginning: 20%, n=1), some faculty members involved (developing: 40%, n=2), or a majority of faculty involved (accomplished: 20%, n=1) in this practice. Analysis of responses about disaggregated data on retention and student success for student sub-groups showed all of cohort 1 CAs were beginning, developing, or accomplished, and all of cohort 2 CAs were developing or accomplished.

Figure 6-6: Cohort 1 (n=9 departments/programs) and Cohort 2 (n=5 departments/programs) Faculty CA Responses on DPI Items Pertaining to Department or Programmatic Student Success Strategies
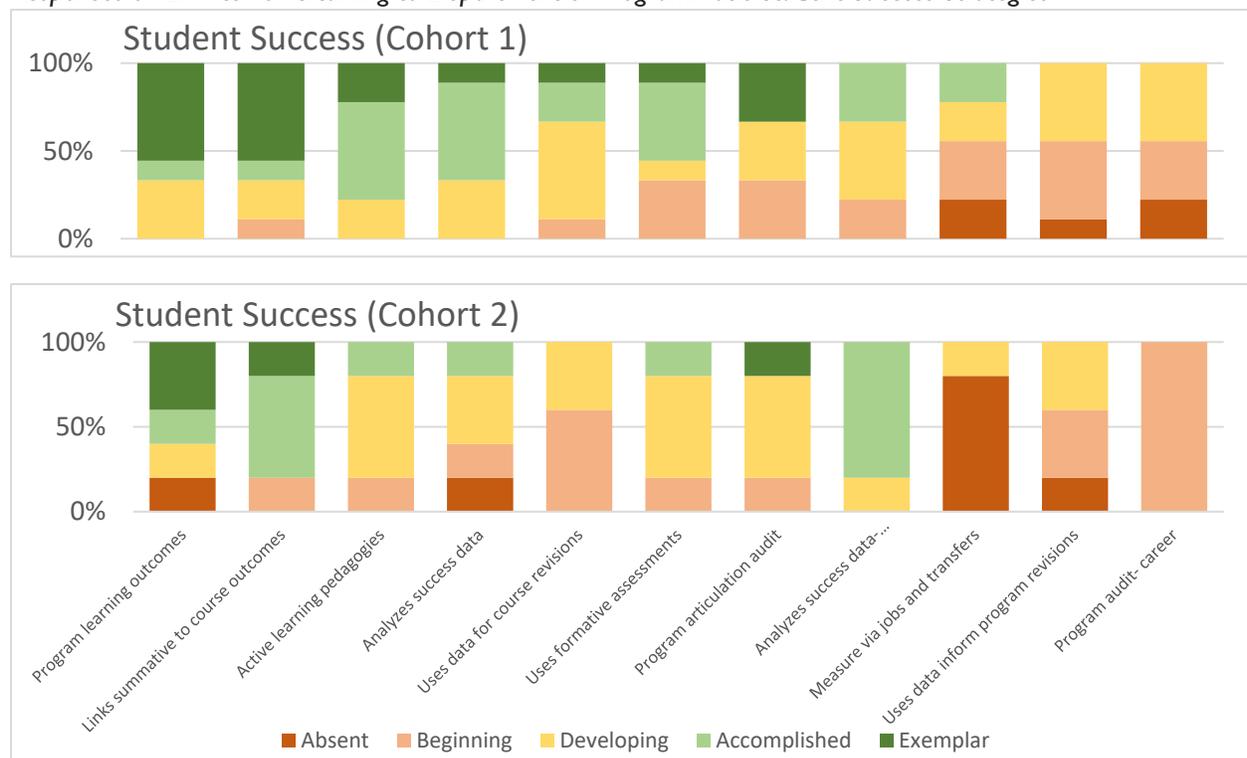
CURRICULAR OR PROGRAMMATIC CHANGE

CAs reported in the June 2019 end-of-workshop survey that they adjusted their instructional practices in response to what they learned from SAGE 2YC PD activities, the ideas exchanged with their fellow CAs, and the data they collected on students' outcomes. Many of the CAs end-of-workshop survey responses indicated that the project influenced curricular and programmatic changes at their institution, with focus and adaptations to meet the needs of institutional context. Despite specific contextual differences across CA teams, common changes at the curricular or programmatic-level emerged. First, CAs analyzed course outcomes data and what they learned from their analysis. Next, specific programmatic strategies highlighted by SAGE 2YC gained traction over the course of the project, such as highlighting diverse scientists. Through the guidance of the SAGE 2YC PIs and their college administrators, half of the teams (9 of 18) reported in their culminating workshop poster that they involved other campus offices in their efforts or explicitly connected their actions to campus initiatives. The majority of teams (12 of 18) indicated that they explicitly included contingent faculty in their change efforts. In the culminating posters some CA teams (6 of 18) reported that regional workshops were a means of spreading programmatic practices related to transfer, and some CAs teams (9 of 18) described ways they addressed career pathways through involving industry partnerships, strengthening field instruction, or including topics relevant to careers (e.g., GIS applications, geophysical techniques, ocean science careers).

The CAs' interest in analyzing disaggregated data to examine student success for underrepresented groups in geosciences courses carried through to changes they reportedly made at the course- and program-levels. Because many of the CAs' work in community colleges having departments that encompass multiple science disciplines, program-level change was defined by the SAGE 2YC project as change that was specific to the geoscience (including geology, oceanography, atmospheric science, physical geography) curricular and extra-curricular elements. CAs in both cohort 1 and 2 reported on courses as sites for change and a means of spreading evidence-based practices. The DPI survey was administered to CAs early in their SAGE 2YC involvement (cohort 1: February 2017 and cohort 2: Spring 2018) and then again in January-February 2019, prior to the June culminating workshop.

Responses of all cohort 1 CAs to the 2019 DPI survey also (see Figure 6.7) reveal their programs use geoscience courses to promote enrollment in the geosciences as follows: a few faculty (beginning: 12%), some faculty (developing: 12%), a majority of faculty (accomplished: 24%), and nearly all faculty (exemplar: 52%). Cohort 2 CAs reported their efforts as follows: a few faculty (beginning: 20%), some faculty (developing: 60%), and a majority of faculty (accomplished: 20%). Beyond the existing courses as sites for change, two CA teams worked towards developing new courses (e.g., environmental justice, oceanography) that encapsulate the strategies they learned through SAGE 2YC. These case examples follow:

> *Case example:* Elizabeth Nagy, Pasadena City College, created a four-part career project (see https://serc.carleton.edu/221450) that involves students investigating careers and interviewing geoscientists.

> *Case example:* Bryn Benford, Lone Star College-University Park, worked with an industry donor to complete the construction of a three-story geology rock wall (see https://serc.carleton.edu/220966). The wall is meant to mimic the field experience that students from other parts of the country might experience.

One CA team developed a GeoTeach CTE certificate, and other examples of curricular-level change

include evidence-based practices in an Honors program or general education curriculum. Still other CAs focused on highlighting the relevance of geoscience careers for their students, and two cases of CAs described some of their curricular changes on the SAGE 2YC website.

The highlighting of diverse scientists was included in SAGE 2YC programming beginning in 2017. In response to the end-of-workshop surveys (in 2017 for cohort 1 and in 2018 for both cohort 1 and 2) CAs described the utility and value of strategies for highlighting diverse scientists as a means of fostering a sense of belonging in students. Results of the 2019 DPI survey revealed the CAs related to their departments/programs in "*Talk[ing] about and show[ing] examples of diverse geoscientists, including underrepresented minorities and women.*" The survey asked that they indicate to what extent their department or program made that effort on a scale of 1 to 5, with 1=none of the faculty members, 2=a few faculty members, 3=a core group of faculty members, 4=a majority of faculty members, and 5=nearly all faculty members. Figure 6.7 shows results on this scale as follows: absent (1), beginning (2), developing (3), accomplished (4), and exemplar (5). In cohort 1 all departments/programs reported efforts in this area as beginning (12%), developing (52%), accomplished (12%), and exemplar (24%) and cohort 2 reported efforts as beginning (60%) or developing (40%). Two cases where CAs described their strategies for highlighting diverse scientists on the SAGE 2YC website follow:

> *Case example: Cheryl Emerson Resnick, Illinois Central College, created Just Like Me posters (see https://serc.carleton.edu/231565), showcasing a diversity of alumni who are working scientists as a means to increase students' interest in learning science as see its relevance in broader society.*

> *Case example: Andrea Bair, Delta College, uses Scientist Spotlights (see https://serc.carleton.edu/221138) including a wide variety of scientists in her courses, allowing students to then personally reflect on being a scientist and doing science.*

Figure 6-7: Cohort 1 (n=9 departments/programs) and Cohort 2 (n=5 departments/programs) Faculty CA Responses on DPI Items Pertaining to Department or Programmatic Broadening Participation Strategies
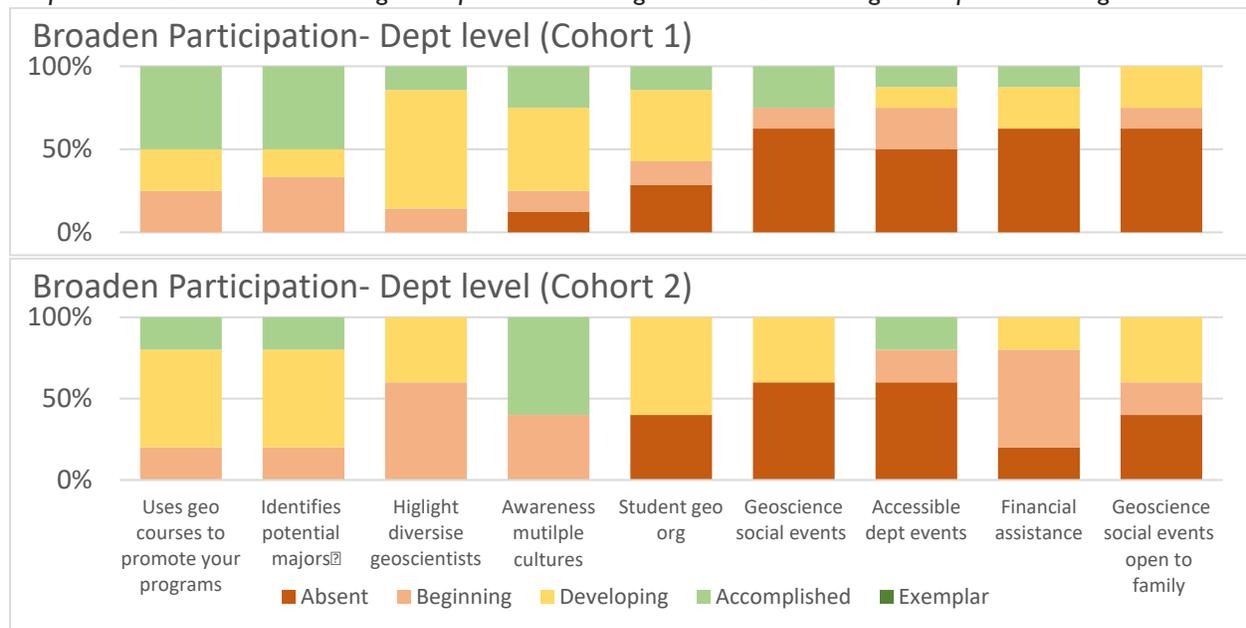
INSTITUTIONAL CHANGE

As part of the SAGE 2YC project each CA team worked with a campus administrator who could connect them to campus resources and offices that could further their programmatic action plans. CAs had varying success in working with their administrators on programmatic and curricular change. Some teams found their administrator to be a source of support and advocacy, or someone who could troubleshoot about programmatic changes; however, these experiences were not universal to all CA teams. These quotes illustrate some of the CAs' perspectives on the nature of their administrator ties.

> *One thing because of inclusion of dean is I didn't have to do arm twisting. He came. It used to be adversarial. I was always able to get into dean's office to talk to him but since his coming into the department, I see that the line is in the same boat with us. He's not throwing us a line. This isn't a huge movement to make some vast curricular changes. His mindset is no longer on the other side of the desk but he is with us. It's significant. He's got a huge division. We have felt put off to the side because of that. He doesn't like that and he's invested now.*

> *Our administrator, like she was able to say, "Okay, well these are limitations we might have or whatever." And then we could say, "Well, maybe we could work with this." And I find it nice to be able to hear the administrative point of view so that I'm not so grouchy about when they do stumped, just having that conversation helps me have a better perspective than, and that helps me look at the program in a way that might work better from both ends, the administrative and so not just they're buying but I have to buy into what their challenges are too.*

> *The Dean was open to idea, and said "let us know how we can help" but then no action taken on that offer we have learned to be our own advocate.*

> *Unlike other teams where I heard horrible experiences, man I hit the jackpot, now not only do I not have to change my administration, I can join them so I saw an opportunity to further what I was planning to do by joining up with what they are trying to do and disseminating it wider. If I had to do that totally on my own without connecting with administration, it would have been really hard and that's why having that administrators come to our workshop was so helpful.*

> *I have not really interacted much with my administrator, fifteen minutes here, this is a crisis that needs to be solved, I want to do this. And it's been very efficient*

> *. . .because of some the different administrators I have, I'm in their...Before I was just under the radar, not visible and now I am, I think...Yeah, I just got asked to participate in designing a natural science retreat for the whole natural science division and I did and it was last month. But I was on the radar, the dean was like, you'd be great for this.*

In their culminating poster, website profiles, and 2019 end-of-workshop survey responses, CAs described many ways they or their teams promoted work on their campuses. The ways the CAs partnered with campus offices aligned with SAGE 2YC grant strands but varied by context. We found no single, typical way in which the CA teams adopted strategies promoted by SAGE 2YC, but rather used the strategies they gained from the grant, as well as from CAs in their cohort, as inspiration for adaptations to their institutional context. For example, one CA team partnered with a campus STEM center to offer career pathway sessions for students, and another CA partnered with the counseling office and other departments to develop new activities for students in geoscience and STEM more broadly. Another CA

team partnered to improve mathematical and writing abilities in students, and yet other partnered with the learning and teaching center to develop a college orientation course for STEM majors and influence curricular improvements related to metacognitive strategies.

In additional examples, a few CA teams reported connecting their work with campus-wide initiatives. One CA engaged with a faculty discussion group to help develop a campus model for improving student success with explicit practices that align with SAGE 2YC strands to facilitate student success and broadening participation. Also, two CAs described becoming more active in their "Guided Pathways" initiative on campus, and other CAs reported programmatic efforts to further their work. Four different teams had existing NSF GEOPaths projects upon which they could capitalize to further their efforts related to connections with industry and 4YCU faculty, or provide authentic research or field opportunities for their students.

In addition to influencing full-time faculty on their campuses, the majority of CA teams (in their culminating posters or in a culminating workshop activity asking them to describe how the grant influenced their regional activities) described ways they included part-time or adjunct faculty. The most common strategy involved inviting these faculty to the SAGE 2YC regional workshops and other in-service PD; however, some CA teams further strengthened their outreach to part-time faculty. For example, one CA team engaged part-time faculty in curriculum development meetings and social gatherings, and another team offered a faculty learning circle for these faculty. Another CA team (which is composed of two-thirds adjuncts) developed a geology-specific orientation for new adjuncts.

SUMMARY

Over the time period of their engagement with the SAGE 2YC program CAs in both cohorts reported changes in practices. Classroom observation of cohort 1 CAs demonstrate shifts in more student-centered practices that align with what CAs from both cohorts also reported in surveys. At the end of program CAs reported on departmental/programmatic practices that align to the SAGE 2YC programming such as using their geoscience courses to promote enrollment or highlighting diverse scientists. The majority stated ways that they now used data to inform program or classroom practices. CA teams reported varying experiences with engaging administrators in connecting CA team changes with institutional change. Ultimately, we found that CA teams reported using strategies they gained from the grant and their fellow CAs as inspiration for adaptations that worked in their classrooms, programs, and institutional context.

7. FACULTY CHANGE LEADERSHIP

In the initial workshop and throughout the PD associated with SAGE 2YC, CAs were asked to reflect on their own abilities and practices as leaders. The CAs were asked about their leadership in interviews, end-of-workshop surveys, and leadership questionnaires. As the naming of participants implies, the faculty were expected to become agents of change—in their own classrooms, in their programs, on campus, in the region, and in the profession. We sought to understand how faculty leadership emerged in the project.

The questions this section addresses are:

- How do CAs perceive themselves as leaders of change over the time of the SAGE 2YC project?
- What influence do aspects of the SAGE 2YC project (e.g., administrator involvement, CoP) have on the CAs as leaders?
- How does change and innovation in leadership manifest in the CAs?
- What are the differences between cohort 1 and cohort 2 in their leadership?

METHODS

Prior to the start of the PD sessions, CAs filled out a leadership questionnaire called the *Bolman and Deal Leadership Orientation*. Question prompts that the ERI team used to query the CAs about their leadership development over time appear below to show the full range of data revealing how CA leadership changed over time. Data from selected site visits and the last two data-gathering points were also central sources of documentation of CA leadership development.

- **June 2016 cohort 1 focus groups**: Who do you plan to work with on your campus to get these proposed change to occur, and how will you work with them? Who do you plan to work with in the profession to get these proposed changes to occur, and how will you work with them?
- **June 2017 cohort 1 lightning interviews**: How do you see your work as a CA influencing others?
- **June 2017 cohort 1 end-of workshop evaluation:** At this point in the project, to what extent do you see yourself as a leader in your department? On your campus? At your institution? Has that changed since the beginning of the project?
- **June 2018 cohort 1 registration form:** At last summer's workshop, Pamela Eddy led a session about using Bolman and Deal's leadership framework, characterizing leadership in terms of structural, human resources, political, and symbolic components. Pertaining to this talk, the CAs were asked: Have you used this framework in your interactions with others on your campus this year, including your administrator(s)? If so, how?
- **June 2018 cohort 1 focus groups:** Tell us how you see your role as a change agent evolving over time.
- **June 2018 cohort 2 end-of-workshop evaluation**: Now that you know more about your leadership orientation, how will it influence your work?

- **June 2019 cohort 1 and cohort 2 registration form:** At the culminating workshop in June 2019, Pamela Eddy led a session on using Bolman and Deal's leadership framework, characterizing leadership in terms of structural, human resources, political, and symbolic components. Per this session, the CAs were asked: Have you used this framework in your interactions with others on your campus this year, including your administrator(s)? If so, how?

- **June 2019 cohort 1 and cohort 2 focus groups:** Write down an example or two of what you've changed, and what you have learned about making change on your campus.

- **June 2019 cohort 1 and cohort 2 reporting out:** What is the most important thing you have gained from the project?

- **June 2019 cohort 1 and cohort 2 end-of-workshop evaluation:** An important part of the SAGE 2YC project is leadership development. Has your perception of yourself as a leader changed over the course of the project? If so, how?

LEADERSHIP DEVELOPMENT SESSIONS

Throughout the project, several leadership development sessions were conducted in the workshops (see Table 7.1).

Table 7-1: Leadership Development Sessions

Workshop	Session Title
March 2016-Cohort 1	*Thinking About Leadership*
June 2016-Cohort 1	*Leadership: Leveraging Change Through Collocation and Networking*
June 2017-Cohort 1	*Leading Change and Bringing Others Along*
March 2018-Cohort 2	*Engaging Campus Supporters*
June 2018-Cohort 1	*Working with your Administrators*
June 2018-Cohort 2	*Working with your Colleagues and Administrators: Strategies for Leading Change*
June 2019-Cohort 1 and Cohort 2	*Leadership Development*

BOLMAN AND DEAL QUESTIONNAIRE

To measure the leadership frames of the CAs, the Bolman and Deal (1988) leadership questionnaire was administered to each cohort at the start of involvement in the project. This framework assesses the prominence of four types of leadership orientation: 1) structural leaders who emphasize rationality, analysis, logic, facts and data, 2) human resource leaders who emphasize the importance of people, 3) political leaders who believe that leaders live in a world of conflict and scarce resources, and 4) symbolic leaders who believe that their essential task is to provide vision and inspiration.

The questionnaire was first administered to 24 cohort 1 CAs in spring 2016 and to 15 cohort 2 CAs in fall 2017, and the questionnaire was administered to both cohorts a second time at the culminating workshop in June 2019 (C1=23; C2=12). The differences in numbers between those taking the questionnaires at the beginning of the project and those taking it at the end of the project reflects

changes in CA participation, with some leaving the project and others joining. This analysis is based on CAs who responded to the Bolman and Deal questionnaire near the beginning and end of the project, ensuring the same respondents were included in the analysis at the two points in time.

Table 7.2 shows the scoring levels that were used for reporting the CAs' results. The Bolman and Deal questionnaire indicates the various percentages as a means of understanding the prevalence of the scaled responses compared the general population. We show these levels of scores to document change over time and show categories in which the CAs were among the minority versus the majority.

Table 7-2: Levels Used for Scoring the CAs' Leadership Frame Orientations

Level	Bolman and Deal's Longitudinal Scoring Ranges
Strong	Only 25% of respondents rated themselves at or above the score.
Preferential	Only 50% of respondents rated themselves at or above the score.
Weak	75% of respondents rated themselves at or above the score.
Very Weak	More than 75% of respondents rated themselves at or above the score.

Cohort 1. When the Bolman and Deal instrument was administered to cohort 1 in spring 2016, the majority of the 23 faculty CAs who continued to the end of the project identified a preference for two or more frames (16 showed two frames and 5 displayed three frames), with only two CAs relying predominantly on a single frame and both of these cases being the structural frame. (Table 7.3 and Figure 7.1 display the numerical scores and graphic representation of results for cohort 1 in spring 2016.)

Table 7-3: Bolman and Deal Leadership Frame Results for Cohort 1 at SAGE 2YC Beginning (2016)

Level	Structural	Human Resources	Political	Symbolic
Strong	13	4	8	5
Preferential	6	2	5	6
Weak	2	7	6	6
Very Weak	2	10	4	6

Figure 7-1: Bolman and Deal Leadership Frame Results for Cohort 1 at SAGE 2YC Beginning (2016)
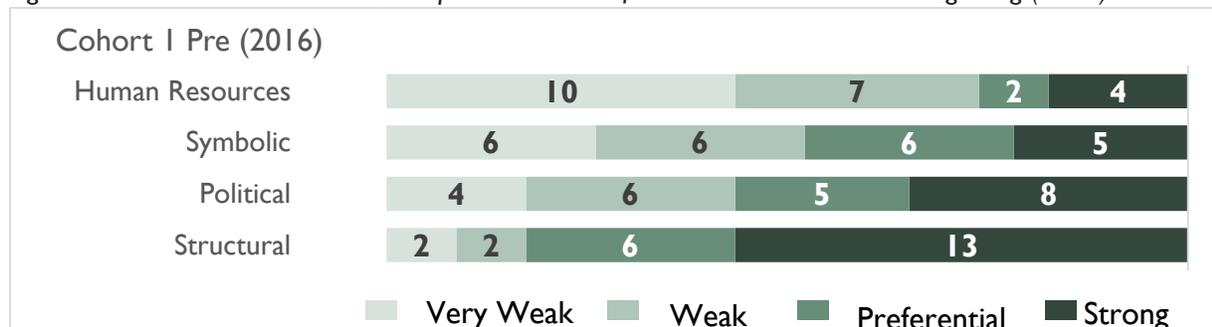
Results for the cohort 1 CAs for 2019 are shown in Table 7.4 and Figure 7.2 below, revealing a pattern of results that looks fairly similar in 2016 and 2019. However, upon closer inspection some variation is present in the results. By 2019, we can see some movement away from the structural frame to other leadership frames, particularly the human resources and symbolic frames.

Table 7-4: Bolman and Deal Leadership Frame Results for Cohort 1at SAGE 2YC Beginning (2019)

Level	Structural	Human Resources	Political	Symbolic
Strong	11	3	8	6
Preferential	4	5	4	8
Weak	4	6	5	7
Very Weak	4	9	6	2

Figure 7-2: Bolman and Deal Leadership Frame Results for Cohort 1 at SAGE 2YC Conclusion (2019)
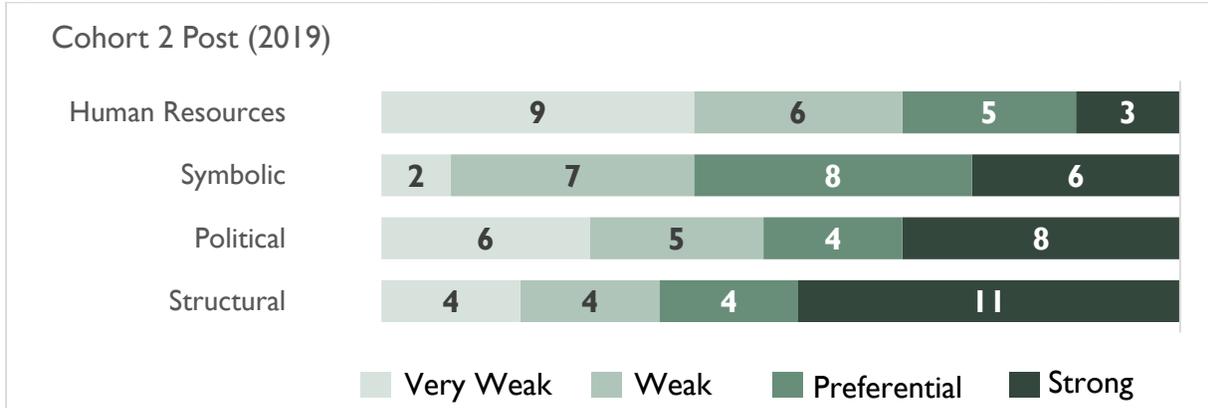
Table 7.5 summarizes these specific changes in frame orientation for the CAs. The negative numbers highlight that CAs moved away from use of the structural frames and moved in preference to other frames (e.g., human resources and symbolic).

Table 7-5: Change in Bolman and Deal Leadership Frame Results from 2016 to 2019 for Cohort 1 Faculty CAs

Level	Structural	Human Resources	Political	Symbolic
Strong	-2	-1	0	1
Preferential	-2	3	-1	2

Cohort 2. The Bolman and Deal questionnaire was administered to cohort 2 CAs in fall 2017 near their beginning in the SAGE 2YC project. Similar to the cohort 1 CAs, results for the two time periods are similar but with a slight decrease in preference for the structural frame from the first to second measurement (see Tables 7.6 and 7.7, and Figures 7.3 and 7.4). Given the shorter timeframe of involvement in SAGE 2YC for cohort 2, it is interesting to see that their movement is similar to the change in cohort 1.

Table 7-6: Bolman and Deal Leadership Frame Results for Cohort 2 at SAGE 2YC Beginning (2017)

Level	Structural	Human Resources	Political	Symbolic
Strong	6	4	3	2
Preferential	2	4	2	2
Weak	4	0	4	4
Very Weak	0	4	3	4

Figure 7-3: Bolman and Deal Leadership Frame Results for Cohort 2 at SAGE 2YC Beginning (2017)
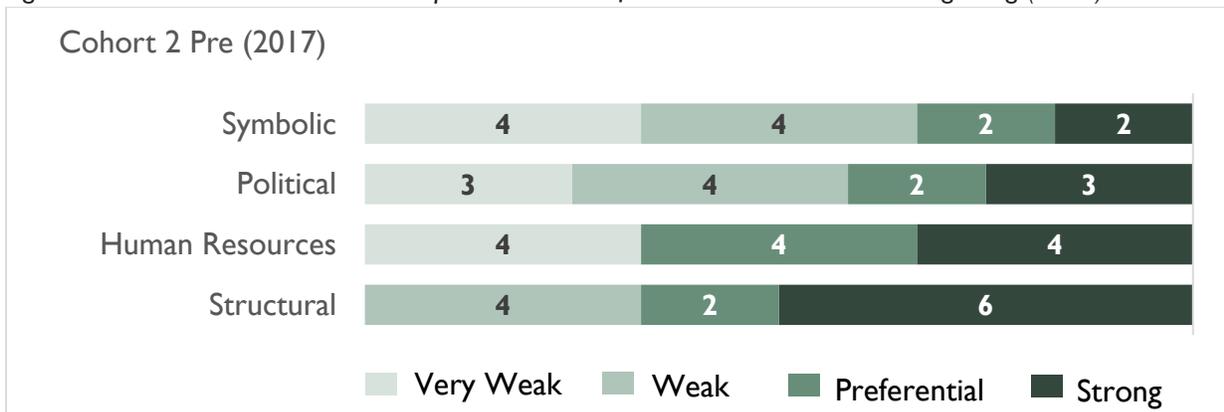
Table 7-7: Bolman and Deal Leadership Frame Results for Cohort 2 at SAGE 2YC End (2019)

Level	Structural	Human Resources	Political	Symbolic
Strong	3	3	2	3
Preferential	4	3	4	2
Weak	1	2	4	4
Very Weak	3	3	1	2

Figure 7-4: Bolman and Deal Leadership Frame Results for Cohort 2 at SAGE 2YC End (2019)
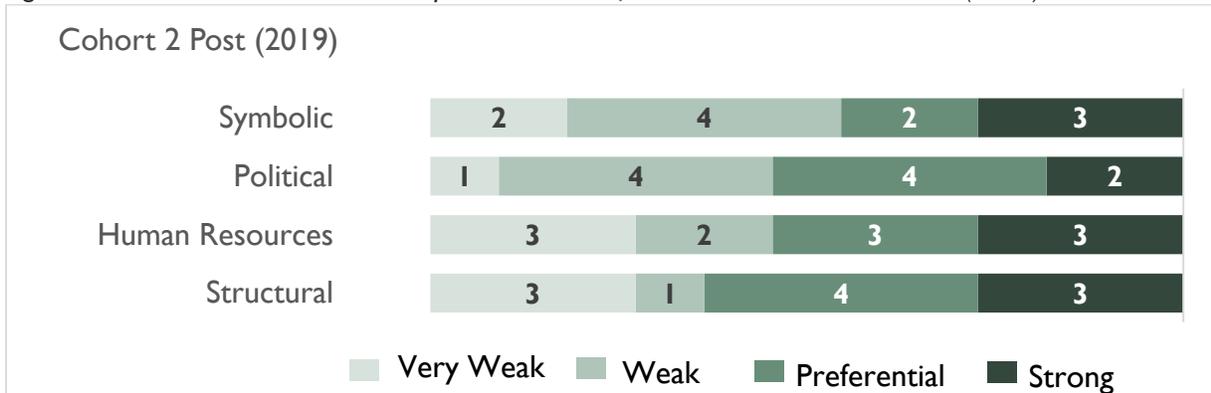
Table 7-8: Change in Bolman and Deal Leadership Frame Results from 2017 to 2019 for Cohort 2 Faculty CAs

Level	Structural	Human Resources	Political	Symbolic
Strong	-3	-1	-1	1
Preferential	2	-1	-2	0

One difference between Cohort 2 and Cohort 1 is that the Cohort 2 CAs reported a preference for multiple frames (9 scored two frames, 2 scored three frames), with only one CA relying predominately on a single frame (again, the structural frame), which is slightly more than Cohort 1 CAs. Cohort 2 CAs are more evenly spread across all four frames at the end of the project than the Cohort 1 CAs, indicating an ability to draw from multiple perspectives in leading and working with others. Cohort 2 results are HR=45%; SY=54%; PL=54%; ST=63% compared to Cohort 1 results of HR=35%; SY=61%; PL=52%; ST=65%.

Figure 7-5 below shows the difference in frame orientations between the two cohorts at the end of the project.

Figure 7-5: Comparison of 2019 Bolman and Deal Frame Orientations by Cohort

2019 Bolman & Deal Preferences
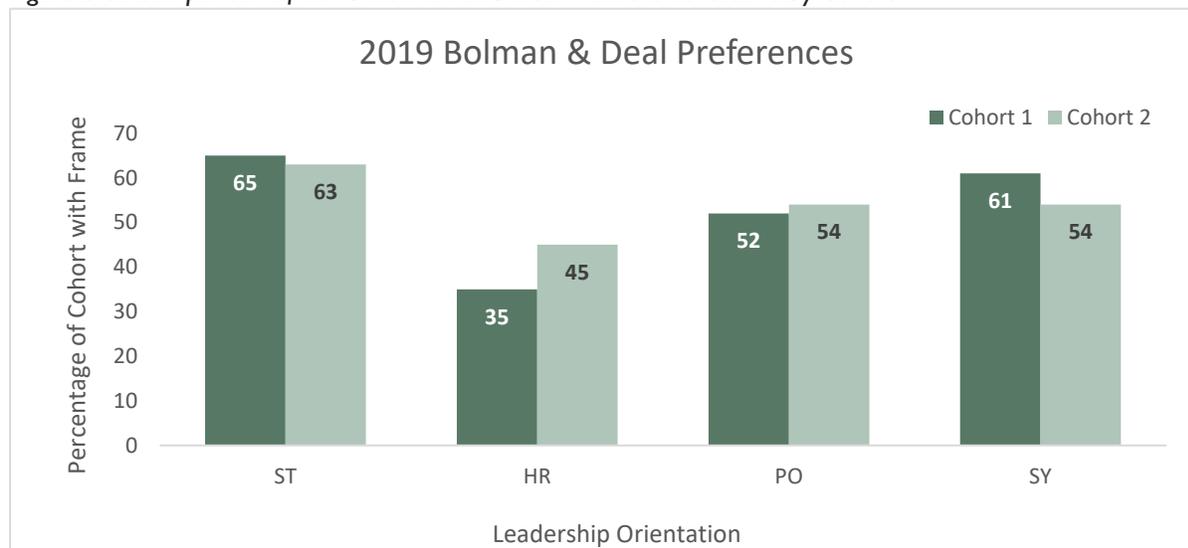
In summary, the Bolman and Deal leadership questionnaire provides two snapshots of the faculty CAs' leadership preference trajectory over the time period of the grant. It is worth noting that when the faculty CAs (both Cohort 1 and 2) were administered the Bolman and Deal instrument in 2019, the majority reported a preference for a multi-framed approach to leadership. Precisely 32 of 35 of the faculty CAs reported using multiple frames, with 25 CAs using two frames and 7 using three frames. By using a multi-framed approach, it is possible that the CAs could tap into different leadership perspectives to motivate others. Knowing the community college context in particular, it is possible that the community college had some influence on the CA's employing multiple leadership frames. Community colleges employ fewer full-time faculty, which means these faculty members often wear multiple hats of responsibility (e.g., curriculum oversight, accreditation, governance). Having multiple leadership strategies to engage colleagues in change efforts, for example working with administrators to obtain resources to execute action plans, may benefit from using multiple leadership frames and perspectives.

QUALITATIVE LEADERSHIP THEMES

Following are the themes that emerged from a range of qualitative data collected. In particular, a focus on the final reporting out on impact, focus group comments, and end-of-workshop evaluations showcased final thoughts of the CAs on the changes in their leadership over the project. As noted in the section introducing the CAs, the individual faculty entered the project from different starting points. Some had been heavily involved in professional development programs on campus and in the discipline prior to the project, some were department chairs already, and some were the initiator for their teams' involvement whereas others were asked to join the team. These varying starting locations influence the amount and type of change in leadership that occurred for the CAs. The perceptions of the CAs on their change in leadership was often corroborated by their administrators, yet some of the administrators noted how they thought their CAs could take on even more of a leadership role or were not destined for positional leadership roles *(e.g., …some of the challenges that are happening in their department, is to try to also bring that leadership towards their department. I think that's been harder and, honestly, I think they've avoided or tried to avoid it because it's going to be difficult work.).* This quote illustrates an

expectation for sharing expertise, mentoring, and leading that some of the administrators held based on the CAs involvement in the project.

Instructional Leadership

A focus on improving classroom teaching strategies and sharing these strategies with others on campus, in the region, and in the geosciences was one objective of the project (the other two strands of broadening participation and career pathways were often incorporated into classroom opportunities as well). The CAs were clear that they felt their own practices were improved as a result of participation, and many commented on how their growing expertise and skill set improved their instructional leadership. Following are some illustrative quotes the CAs mentioned in this area when asked how they were different due to their participation in the project.

> *I felt like I was a good teacher before, but I feel like I'm much, much, better now, and nimble, and effective in the classroom. So there's a part about feeling like I'm more impactful, but I'm able to do it with less effort than before.*

> *And I think a lot of my own classes and I share with everybody else my materials and the control is going back through and revisiting and assessing and I'm cleaning up and revising the materials makes a big difference*

> *[In] just thinking about ways to sustain and institutionalize change, and sharing expertise, I feel like it's within my classes it's sustainable, in a sense that I'll always be thinking, and adding, and using evidence based teaching. But, sharing that knowledge base with other faculty, so it can impact more students, and looking at ways within the college to create programs or structures that can sustain change, and find funding within the college that can make sure that those things continue to happen.*

> *Increased self efficacy as a teacher, my belief in what I can do is certainly changed a lot. It's more than just confidence, it's a belief that I know I have that skillset.*

> *The idea of having something to offer my peers, as far as, things that they could be thinking about in the classroom has given me a lot of leadership opportunities.*

> *An increase in the comfort level in discussions with other faculty and administrators and leadership roles, that I never had before SAGE. And the rate of change in my classes is accelerated pretty dramatically.*

> *Helping develop a course and new course materials to be shared among faculty in the department. Also to be a resource for faculty in other ways as needed.*

> *I think the common theme that pulls together everything I learned a more intense vigor to advocate for students.*

Collaborating with Others

Working within a team was a structural element of the project, and with the exception of one person working alone after the first year, all the CAs engaged with others in building action plans and hosting regional meetings. This structural project format, and the focus on building a CoP primed the CAs to think about how they would work with others, how they could assert influence for change, and how they could leverage their own action plans with other initiatives on campus. Thus, it is perhaps less surprising that many of the CAs commented on the role of collaborating with others as part of their leadership.

For me, I've started to be able to build the base of support and that's I think part of the leadership or making change process for me

Community was one of them, and just the importance of a sense of community, especially on campus as the only full-time Geo-Science instructor, and just really trying to build a community with part-time faculty.

And just that leadership piece as well, feeling more confident about building collaborations, to say things to folks. And having the confidence to help others improve.

I definitely feel like part of a community in a way that I didn't before, on my campus and here, rather than just kind of being on my own.

I know I'm a good teacher, I know I'm a good geologist, but now I feel like I know why I'm a good teacher and there's the confidence that comes from that. I think two, I've become more strategic in how I think about my relationships with people across campus.

Seriously before starting this, I would think of my professional life as kind of introverted, my work goals are secluded and I was one person, and now every time I'm doing things it's more of the extroverted where I think, "How do I bring all these other people into what I'm doing?"

[Our administrator] told us yesterday that we're strong, independent, people and we get a lot done, but we need to sometimes break out of the independent thing and reach across the table. It's a good reminder, he's absolutely right and we can probably get more done if we have more of those lines of communication, and he's good at that kind of thing.

Increased Confidence, Agency, and Awareness of Institutional Resources

The concept of "imposter syndrome" was mentioned by several CAs when prompted with questions about their leadership. Developing confidence over the timespan of the project helped the CAs recast their self-perceptions and awareness as leaders. For those already in leadership positions or heavily invested in prior professional development, confidence manifested by being "re-energized."

But from my perspective, the biggest change has been finding some footing and a lot more confidence in taking on leadership roles within the college as well as the larger community.

I definitely feel more confident now to be part of the conversation of the larger institution. Beforehand I probably wouldn't have joined initiatives, because I wouldn't have felt I knew enough to participate.

This may sound ridiculous, but I feel like I get finally get it. I feel like since I got in this meeting I'm like, "Oh, I get it. I get what this whole thing was meant to be." And I feel like I can do a ton more. I feel an urgency, I guess. But I also feel like I know where resources are much better.

I actually now view myself as a leader in the department, and have a burgeoning awareness of my leadership style (including its weaknesses/blind spots/barriers). I am more confident, more informed, more connected, and more capable across multiple aspects of my job (as a teacher, as a colleague and now as a program chair).

The confidence thing, I definitely have a lot more confidence.

And a confidence to go beyond that too, and I feel like this group supports us being risky and trying new things. So not just energizing, but that it's okay to try things, and if they don't work, it's okay.

I never feel like I fail, I feel like I have learning opportunities, that's what I call it. So I never have felt that way, I just like, "Okay, what went wrong and how can I twist it to make it better?" But when you come into this group, sometimes I don't have those answers how to make it better, but I find those answers here.

I feel I have a better capacity to actually be a leader. Part of that goes with the confidence, but I think part of it is, we've all got lots of great ideas and now we have kind of a forum to get energized, to get feedback, but we've learned so much.

Now I'm convening workshops at GSA and the Rendezvous without really thinking twice about, could I, should I, it's just like, of course I can. And so could pretty much everybody else but it's given us confidence I think-"I can do this!"

It's almost made the invisible, visible. Like CA was saying, you're in a rut, you don't see this stuff, whereas now you see all this stuff that you can participate in.

I feel more confident and it has changed my identity as a leader to promote change in my classes and at my institution.

My leadership skills have improved immensely over time and my "imposter syndrome" has reduced immensely as a result of this experience.

I think I was used to doing stuff by myself and a lot of us are, and when I started working with other people it's more like, I can get this done faster, but now it's more like, no I can get it done different. And there's parts that I should not figure out and make the group figure out because the group will figure it out better.

So there's a saying in geology that "the best geologist is the one who's seen the most rocks," so you get a sense of the commonalities and the range of variation, and I think that is sort of an angle to view this sort of calibration of seeing everyone's different viewpoints. It lets you know what the envelope of possibilities looks like, as opposed to the more provincial, "Oh, I've seen this. I've talked to this one other person who got a couple examples from her."

Motivation to saying "Yes"

When starting the project, many of the CAs focused on their classroom teaching and their programs. Some faced different priorities when seeking tenure or working as an adjunct, whereas others were already heavily involved in professional work or leadership on campus. Corresponding with an increased sense of confidence, was a willingness to say "yes" to leadership opportunities. Importantly, not all of the chances to lead were conventional, positional leadership roles. The CAs used different opportunities to work as mid-level faculty leaders irrespective of holding a traditionally named position of leadership.

I feel like one effect that I've drawn out of SAGE is that I feel it's my responsibility to make change happen. It's not like I've been given new abilities, it's like, "You had these abilities now make it happen." Yeah, or it's a moral imperative. I can't shirk this responsibility. I have gotten a moral imperative. When you see things aren't working and you have a way

forward, you have to act. Especially after seeing what you all [in the SAGE project] have done, and seeing your moral imperative. I'm inspired to carry that forward.

I have put myself out there and tried to join committees and groups on campus and I don't think I would have a year ago.

I think it's, again not trying to be self-aggrandizing or anything, but it's just that like, "No, look at this cool stuff we did." And being willing to write the little PR piece that goes in the campus newsletter blurbs or things like that.

Well for me, one of the biggest things that I could say is, that I now have something to talk about. I can communicate with other faculty, I can understand the administration. I now understand that there is a level that is doing something above that I can tap into, that before I felt like we were totally spheres that didn't overlap at all. And I'm also at the point now where, I want to be at the table when change is made, guide it, shape it, push it in my direction, rather than float along with it. Where before I'm like, I'm not doing that. I wouldn't even contribute.

I am not powerless as an adjunct faculty, and I can help make change in my region and help other people as well.

I feel more confident as a leader, and more willing to step up and play a role at the institutional level. It has honestly made me think of the impact I could have as an administrator some day. This is possible because SAGE gave me a set of tools I can use to lead. Before SAGE, I guess I assumed leaders were born with some inherent quality to lead. But, like anything, leadership is a learned trait, and SAGE pointed this out to me.

Connecting with Administrators and Shifting Perspectives

A central element of the project was including administrators to work with the change agent teams. As noted in the administrator section of this report, cohort 1 saw a high level of turnover of administrators during their involvement. When the CAs reflected on the benefits of their administrator involvement in the workshops in particular, and in the project in general, they commented on their newfound ability to see a different perspective of the institution and of their administrator's role. They spoke of strengthening relationships with their administrators and breaking down of the "us" and "them" mentality typically ascribed between faculty and administration. Finally, due to increased relationship building, the CAs discussed how they understood better how to tap into resources on campus.

I have a better sense of how to strategically execute some of those [changes], but also how to do things like work with your administrators in a way that makes sense from their framework. I think that's been really powerful.

CA mentioning about being strategic, and I also feel with that strategic views being more patient and, I guess, as CA was saying, being able to understand ... It's like it's given me the pause to take a breath and try to think about how is an administrator going to view this? And even though it makes total sense my brain of why something would be a good idea, [how do I convey it to an administrator?]

The way I think of this is this like spheres of influence, you have yours as a faculty member and your Admin has theirs and you can look for that diagram of overlap. But then also it's that idea of sometimes as a faculty member you don't realize that you might be able to

interact with some of these other departments on campus in ways that will benefit you ultimately, so they [the administrator] can kind of help you expand that.

Our roles had to be defined as somewhat oppositional, but we were now pointed in the same sharing the goal and we're in a different environment.

So [our administrator] is already a convert and wants more active learning and sense of belonging in the classroom. And he really wants all the instructors to do more of what we're doing.

Well giving them the opportunity to see our work and for us to see the larger picture thing they saw, gave me the opportunity to understand a little bit more. Our administrator, like she was able to say, "Okay, well these are limitations we might have or whatever." And then we could say, "Well, maybe we could work with this." And I find it nice to be able to hear the administrative point of view so that I'm not so grouchy about when they do stumped and [can't give us what we asked for].

I think it humanized my boss a little bit more. Not that, I mean she's young and super approachable, but she has her set of problems, too. And how can I help her with those problems too, because I work with the same faculty that I complain about. They're not moving, so does she. So, how can we also be a team in that way to solve the similar problems that we're having that we probably didn't look at from a different point of view, which has been cool. She had a totally different way. Before this I would just do everything on my own, and I would find this dean that I would have to talk to, because there is so many administrators, but she goes to meetings with them. I don't need to chase that person, she can do that for me, and figure those other things out for me, and I guess I didn't think about that beforehand. But she's got way more connections than I do. I don't have time to do that stuff and she does, so that was awesome!

I think I've built a better relationship with my administrators. I think, you know, in order to make change you have to come up, you know, it has to be a shared solution with, find a share solution with your administrator.

The hardest thing or what I have learned about it is, if you need to seek administrative on the assistance or approval, it's been a failure for the most part. It's hard to move and make change. But her coming to this and interacting with the project, learning what we're trying to accomplish, has been without a doubt the best thing for us to make progress with our program. And it has been ... I think it's going to be program changing for her to have come in.

It's not just the time, but it's also the atmosphere of being able to explore in the context kind of what CA was saying, in the context of what we've been able to do and have their focused attention on what we've been doing beyond the elevator pitch that they were going to be reimbursed.

Yeah. I mean, we all have pretty much good control over how to a change our classroom, but if you want to change a program, you've got to have the administrator. So I don't know whose genius idea that was, but it would not have happened at the level that I am seeing it happen if it hadn't been for their inclusion.

But I think one of the big things that he can bring to the table is an understanding of how the administrative side works. We see one side of the table and he can see the other side and having a dialogue helps us to understand how we can bridge from side to side, and he's also really good with communication and can help us understand, "Okay, well if you want to do this, that's great, but you should talk to so and so, and so and so first because they'll have thing positive things they can contribute to the conversation too," instead of us just going out on our own.

Before I was just under the radar, not visible and now I am [visible]....I just got asked to participate in designing a natural science retreat for the whole natural science division and I did and it was last month. But I was on the radar, the dean was like, you'd be great for this.

I find when I ask for things, I get them a lot them easier. There's almost a trust now, that I'm asking for this for our classes and it's the, yeah, you don't need to explain in full detail, I trust what you're doing, sure we'll do that. It's nice to just have that backing.

SITE VISITS

Site visits occurred for 10 of the teams [6 for cohort 1 (NY, TX, VA, SCA 1, SCA 3, OR-Portland) and 4 for cohort 2 (VA, Western WA, SCA 3, OR- Willamette Valley)]. During the site visits, classroom observations were conducted and CAs were individually interviewed (along with administrators and in many cases student focus groups).

One of the site visit protocols included the question: *How do you perceive of yourself as a leader?* The responses to this interview prompt combined with follow-up interview questions related to what was observed in classrooms connected to how the CAs were connecting their identity as leaders to their new knowledge and teaching practices. Examples highlighting individual changes, team developments, and multiple teams gathered through site visits follow.

Case example 1-Individual Leadership:

First, the CA reported on their general perception of their leadership approach:

I am pragmatic, inclusive, I'm not a power-hungry leader. I understand the need for other perspectives and I also understand that everyone has their strengths and that I don't have. When I'm working with a group then I try to get everyone involved so that I'm not doing all the work because I think if I'm doing all the work then something is wrong.

Then went on to describe how they characterized their positional leadership as a colleague:

I had to lead something as someone was out. We were doing a general membership meeting as I'm doing it, I had my other officers around and I would say something and I would ask "Kevin" do you have something to add? and then "Cynthia" and we went around the room and when we left one of my colleagues said "that was the best one, it feels so good when we're all involved" and that's my style. I want everyone involved because I know that everyone brings their own perspective, their own strengths, and when we do that, we get better results.

And then stated how they saw their leadership style playing out in their classroom and in relation to what they had learned through the SAGE 2YC program:

I used to be, before the program, I used to know exactly what I was talking about to the minute and it has been difficult to let go and that's probably the biggest change is much less talking in the classroom and the biggest fear I had was thinking about program itself . . . my fear was if I'm not hitting these topics then the students don't have the material and when they transfer that was always the concern; but I'm learning now is that I'm not talking as much but I'm getting through more because it's evolving that way through students [involvement], their own discussion and it's better.

Case example 2-Individual Leadership:

In comparison, this CA described the challenges they had encountered in leading their colleagues and how it contrasted with their comfort in the classroom.

I'm a shy person. And in the classroom it's never been an issue for me and I don't get nervous, I don't have butterflies on the first day. But I think that that's a function of someone, I think my leadership in the classroom and in the field is really strong. But it's because I'm in a supervisory capacity and those folks are not my peers. Right? Those are our students. When I get into a situation where I'm meant to be responsible for executing some task and either it's with students but I'm with a whole bunch of other faculty, I don't do very well. And I ... every time I run one of these [regional] workshops honestly, I just feel like a total freaking fool the entire time. And I think part of it is just imposter syndrome.

The CA went on to describe how through their confidence in teaching they are seeing themselves as having capacity to lead colleagues and the relationship to experience in the SAGE 2YC program.

What qualifies me to be up here, talking about effective teaching strategies because I'm far from perfect and I'm not claiming to be. I think I've improved but I think my leadership style is that I will reluctantly lead if nobody else is doing it. But if I see on a discussion board or something that everyone's supposed to be responding to that but nobody's responded, I'm like, "Alright". . .

I think it's improved but I don't see . . . I don't aspire to be the president of the SAGE 2YC division of GSA or something like this. That's just not my jam. . .

When I'm at one of these regional or the face to face SAGE meeting for example . . . or if I'm in a room at GSA with all these high rollers in the Geoscience education community. . . I'm open to contributing my ideas.

Case Example 3-Team Leadership:

The site visit interviews afforded the CAs a time to reflect on their leadership style and in response to prompts about teamwork, some CAs reflected on the leadership of their team members. During the individual interviews, one CA reflected:

I think that's part of my Type A, a control hat that I like to wear. I also think that one of my strengths is bringing that aspect of organization and saying, "If this is what we want, here's how we're going to get there." . . . I think encouraging people to do things in a logical, step by step fashion. If we have an intended outcome, getting there means that we have to go through these policies, these procedures, create these documents, do that sort of thing.

I don't know. I think that one of the things I would say is that often times, people are interested, but they want to be told what to do. A good leader can encourage change or

encourage productivity or movement by presenting it in an organized way, saying, "This is what I want from you. It's not that much of your time and effort to do these things." Being very definite in terms of what you're requesting from folks.

And then this same CA reflected on how their team members' leadership styles complemented each other.

CA2 is our visionary leader. CA2 comes in with the big ideas. Then CA1, I think, she's our, what is it? The humanitarian? We always joke CA1 brings the snacks, but basically, she also, I think, plays a key role in just kind of bringing my need for order and CA2's big ideas together.

This team was aware of their leadership preferences due to the Bolman and Deal questionnaire. As one stated:

Like the very first workshop we had in Williamsburg, where we defined our sort of leadership roles. I mean when we took the test, we were just like, "Well, we all wear our hats proudly!" And we have continued to wear those hats proudly.

In this team, CA1 found such value in knowing the information gleaned from the questionnaire that when she chaired a committee on campus, she had all the committee members take the Bolman and Deal questionnaire at their first meeting. She felt that knowing the preferences of each committee member would provide a way to capitalize on individual talents. She added:

I've made other committees that I'm on take that survey. And then we can be like, "see this is why the five of us work, but this is why the three of us don't work." Because we're all trying to come at it from the same approach.

During the team interview that preceded the site visit for this CA's group, the notion of what each member brought to the team based on their individual perspectives and leadership preferences was exemplified in the following comment by CA2:

Singly, none of our kites would get off the ground, but collectively we've got the biggest kite!

Each team member next reflected on the efficiencies they experienced with working within their group.

CA1: Sometimes I sit back and think, oh my gosh, I can't believe little peon me is doing this stuff. I certainly couldn't do it without everybody else. That's both confidence boosting and just continuing this sense of empowerment that I can make a difference, I can do something.

CA2: So I think one thing that's happened that's evolved, that's striking for me is the efficiency, I think, at which the three of us can work together. That feels really good. Being able to offer professional development opportunities like this is something that I've wanted to do and I wouldn't be able to do this without C3 and C1. It just feels really good to be able to do what we're doing, but to be able to do it so efficiently, I think and I never would have anticipated that.

CA3: I would say I have a stronger understanding of my role in teams. And knowing I have a better sense of what I can bring and why that is. There's that idea of when you're in a group

and you can see what needs to be done, you kind of know what kind of person you need in that role and that person just isn't on the team. Then it sort of falls to you to kind of either fill in the gap or try to find other ways to get there.

In other team interviews during the site visits, concurring comments were offered regarding each member of the team playing a role, and having an awareness of their role and their contribution to the team. For example, there was often an individual who took the lead in tracking deadlines and setting up meetings. Other individuals made arrangements to conduct the regional meetings. Collectively, the teams worked on the agendas and the delivery of the regional workshops.

Case Example #4—Team Leadership Across Cohorts

Half of the cohort 2 teams were in regions where a cohort 1 team was located, and in the case of one team, on the same campus. This proximity and connection was sometimes capitalized on, and other times not. For each of these teams, cohort 2 participation was linked to connections with cohort 1. One form of connection was personal CA to CA that occurred when individuals knew one another (e.g., on the same campus, attended the same university). Another form of connection occurred when members of cohort 2 attended regional meetings sponsored by cohort 1. In these professional development workshops in the region, information was shared that members of Cohort 1 had learned throughout the project, which inspired individuals in cohort 2 to apply to the project when the opportunity occurred and increased awareness of SAGE 2YC in general. How the teams collaborated highlights a form of leadership beyond an individual campus, and can contribute to the building of regional change.

Example 1. The two teams located in Virginia had strong ties among the full-time faculty members as all had participated in national geoscience projects in the past (e.g., NAGT, AGA, GSA, Cutting Edge). The community colleges in Virginia are part of a state system, thus all the campuses have an affiliation among one another. When a CA from cohort 1 was asked about their network, they reflected: Actually, there's a couple folks that are from cohort 2 now. They're people at NOVA that I've interacted with before. We've interacted in other contexts, so for example, planning, being on GSA committee together or just attending New Horizons in the past and seeing each other's presentations and sharing information. The system hosts a professional development program each year titled New Horizons, and the cohort 1 team presented at this conference on strategies they learned during the project. The teams informed one another when they were hosting a regional activity, but did not engage in any specific cross team activities.

Example 2. The two teams in Oregon were located on different campuses. cohort 1 team members were at three different locations, and cohort 2 team members were at two different campuses. Cohort 2 team members first became exposed to the project as they had attended some of the regional meetings conducted by cohort 1. When asked about the connections across the cohorts, a cohort 2 CA said, *Yeah, I reach out to anyone who will help me…. I had gone to meetings with cohort 1. Setting up meetings and networking has been most important things. Geology tend to be departments of 1. It's been invaluable.* The other cohort 2 CA noted how the Cohort 1 team anchored work in the state in Portland during their participation in the project and that the regional workshops they did provided an entrée for cohort 2, and with the addition of Cohort 2—a corridor of support was emerging in the state. The inclusion in cohort 3 of Lane Community College was seen as a further expansion of this corridor and a spread of innovation due to the leadership of the CAs in cohorts 1 and 2.

Example 3. The dynamics of the teams in Southern California show the most complexity. Initially, cohort 1 consisted of a single team in the region with two CAs, one from Mt. SAC and one from Pasadena

Community College (PCC). In 2016, a third member from Mt. SAC was added to the team. Another change occurred in 2017 when two distinct teams were formed for the region, one housed at PCC and another at Mt. SAC. Differences in work style and scheduling provided the impetus for this shift. At that time, two other team members were added to the PCC team. These two new CAs had attended and were involved in the first regional workshop hosted by cohort 1. These separate teams operated well within their college settings and still coordinated and shared information on the regional meetings. The addition of the third team in the region involved a cohort 2 team from Mt. SAC starting in 2017. This additional team resulted in there now being four faculty members at Mt. SAC involved in the project. Yet the teams for cohort 1 and cohort 2 at Mt. SACS operated fairly independently of one another with scant collaboration occurring between them. On the one hand, each of the teams focusing on specific action plans and foci brought about change on campus. On the other hand, the lack of collaboration among the teams presents a missed opportunity for leveraging change in the region.

Site Visit Observations

The context in which leading occurs makes a difference in how individuals lead as different colleges have their own culture, policies, expectations, and policy oversight. An advantage of conducting site visits was the opportunity to visit the CAs classrooms and offices. The geology faculty we visited unsurprising had rock samples prominently displayed in offices, hallways, and classrooms. The oceanography faculty had wave pools to illustrate tidal pools and other features of the sea. Many of the classroom observations occurred during combined lecture and lab sessions, and rock boxes and tactical examples of the lunar influence on tides were often part of these exercises and other hands-on type of experiments. Most of the faculty used a PowerPoint presentation of some form to organize their classes, with several including times for interactions. For example, in one classroom observation, the class was put into teams in which they had to come up with estimations and hypothesizes about volcanos. This activity involved teams in a game in which they had to opt out before the volcano blew lava out. The students were actively engaged, offering insights, and getting excited about the outcome of the activity. In other instances, students engaged using tablets to look up information for a group activity, students received bags of materials that they used to identify phases of a process in oceanography, students used rock boxes to identify samples, and students used handouts to identify layers from earthquake activity, to name a few of the in-class activities.

Each campus was different in size and layout. Bigger campuses had large parking garages around the perimeter and classroom buildings over a large expanse of space, others were single buildings in office complex settings, and yet others were small campuses with a few buildings. This campus context contributed to the feeling of culture on the campus, ranging from a sense of a being a commuter culture in which students came in for their classes and left immediately to mirroring a four-year campus with amenities including a cafeteria, recreation center, library, and student activity building. This physical context contributed to expectations of faculty, as did the presence of a union environment or shared governance.

Evident during the site visits were hallway, office, and classroom displays focused on the geosciences, posters regarding career opportunities, listings for GeoPath and internship opportunities, announcements for geology club activities, and posters of geoscientists at work. At the Lone Star-University Park site, a three-story geology rock wall in the science building displayed a view of the layers of the earth through the earth's different eras (see Figure 7-6 below). This interactive display is used in classroom activities in which students can touch the rocks, see the layers, and apply their class knowledge. This campus also installed a series of rocks around the campus in a Rock Garden to allow students an opportunity to do field work outside that was right on campus. These artifacts of CA

leadership put a perspective on the influence of the CAs on campus and highlighted how the learning context was built for students.

Figure 7-6: Geology Rock Wall—Lonestar—University Park
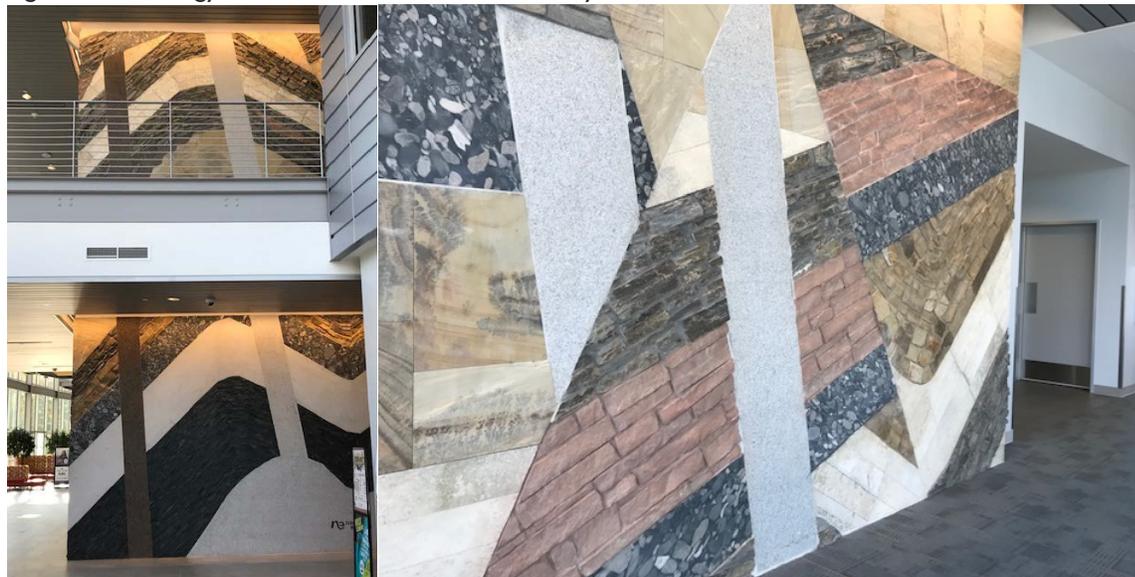
Site Visit Corroboration of Leadership Themes

During the site visits, CAs interview responses also touched on themes previously described, such as greater confidence in leading and instructional leadership.

> *I feel like I'm a leader in disseminating information about active learning, and what can be done in classrooms. I'm hoping, like I said, to be a leader on a proposal and lead a research related program. When I go to GSA I feel like I represent people who are kind of on the breakthrough of doing important things for two-year colleges. . . and I think my colleagues here respect me if I have a new idea.*

> *I think one is that I feel a little more empowered to play that role, to be in that role. And I guess I feel like that because I've been through enough workshops . . . Two things have happened. One is that I've learned new material, but I've also had it reinforced enough times that realize that, oh wait, I actually do know how to do this and I am legitimately in a position to be able to share it with other people. So my confidence in being in that position has definitely increased.*

> *It's a [instructional] language. . . we were talking about rubrics and people who had been teaching a lot longer than me, and they were arguing that rubrics weren't a great idea. I disagreed and said that a rubric lays out what you are expecting and what's being graded and keeps you honest. . .I could actually disagree . . and I could converse and could actually evaluate what they were saying. . . and before you said this, well that's how it is.*

However, despite that newfound confidence, this CA did not perceive that their colleagues necessarily valued what they could now contribute but also recognized it might be a departmental cultural constraint.

At the same time, though, I'm not sure I see many people asking other people for advice either. So, there might be a cultural component, too. Because I don't feel like people asked me for my opinion much beforehand either. I think I've been...I've learned how to be more effective at working with the department, both in terms of understanding, what it is people want to hear, what they're concerned about. And also understanding what I need to do, in terms of not necessarily maybe being aggressive, but maybe being more assertive.

Administrator Perspectives

Some administrators for the CA teams were themselves geoscientists, so the CAs felt like it was easier to relate to them and that they didn't have to explain so much about why what they needed in terms of support. Yet, this was not always the case. Administrators seemed to know the CAs, but not always the work they were doing that linked to SAGE 2YC. On an early site visit, one CA team's administrator knew about their campus-based work but was less aware of how to tap lessons learned by the CAs as part of the project. On another site visit, an administrator commented on how the CAs asked to share information learned in SAGE 2YC so often in department meetings that an item titled "*teaching pedagogy"* had to be added to the agenda. Having an awareness of the CAs' work gave administrators an opportunity to recommend them for other projects, such as institutional effectiveness and faculty learning communities.

Administrators who attended the SAGE 2YC workshops were able to see direct links between what the CAs were learning and actions on campus. These administrators could see ties between what the CAs were doing in their action plans and institutional initiatives. They also had a nuanced sense of the CAs' strengths as leaders, with some focusing on instructional leadership and others on campus or professional leadership. One administrator commented, *"[The CA] demonstrates a willingness to learn, which aligns with the inquiry mindset sought in the SAGE 2YC project."* A similar orientation was noted by another site administrator who stated, *"[The CA] is an adaptive educator who promotes reflection."*

Finally, the observations of campus administrators and CAs did not always align concerning CA actions and leadership. For example, during one site visit a CA was asked if they thought their administrator knew what they were doing, and this CA's response was, "*I mean, we'll meet with the administrator and that's a meeting that's requested by us. We'll meet once a semester to just update on progress but I mean, no." However our* interview with the administrator surfaced a list of curriculum and program changes being made by the CA team. Thus, CA and administrator relationships did not always look the same from these distinct positions, with differences in perspectives influencing understanding.

SUMMARY

The Bolman and Deal leadership questionnaire provided two snapshots of CA leadership preferences over the time period of the grant. When the CAs in both cohort 1 and 2 were administered the Bolman and Deal instrument in 2019, the majority reported a preference for a multi-framed approach to leadership. Precisely 32 of 35 of the CAs reported using multiple frames, with 25 CAs using two frames and 7 using three frames. By using a multi-framed approach, it is possible that the CAs could tap into different leadership perspectives to motivate others, and it is possible that the 2YC context had some influence on the CA's employing multiple frames. 2YCs employ fewer full-time faculty who therefore have to wear multiple hats (e.g., curriculum oversight, accreditation, governance). Using multiple leadership frames to engage colleagues in change efforts, for example working with administrators to obtain resources to execute action plans, may benefit CAs in the 2YC environment.

Looking at the focus group results, the CAs stated their work new classroom practices gave them greater

confidence to share these strategies with others. One CA described a shift to becoming more intentional regarding collaboration, asking *"How do I bring all these other people into what I'm doing?"* and stating that bringing people in was related to *"a belief that I know I have that skillset."* Another CA reported that initially s/he *"did stuff but nobody knows about it, but had shifted to realizing that you have to tell people."* For some, "seeing" themselves as a faculty leader was one way they changed. For example, a cohort 1 CA observed when asked if their perception of themselves as a leader changed over the project*: "Yes it has! It has educated me on the many ways I can grow as a leader. The mere fact that it's ok to call myself 'leader' has been positive. In fact, because of the [SAGE 2YC administrator workshop] presentation to our administrator, she now has used the term 'leader' in reference to me and CA. THIS is HUGE!"*

Site visit results revealed that the CAs understood more about campus operations at the conclusion of the project than at the start, and relationships built with administrators provided the CAs with insights into larger campus initiatives and an awareness of campus resources. Differences in leadership between cohort 1 and 2 were subtle. Cohort 1 showed slightly more transition to multi-frame perspectives and took on more named leadership positions, according to data gathered by our ERI team over a longer period of time. Recognizing that CAs started the project later but having a range of backgrounds, cohort 2 CAs reported using multiple frames in their leadership.

Several CAs moved into positions of leadership over the course of the project (e.g., department chair, directing teaching and learning centers, leading accreditation teams). Many CAs also assumed leadership roles in NAGT and led sessions at national conferences (e.g., GSA, Earth Educator's Rendezvous, Early Career Faculty Workshops). The growing confidence of CAs seemed to increase the faculty's sense of agency and provide a springboard for other opportunities to lead. What emerged in the site visit data was evidence that the CAs were becoming faculty leaders, and their leadership manifested in different ways. This type of mid-level leadership is increasingly important as 2YC faculty face growing complexities, including retiring top-level leaders and declining resources (Garza Mitchell & Amey, 2020).

8. COMMUNITY COLLEGE ADMINISTRATORS

The initial proposal for the SAGE 2YC project intentionally identified the active involvement of campus administrators as integral to supporting the work of the CAs, noting "*Each Leadership Team will work with their administrators to identify strategies to make a difference in student success at their institutions, tied to ongoing institutional strategic planning.*" Each CA team obtained a support letter from a campus administrator at the start of the project, though there were often changes in personnel that meant that the initial signatory for the support letter differed from the administrator present at the end of the project.

Questions that framed the research on community college administrator's involvement in supporting CAs in the SAGE 2YC project are:

- How were administrators involved in SAGE 2YC, including involvement in annual workshops?
- What did high, medium and low administrator engagement look like?
- What roles do administrators play in supporting faculty CA learning and leadership development?

METHODS

Two workshops were outlined in the SAGE 2YC proposal to support administrator engagement with their CA teams. During these workshops, and in some cases as a precursor or follow-up to them, administrators were interviewed via phone or in-person about their engagement in SAGE 2YC. These qualitative interviews provided insights into how the administrators were involved in the project and how they supported their CAs in learning and leadership development.

Site visits occurred for 10 of the CA teams [6 for cohort 1 (NY, TX, VA, SCA 1, SCA 3, OR-Portland) and 4 for cohort 2 (VA, Western WA, SCA 3, OR- Willamette Valley)]. During these visits, an interview with the site administrator was conducted either in person or as a follow-up interview after the site visit. A total of 12 interviews with administrators occurred. Finally, the proposal outlined that administrators would be included in interviews during site visits.

ADMINISTRATOR INVOLVEMENT

The administrators for cohort 1 were invited to three different SAGE 2YC workshops [June 2016, June 2018, June 2019], and cohort 2 administrators were invited to the culminating workshop in June 2019.

The intention of administrative involvement with the CA teams was to help the CAs access resources to support their action plans, to highlight CAs work of changing programs through a focus on teaching, broadening participation, and links to career and transfer, and to tie in the action plans with larger institutional initiatives on campus. Often, teaching faculty are unaware of larger initiatives underway on campus or the ways in which others on campus are working on parallel goals and activities. As one administrator reflected*, "It is funny to me—[CA] was like "As a college we should be doing this," and I was like, "Yeah, that's already out there and happening!" I have not done my job so you know it is happening… what we are doing at the college is so obvious to me but it still remains, not obvious to her or to the rest of the people in the room."* Another intended outcome of administrator involvement was to help the CAs connect to other people who could support their change work and help them avoid working in isolation from larger campus initiatives.

THE ADMINISTRATORS

Table 8.1 highlights the administrator participation for each of the teams and changes that occurred in administrators over the course of the project. The duration of the project differed for both cohorts and as a result, more stability in the tenure of administrators was found in the smaller group associated with cohort 2 that had two years of involvement with the project; no turnover occurred for cohort 2 administrators whereas for cohort 1, only four of the 11 teams retained their administrator throughout the four years of the project [marked with an asterisk in the table]. A total of 35 different administrators were involved with cohort 1 teams, and eight administrators with cohort 2 teams.

The opportunities for the administrators to interact with their CAs varied for each of the cohorts, and not all administrators were able to attend the workshops. Administrators in cohort 1 had the opportunity to attend three workshops, with four attending all three, five attending two, 18 attending one, and eight (23%) attending no workshops. What remains less known about the administrators that did not attend any workshops is the level of their involvement with their CAs on campus.

Table 8-1: Summary of Administrator Participation by Team Location

Cohort 1

Team Location	# Administrators Affiliated with Project	Workshop Attendance		
		Workshop 1 2016	Workshop 2 2018	Workshop 3 2019
Florida	1	1	1	1
Illinois (2 colleges)	3	2	2	1
New York	2	1	1	1
North Carolina	2	1	1	1
Northern California	1	1	1	1
Oregon (2 colleges; 3 campuses)	7	2	3	2
Southern California 1	2	1	-	1
Southern California 2	4	2		1
Texas (2 campuses)	4	2	2	2
Virginia (2 colleges)	4	1	1	1
Wisconsin (2 colleges)	5	1	-	1
Total	*35*	*15*	*12*	*13*

Cohort 2

Team Location	# Administrators Affiliated with Project		Workshop 1 2019
DC Metro	1		1
Massachusetts	1		1
Michigan	1		1
Oregon (2 colleges)	3		3
Southern California 3	1		1
Western Washington	1		-
Total	*8*		*7*

ADMINISTRATOR PROFILES

Three profiles developed using data from registration forms, interviews, end-of-workshop evaluations, and site visits appear below.

Highly Engaged Administrator Connections and Mentoring

The highly engaged administrator connection with CAs occurred when the administrators held high awareness of the project, became active in making connections among the change agents and other individuals or support areas on campus, and helped promote their CA for other opportunities. These opportunities included leadership on campus committees, nominations for faculty fellow programs, and tapping for departmental leadership roles. An active mentoring component was evident in this administrator profile.

- Know what is going on in project

- Leverage CA work with campus initiatives

- Tap CA leaders for positions/opportunities

- Help replicate programming on campus (e.g. example above of building similar connections with other departments to "brag" on what they are doing).

Mid-Level Administrative Engagement

Administrators in this mid-level profile of support held a general awareness of the project. Less awareness of the project sometimes occurred because of a recent move of the administrator into their position or because of a shift of responsibilities. Administrators in this category did not actively work to remove barriers for the CAs, however, they were supportive when specifically asked for resources or connections. This profile of engagement represented more passive involvement.

- Generally know of the work of the CAs

- Supportive when asked, but not proactively advocating

- Did not seek out the CAs with intention to tap their newly acquired knowledge on teaching and learning.

- Did not focus on leadership development for their change agent.

Low-Level Involvement

The administrators in this category held a role that involved more oversight versus collaborative connections with their CAs. For some, this more perfunctory role occurred because they were named as the contact administrator based on their position in contrast to administrators who embraced their project role involvement. Competing administrative job responsibilities meant some of the administrators had less opportunity or ability to be more involved.

- Less awareness of details of the CA work

- Not intentional about leveraging work as a result of a lack of awareness

- CAs tend to be highly self-motivated and already seen as leaders on campus

- Did not advocate for leadership development for the CAs.

Administrator Workshops

When the administrators attended one of the SAGE 2YC workshops, they participated in a range of

activities at the workshop that differed over the course of the project. Typically, however, administrators and CAs had time to review and work collaboratively on the CAs action plans. There was also a dedicated professional development session for the administrators (Table 8.2 summarizes program offerings throughout the project.)

Table 8-2: Summary of Workshop Offerings for Administrators

Year	Offerings
2016	• Keynote presentation & workshop by Saundra McGuire on *Metacognition* • Review and development of CA action plans with the CA team • Presentation on *Pathways to Results* • Presentation on *Project Goals and Institutional Goals* • Workshop on *Leadership: Leveraging Change Through Collaboration and Networking*
2018	• CA Poster session • Review and feedback on CA action plans with the CA team • CA Action Plan presentations • Presentation on *Institutional Change: What Does the Research Tell Us?* • Workshop on *Leveraging your Change Agent*
2019	• Building sustainability plans

The administrators found value in the presentations and workshops in which they participated, in particular noting how the 2016 presentation by Saundra McGuire on metacognition was useful and how they could see utility in this work beyond the SAGE 2YC project. Learning occurred for the administrators too as a result of the reporting out by the teams on their team action plans. Administrators were able to pick up strategies beyond what their own CAs proposed. Interacting with administrators from other states helped them to understand similarities faced in community colleges across the nation in the quest to support student success. As one administrator reflected after the 2018 workshop, *"I had good discussions with change agents and other administrators about how to motivate faculty to be involved because the success of continuing this project depends on their involvement."*

ADMINISTRATOR FEEDBACK

Administrator feedback was gathered at several points in the project. First, registration forms for the workshops included prompts to which the administrators responded. Second, short, lightning-round interviews occurred with the administrators in 2018 (cohort 1-14 interviews) and 2019 (cohort 1 and 2-18 interviews). The administrative interview questions asked about the type of support available on campus to support the development of leadership in the CA and how the administrators were capitalizing on the CAs action plans and work on the project to advance campus initiatives, including the type of evidence used to determine if changes to student success were occurring. Finally, the administrators were asked how CA networks were emerging on the campus and in the region, and what would help sustain these developing networks. Finally, end-of-workshop (EOW) evaluations were collected from the administrators. The administrators' feedback identified several important aspects of the work of the CAs from their own perspectives: **(1)** the type of support they provided to the CAs, **(2)** the leadership development of the CAs, **(3)** leveraging of the CAs' accomplishments, and **(4)** the development and sustaining of a CoP.

As noted above, there was a high level of administrator turnover in cohort 1 and the length of involvement of cohort 2 in the project was shorter. Both these factors influence the ability of the administrator to offer detailed insight on the change in leadership development of the CAs over time.

In soliciting feedback from the administrators on their perceptions of their involvement and on the development of the CAs over time, four themes emerged. First, the administrators noted the central role they played for the CAs as a source of support. Support ranged from connecting CAs to resources on campus, providing feedback on action plans, and ongoing mentoring. Second, the administrators reflected on the ways in which the CAs own leadership developed over the course of the project. Next, the administrators noted how they were leveraging the work of the CAs at their institution. Finally, the administrators reflected on the sustainability of the community of practice developed over the course of the project.

Administrator Support

The administrators saw their prime role as a supporter and facilitator for their CAs. One administrator summed up: *"I see my role as supportive. I will need to identify resources, particularly financial resources, to support and sustain the work. Additionally, I see myself as an advocate for the work, representing its importance to our institutional mission and our priority on successful transfer and degree completion to our leadership team."* The intensive time to meet with the faculty during the program workshops enabled them to discuss barriers and how administrators could help eliminate them. One administrator noted, *"I have learned that faculty members need more support or sometimes they may not know the support that is available to them. I need to do better at communicating with my people to know what they need and what I can help support."* Promoting and communicating more broadly about institutional resources served to educate the CAs on resources they could tap and how to connect with others on their campuses who could champion their goals.

Another role for the administrators was as a connector—to resources, to data, to others supporting campus-wide initiatives, such as guided pathways and its predecessor, Completion by Design. As one administrator reported: *"My faculty did not know that our institutional goals were so closely aligned to her project. This can be used to leverage support of the projects' initiatives."* Administrators also saw how they could connect the CAs' plans with others on their campus. It seemed when the administrators knew more about the work of the faculty, they could advocate for them. An administrator reflected on this point, *"I see myself as an advocate for the work, representing its importance to our institutional mission and our priority on successful transfer and degree completion to our leadership team."* The CAs did not always know how to "brag" about the work they were doing, and the administrators saw ways to use their knowledge of the CA work to become advocates to other campus leaders. Valuing this new knowledge, one administrator added, *"Thank you for including administration in your discussions. It's super important that faculty initiatives do not get lost in the noise. And faculty aren't always good at bragging on themselves, without the impetus of being forced to interact with their administrators."*

When asked how they supported their CAs in surveys or lightning-round interviews, administrators noted they provided access to campus space and funding to support the CAs regional workshops. They also offered financial support for conference travel and other professional development workshops. Also, because SAGE 2YC required CAs to gather course- level data, several administrators noted their role in facilitating these data requests. They also provided opportunities for the CAs to present on campus in division and campus-wide professional development workshops.

The administrators found great value in the intentional design of the SAGE 2YC to have dedicated time to interact with their CA faculty during the workshops, which gave them the opportunity to provide direct feedback to the CAs that could support their action plans. The structured time away from the daily routine enabled administrators and their CAs to dive deeply into strategizing on the team action plans. As one administrator commented: *"This [time with my CAs] opened my eyes to the amazing work my faculty is doing."* Having time for brainstorming and idea generation was what the administrators valued most about this group time. One administrator recognized the novel approach of the SAGE 2YC project in stating: *"It was very innovative to bring faculty and administrators together. This type of collaborative work provides the foundation for institutional change;"* and another administrator observed, *"I have not been to a workshop quite like this. Having the faculty begin their work and then share with their administrators was genius. It worked very well."* The interactions with the CAs provided the administrators a way to learn what the faculty members did not know, to share information on campus resources with the CAs, and to interact with other administrators from around the country. The administrator interactions with one another provided a way for them to compare strategies and to learn that other campuses shared similar issues.

Evolution of Leadership Development of CAs

In 2018 and 2019, the registration form for the administrators asked for reflections on the leadership development of the CAs. The prompt on the form asked: *Leadership development is an important aspect of the SAGE 2YC project. How have you seen your Change Agent(s) developing as leaders since participating in the project?* The administrators commented how CAs were "reenergized" due to their work on the SAGE 2YC project. The administrators noted how several CAs took on new leadership roles that ranged from department chair, committee leadership, and conducting professional development for others on campus. Following are some of the quotes of administrators regarding the ways in which the CAs evolved in leading on campus.

> *They have both taken on roles in the college that they might not otherwise have done. Also, their connections to the colleges around us are much stronger.*

> *More active involvement in curriculum development and cross-fertilization of teaching strategies with other science departments within our college and regionally.*

> *Our Change Agents have become more resourceful and know how to make requests of people to gain a more positive response. They have been able to identify what motivates faculty to be involved and worked with them using this knowledge.*

> *I see the change agents contributing to changes in their classrooms. More importantly, I see the changes that my change agents have inspired in other faculty.*

> *More active involvement in curriculum development and cross-fertilization of teaching strategies with other science departments within our college and regionally.*

> *They have both taken on roles in the college that they might not otherwise have done. Also, their connections to the colleges around us are much stronger.*

> *[CA] has used data collected in his courses for the project as an example of how the college could look at student success as related to various populations of students. His sharing of*

these data led to a new metric-in-development for our accreditation reporting that addresses equity in our classrooms.

[CA] is an incredible instructor, but having a peer connection to bounce ideas off of and to collaborate across campuses and states has built a strong professional network for her.

Supplementing the registration information, lightning-round interviews were conducted with administrators in 2018 (cohort 1 only) and in 2019 (cohort 1 and cohort 2). The questions for each of these interviews differed slightly, with the second round asking about longitudinal changes in the CAs development.

The administrators discussed the growth in leadership of the CAs over the time of the project. The administrators used terms like "energized," "confident," and "stabilizing force" to describe the CAs. A central element was that the CAs not only had taken on leadership roles in programs and on committees, but were seen as peer leaders on campus. The CAs were seen as early adopters in changing their teaching strategies, in looking at their data to understand student success (or not), and working with others to support transfer and careers. As a result, the administrators felt faculty peers looked to the CAs as leaders because they could show how the changes employed were working and discuss related challenges.

Having the ability to see the bigger institutional context evolved for many of the CAs over the project. One administrator noted, *"For both of them, I think this project was really critical in getting them to think about and understand and look at ways to have an impact beyond just with students but with other faculty and in particular for these two because of what they're working on, connecting the college to external focus as well."* The administrators were able to share with CAs

Understandably, there were differences in leadership growth for cohort 1 CA and cohort 2 CA. Even so, the administrators noted that growth was also evident in the CAs in cohort 2 whose involvement was shorter. Some examples follow to illustrate the type of evolving leadership development.

Cohort 1 2019 Administrator Reflections on CAs

It's easy for him to get buy-in from colleagues. His colleagues look up to him now.

She has seen how her discipline and department fits in the greater scheme of things to expand the geology program.

She has a broader understanding of decisions that have to be made and so other faculty will talk to her, She's passionate, so if she does feel like administration is doing the wrong thing, she can go to her administrators and talk to them about it, but do it from a place that's not angry.

CA1 is working on project for the Vice President of Academic Affairs to get a new teaching center started; CA2 is instrumental in the department and leading training on campus. Both connect with other stakeholders on campus.

Cohort 2 2019 Administrator Reflections on CAs

CA is already looking for new opportunities now that SAGE is ending. She's also gone after a leadership position in representing our faculty on the Faculty Association.

I saw improvement in CA in her tenure packet. She became the STEM coordinator—a clear leadership role and spoke about general faculty support to me.

CA's leadership is outstanding! The part-time faculty are working closely with him and looking to him for leadership and support. The other area where I see him leading from a faculty perspective is understanding from a broader institutional framework and figuring out he can influence change there too.

CA is the leader of the division. He has done more collaboration between the faculty in different disciplines and other institutions.

Leverage for CA Work in SAGE 2YC

When the administrators were asked how they were leveraging the CAs' participation in the project to advance change on campus, several common areas emerged during the lightning-round interviews. The administrators noted the positive change CAs brought back to campus based on their participation in SAGE 2YC: bringing focus to students and learning outcomes, advancing pedagogical practices, and supporting other full-time and part-time colleagues. Such changes were viewed as "refreshing" and "transformative." The administrators capitalized on the CAs' involvement in SAGE 2YC by using the CAs as role models and mentors on campus, and several of the CAs conducted PD sessions within their division and in their teaching centers. The administrators talked about how they highlighted their CAs' work to motivate other faculty to get involved in professional learning. For example, the administrators highlighted the work of the CAs in leadership meetings with other deans. Such showcasing of faculty work helped to create even more opportunities, resources, and connections for geoscience and STEM faculty. As a result of participation in the project, the administrators understood the importance of building stronger connections between faculty and those in administrative positions. An outcome of this connection was to help CAs understand and connect their work to institutional strategic goals.

Many of the CAs conducted professional development sessions on their campuses, sharing with others on their home campus what they learned about in the SAGE 2YC workshops. Examples included bringing speakers to campus on topics they were exposed to at the workshops, mentoring other faculty, and sharing pedagogy tips in program/department meetings. In reflecting on the three strands of the project [increased student success, broadening participation, and career/transfer pathways], one dean reflected in a registration prompt, *"The number of geoscience student success stories (measured by success geoscience completion and transfer) have increased since participation. I attribute participation in SAGE 2YC for the increased awareness of careers in geoscience at my campus."* The CAs provided a visible role model, with some being tapped to work to mentor struggling faculty and to build support structures for adjunct faculty members.

Involvement in the SAGE 2YC project expanded the reputations of the CAs and helped build buy-in for them on campus. One administrator commented, "*When [Name] presents that, it's really powerful to say, "Hey, I did this and look at my class and look what I've learned from this."* The CAs grew in expertise due to the project, and the administrators noted how the CAs were viewed as leaders by their peers. The 18 administrators interviewed after the culminating workshop indicated how this type of reputation building was common among their CAs. The expertise that some CAs developed helped other program/departmental faculty see them as a resource.

Leveraging of the CAs occurred in a number of ways institutionally. For example, one administer

reflected*, "She's creating a culture I think of change, she's been a resource, I think, to the department. But I think this is really sort of greased the wheel for us to discuss what's going on. And the statistics and the numbers that she was able to obtain from the school with the population served and everything else has really helped us get an idea of who our audience is…. who's being underserved. I think that really helped. It brought about a lot of discussion, and that's because of this program that she obtained that data."* Change of individual practice, and work within the program/department to increase awareness of teaching strategies can begin to contribute to campus change.

Another administrator related that because the campus had limited travel funds for faculty PD and had cut the Teaching and Learning director the *"…grant was a lifeline. It really helped us to change our culture in our department and it's spreading…"* A theme related to leveraging addressed how the CA activities and model could work for the disciplines beyond the geoscience program, as one administrator offered *"within science, everybody knows both of them."* Another dean commented on sharing beyond the geosciences too, *"I discuss at the deans' regional meetings the Geo work that can be done in chem and physics."* Thus, when administrators were aware of the work of the CAs in the SAGE 2YC program, they too learned more in depth about what the CAs were learning. For example, a dean stated, *"Broadening the success to all students is a key goal/initiative at our college. SAGE participants have made contribution to strategies and practices - not only within their department, but throughout the campus."* Some of the administrators saw larger campus changes due to leveraging of the work of the CAs.

As well, the administrators commented how their CAs who had this larger institutional context provided another lever for change for the college. One administrator reflected of his CA, "*She has a broader understanding of decisions that have to be made and so other faculty will talk to her*." In particular, two CAs were leading initiatives on their campuses to build teaching and learning centers.

Yet, given the turnover in administrators in cohort 1 as noted above, several administrators noted a caveat in their comments that they were new on campus or new to the project so felt less up to speed on expectations for their role. Understanding how faculty members can deal with administrator turnover is therefore important.

CoP Sustainability

A discussion topic throughout the project centered on the sustainability of the efforts of the CAs and expansion of involvement of others in the institutional community and in the region. To keep up the momentum of this work for the CAs and the campus, the administrators mentioned the need to maintain and continue to build upon the communications, resources, and relationships they had developed with the CAs. The sharing among the CAs helped build a national network they could tap.

Administrators had varying knowledge of how CoPs were operating on their campus and in the region. Most knew about the regional workshops, and some had attended them. Most often, the CoP the administrators saw emerging came from the relationships the CAs developed on campus, and the ways the CAs saw their work linked to institutional mission and objectives. One administrator reflected on the growth of his CA and said, *"It's easy for him to get buy-in from colleagues. His colleagues look up to him now."* An administrator of CAs from cohort 1 added, *"I see the changes that my change agents have inspired in other faculty."* The administrators were most privy to the communities the CAs engaged with on campus.

The regional connections developed during the project were continuing. The administrators that knew less about the regional workshops focused more on the ways CAs were conducting PD on campus. Those who aware of the regional workshops saw them as a means to build connections and relationships within the state. In this area, the turnover of the administrators meant less knowledge about the larger communities in which the CA were engaged.

In looking forward, the administrators helped the CAs think about the sustainability of their work versus sustaining the CoPs. A strategy used by one administrator involved institutionalizing the work in campus plans: *"We will be working on incorporating her goals into the departmental operational plan and sustainability of the project beyond the grant."* One administrator observed: *"A lot of ideas presented can be applied to other disciplines. I am hoping that the change agent will be able to share these ideas with other people at the college and to foster some collaborative work."* An administrator noted how their CAs were on a team with faculty from another college, and how this connection helped improve the CoP in the region.

Given the more campus focused attention of the administrators regarding CoPs, most discussed ways in which they observed their CAs networking on campus and building relationships. Two of the administrators stated that they hoped to have their CAs gain more of an institutional programmatic perspective beyond the work they are currently doing. As one administrator described, *"…I think there is a little bit of getting them to think more programmatically than simply course wide. They certainly think more that way than I did when I was a faculty. I think that's progress…"* Another administrator offered: *"I am very interested in scaling up the effective experiences gained from this project."* Sharing what was learned in the SAGE 2YC project with the larger campus community begins to sustain the CoP on campus. Given the benefit the administrators saw in engaging with their CAs, they noted how continued communication and check-ins with the CA would help keep up the momentum of the project. Teaching centers provided an identified area to locate some of the work of the CA to provide ongoing sustainability on campus. Looking for grants that align with the work of the CAs was seen as another means to sustain the work of the group.

A final comment by an administrator is noteworthy with respect to sustaining the momentum of improving student success through faculty learning about exemplary practices. One administrator from cohort 1 who attended all three workshops with her CAs noted the learning that occurred for her as well. She reflected, *"So after coming to this meeting I decided to meet with each department for an hour; some of these went great, some went OK. I wanted them to tell me what they do well – I called it their "brag" because that's what I saw here. Something that "I don't know that you're doing," including something that's challenges. "What are the challenges that I can help you with?" It was really great! …Now I can brag about what the departments are doing to with the president and that's the biggest take-away from instructional lens [from SAGE 2YC] that I gained that has impact on the entire college."* This level of replication aids in sustainability of the grant project after completion.

SUMMARY

We summarize this section with results from college visits where administrators, CAs and students were interviewed. The interviews with administrators delved into their varied roles in engaging with CAs during the project, including gathering of information from administrators who were not able to attend the annual workshops. These on-site interviews helped corroborate the information presented above and also contributed to profiles of administrators located above. These qualitative data reinforced information shared above concerning administrators' varied roles in facilitating CA learning and leadership development in their campus environment. Ranging in the intensity of support, administrators provided varied guidance and mentoring for the CAs, including examples of the outfitting of labs and the acquisition of data needed for the project. In some cases, administrators' support also extended to supporting student engagement opportunities in the geosciences, including assisting in finding resources for field trips and lab equipment. Though not consistently so, we did observe that the proximity of administrator and CA offices may have contributed to the intensity of engagement of administrators in CA learning and leadership development.

9. CHANGED COURSES, STUDENT PARTICIPATION, AND COURSE OUTCOMES

We studied changes that the cohort 1 and 2 CAs made to their geoscience courses and student enrollment and success in those changed courses. This section discusses the changes made by the CAs in comparison to other faculty on their campuses who taught geoscience courses but were not part of the SAGE 2YC project (called non-CAs). This section paints a picture of CA course changes and student success in response to a major purpose of the SAGE 2YC grant to improve geoscience education and enhance student academic success in 2YCs.

Questions for this aspect of the evaluation are:

- What changes do CAs make in their geoscience courses, and how do these changes compare to changes made by non-CAs in their same colleges?
- What are the completion rates of students in geoscience courses that CAs change, and how do student sub-groups (gender, racially minoritized status, age, and Pell eligibility) perform in those changed courses?
- What can be learned about pathway progression from the SAGE 2YC evaluation?

METHODS

Using an Excel template designed by the ERI team, data were gathered on geoscience course changes by CAs and non-CAs to evaluate student participation and course success as measured by student completion with a grade of C or higher. This aspect of the evaluation aligned with the three themes of the SAGE 2YC grant to: 1) increase students' academic success through higher course success rates, 2) broaden participation of historically underserved student sub-groups, and i3) enhance students' professional pathways (see Figure 9.1).

Figure 9-1: The Three Major Areas of Course-level Assessment
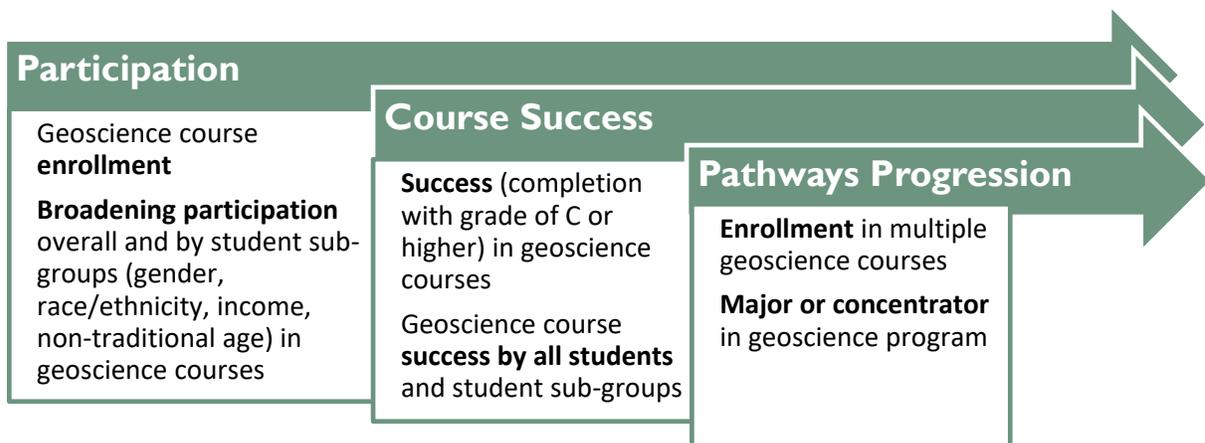
The Excel template was designed to enable the CAs, often in conjunction with institutional research (IR) staff, to report on the geoscience courses taught at their colleges on a term-by-term basis. For each geoscience course taught during the grant, the CAs reported on whether they changed the course, and they also reported on whether other faculty teaching geoscience courses at their colleges who were not part of SAGE 2YC, called non-CAs changed their courses. How these courses were changed was recorded

in the template using a menu of options developed by the ERI team, with input from project leaders. This analysis of course changes provided insights into instructional reforms implemented by CAs relative to non-CAs to provide a sense of the scale and type of course changes over the time period of the grant. It helped to answer the question of whether the changes made by CAs made were associated with their 2YC grant experience or whether they were more commonplace among all geoscience faculty on their campuses. Also, because of the designated role of CAs is to be "change agents", we wanted to know if the changes they made to their courses would spread to non-CAs in that we would see non-CAs make course changes similar to the ones made by CAs during the grant.

The Excel template had six tabs, with each tab having a distinctive focus related to the goals of the project (see again Table 9-1). To simplify the data collection process and promote accuracy and ease of administration, we adopted operational definitions for variables using the federal Integrated Postsecondary Education Data System (IPEDS). Each worksheet of the Excel template provided detailed instructions to assist teams to gather and report the requested data (see Table 9.1). In addition, the ERI team conducted phone calls with the CA teams and IR staff to walk them through the Excel template and answer questions of any kind. During the third and fourth years of the grant, the ERI team conducted webinars and zoom meetings with CA teams and IR staff who expressed interest in using the data for program improvement, and approximately half of the CA teams participated in these sessions.

Over the course of the grant, the Excel template was modified to correct a few computational errors and also to simplify the data entry process. Graphics that auto-populated from data included in the initial template were removed to free up space for term-to-term data entry. Once the CAs and their colleges' IR staff became familiar with the data requested by SAGE 2YC, most had no difficulty providing the data on the annual schedule established from near the beginning of the grant. However, a few colleges were never able to supply the requested data because of research capacity issues or other reasons unknown to the ERI team. Because project leaders were also tasked with assisting the CAs to gather data, supporting the data analysis, some aspects of data reporting were not apparent to the ERI team. This was especially true for the cohort 2 CAs who were guided through the data collection process primarily by members of the project leadership team and less directly involved with ERI team.

Table 9-1: Course-level Data Gathered by the Excel Template for SAGE 2YC

Tab	Data Gathered
1	Course sections taught by CAs from first term to last term data were submitted for SAGE 2YC project (see Table 9.3 below for details).
2	Course section details, including whether the course/course section was taught by a CA or a non-CA, whether the course was changed and how it was changed, and the delivery mode (e.g., face-to-fact, online only, hybrid).
3	Course section enrollment and successful course section completion for all students, as indicated by a grade of C or higher in each course section.
4	Course section enrollment and successful course section completion disaggregated by four student subgroups: gender, race, age, and Pell-eligible status.
5	Pathway progression is measured by the number of students who declared geoscience as the college major or who took multiple geoscience courses, in a total and disaggregated by gender, race, age, and Pell-eligible status.
6	Type of changes made to each course section according to the interventions introduced to CAs through the SAGE 2YC grant, including active learning, group learning, metacognition, etc.

Developed during the fall of 2016, the template was first used by the cohort 1 CAs to report data from spring 2017 to the end of the grant although some CAs provided data for a semester or two earlier than spring 2017. The template was used by cohort 2 to begin reporting data for Fall 2017 to the end of the grant. Data were gathered for cohort 1 and cohort 2 through winter or spring 2019, which was near the end of the original 4-year time period of the grant. The template was completed on an annual basis, typically April and May, to prepare data for the summer workshop that occurred in June of each year. Data files prepared by the CA teams were uploaded into a password-protected folder maintained by the Science Education Research Center (SERC), and these data files were downloaded by the ERI team to conduct data analysis and provide summary results to CA teams and project leadership. Starting in year 3 of the grant, selected data were included in the annual report to the NSF.

Table 9-2 shows the data provided by all CA teams over the course of the grant. (Readers are reminded that some teams had multiple members in a single college and some involved members in multiple colleges. (For more information on the composition of teams, see again Appendix B.) Important to note in this table is that two cohort 1 teams and three cohort 2 teams did not submit data that the ERI team was able to use for this evaluation. Various issues emerged to impede data collection at selected colleges (e.g., no data were supplied or some data were supplied but missing key variables needed for data analysis, or supplied data had sufficient errors to make it unusable for reliable analysis). Also, some CA teams did not submit data through to the end of the original grant period of Summer 2019, ending their data submission with Fall 2018 or Winter 2019 terms. With the exception of one college in the Illinois team, all teams that ended data submission in Winter 2019 operated on the quarter system wherein submission of their data would extend beyond their original contractual agreement with the project.

Table 9-2: Cohort 1 and 2 Useable Data by Term

Team	System Type	SP17	SU17	FA17	WI18	SP18	SU18	FA18	WI19	SP19	No. Terms with Data
Cohort 1											
Florida	S	X		X		X		X		X	5
Illinois	Q	X	X	X		X	X	X		X	7
New York	S	X		X		X		X		X	5
North Carolina	S	X		X		X		X		X	5
No. CA	*Data file unavailable or useable*										
Oregon	Q	X		X	X	X		X	X		6
So. CA – Mt. Sac	*Data file unavailable or useable*										
So. CA - Pasadena	Q	X	X	X	X	X	X	X	X		8
Texas	S			X		X		X		X	4
Virginia	S	X	X	X		X	X	X		X	7
Wisconsin	S	X		X		X		X		X	5

Team	System Type	SP17	SU17	FA17	WI18	SP18	SU18	FA18	WI19	SP19	No. Terms with Data
Cohort 2											
DC Metro	*Data file unavailable or useable*										
Massachusetts	*Data file unavailable or useable*										
Michigan	S			X		X		X		X	4
Oregon	Q			X	X	X		X		X	5
So. CA – Mt. Sac	*Data file unavailable or useable*										
Washington	Q			X	X	X		X	X		5

Note:

1) System type refers for Semester (S) and Quarter (Q). Because the 2YCs operated on a semester or quarter basis their data submissions varied by system type, with CAs operating in semesters providing data for up to three terms per year, and CAs operating in quarters providing data up to four terms per year.
2) Some CA teams provided no useable data and were omitted from this section of the report. However, some CA teams provided partial data pertaining to specific analysis processes, and when possible, these teams' data are included to the extent possible and noted in the discussion and tables in this section of the report.

COURSE SECTION CHANGES DURING THE GRANT

Results pertaining to the number of course sections that cohort 1 and 2 CA teams taught and changed in each year of the grant are presented in this section, also comparing these results for CAs and non-CAs. This analysis documents the number of course sections changed by CAs compared to non-CAs in both cohorts (1 and 2). In total, the CAs reported changing 186 of 216 (86%) of the course sections they taught during the three years of the grant compared to 65 of 816 (8%) by the non-CAs over the same period. These data reveal that the cohort 1 CAs changed the vast majority of their course sections by year 3 of the grant, but also continued changing their course sections through to the end of the grant. This finding suggests the geoscience CAs engaged in changing their courses to incorporate new instructional strategies and pedagogical approaches associated with the SAGE 2YC grant. Particularly among the cohort 1 CAs we saw a substantial proportion of course sections changed near the beginning of the grant, but some toward the end. Comparing the changes made by CAs to non-CAs reveals a starkly different pattern, with non-CAs changing a much smaller proportion of their course sections. These findings suggest the benefits of being part of an NSF project where PD is offered and faculty are supported in their efforts to change courses. Comparing the scope of changes made by CAs and non-CAs, it is possible the non-CAs were more challenged in making changes when they were not the direct recipients of PD associated with a project like SAGE 2YC grant.

Figure 9.2 compares the cumulative number of course sections changed by faculty CAs compared to non-CAs, showing the majority of course sections taught by the cohort 1 CAs were changed compared to about 60% of course sections taught by cohort 2 CAs. The difference in percentage of course sections changed by the two cohorts is attributable primarily to the difference in the time that the two cohorts were involved in the grant, as well as differences in prior engagement in PD. Specifically, many cohort 1 CAs reported changing courses early in the grant as they had already participated in PD associated with

prior geoscience NSF grants. By contrast, most cohort 2 CAs had little or no prior experience with PD associated with an NSF project like SAGE 2YC, and therefore newer to implementing changes associated with the SAGE 2YC PD. With respect to the SAGE 2YC grant, the cohort 2 CAs had about one-half the time to change their changes compared to the cohort 1 CAs.

Comparing the two cohorts to non-CAs, we found much greater amount of course section changes among the CAs than non CAs (see again Figure 9-2). Over four years, the cohort 1 CAs reported changing approximately 88% of their course sections compared to only about 8% of the course sections reported as changed by non-CAs. Over the last two years of the grant, the cohort 2 CAs changed slightly over 60% of their course sections compared to only about 3% of the non-CAs. This translates into 186 course sections changed by cohort 1 CAs (approximately 17 course sections per team), and 28 course sections changed by cohort 2 CAs (just under 6 course sections per team). By comparison, a total of 65 course sections were changed by the cohort 1 non-CAs, and only 2 by the cohort 2 CAs.

Figure 9-2: Total Number of Course Sections Changed by Cohort 1 and 2 CAs and non-CAs
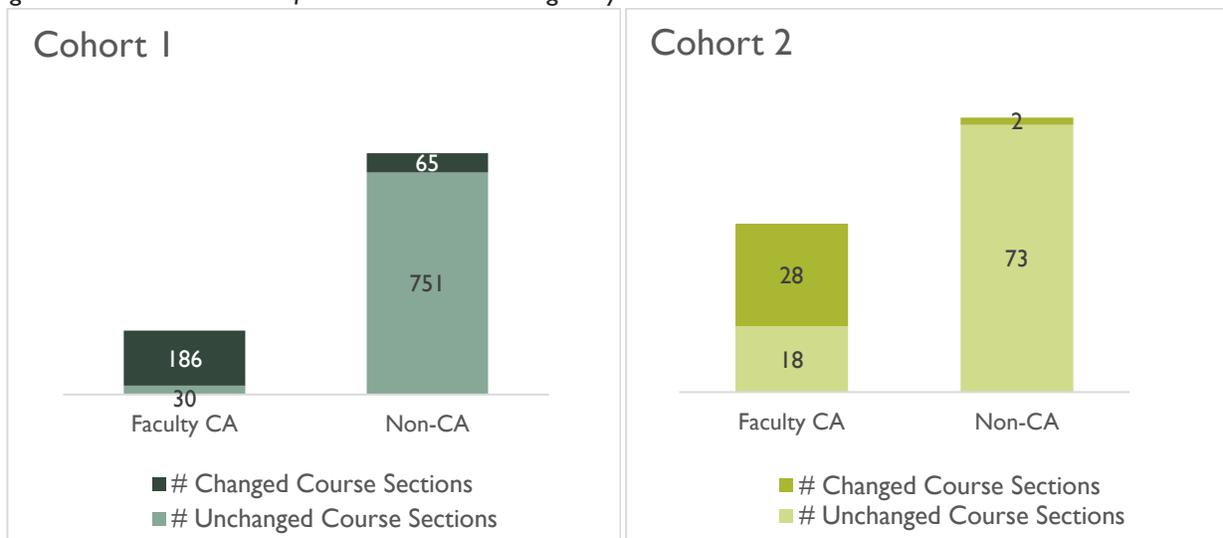
Figure 9-3 breaks down the total course sections changed for all years of the grant to each year of the grant for cohort 1 and 2. As noted previously, the quicker pace of change for cohort 1 is due primarily to the earlier start of these CAs in the project but may also be attributable to their previous involvement in PD similar to SAGE 2YC. By comparison, the pace of change was different for the cohort 2 CAs in that none were involved in PD related to SAGE 2YC prior to the grant. For cohort 2, course section changes accelerated during their second year of their engagement in SAGE 2YC, which was year 4 of the grant. These results point to the need for projects like SAGE 2YC to be attentive to prior experiences that faculty bring into the PD. It is important to ensure that CAs build on prior knowledge and equally important to provide sufficient time and support to enable CAs without previous PD to learn how to implement changes advocated by the grant.

Figure 9-3: Percentage of Course Sections Changed by Year for Cohort 1 and 2 CAs and Non-CAs
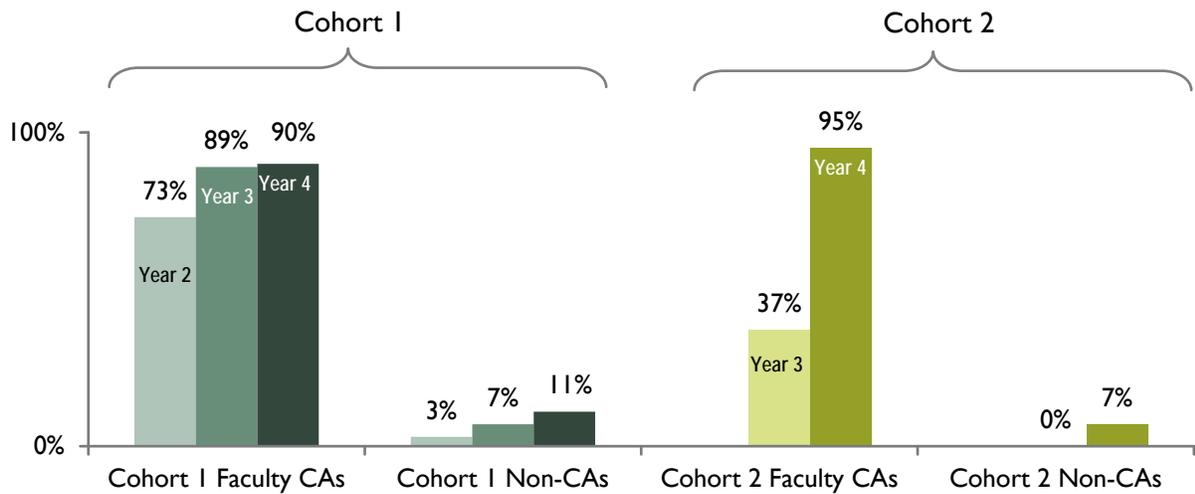
Since only a small proportion of non-CAs changed their course sections, we focus the remainder of this section on the results associated with the CA teams. This analysis also focuses on the changed course sections of the CAs since the vast majority of their courses were changed and our primary interest is in what happened with student participation, course success, and pathways relative to these changed course sections.

COURSE SECTION CHANGES BY DELIVERY MODE

Research shows enrollment and retention rates are associated with instructional delivery mode in that online delivery tends to be associated with lower course success rates than f2f instruction. Given the emphasis of SAGE 2YC on course success, we gathered data on the delivery mode for course sections according to face-to-face, online, and hybrid formats. We gathered these data to understand whether changes made to course sections using these delivery modes would relate to student enrollment, including broadening participation, and course success. Our intention was not to assess the direct effect of these formats on course success but to take these formats into account, as needed, in assessing the relationship between changed course sections (according to the SAGE 2YC grant) and course success.

Figure 9-4 shows seven of the nine cohort 1 teams reported the vast majority (over 60%) of course sections changed by the CA teams to be offered in a face-to-face format. In fact, many CA teams taught nearly all their changed courses in the face-to-face format, which made the delivery format relatively moot in assessing course success for these teams. However, four cohort 1 teams (Florida, Illinois, North Carolina and Virginia) showed a different pattern from the rest of the CA teams (cohort 1 and 2) in that they offered more course sections in an online or hybrid format. For example, the Florida team taught 100% of its changed course sections using a hybrid format, and the North Carolina team offered the majority of changed course sections using either online or hybrid. Though not used as extensively, nearly 40% of the changed course sections taught by the Virginia team were online or hybrid, and 30% of the changed course sections taught by the Illinois team were online.

Figure 9-4: Percentage of Changed Courses Taught by CA Teams by Delivery Format
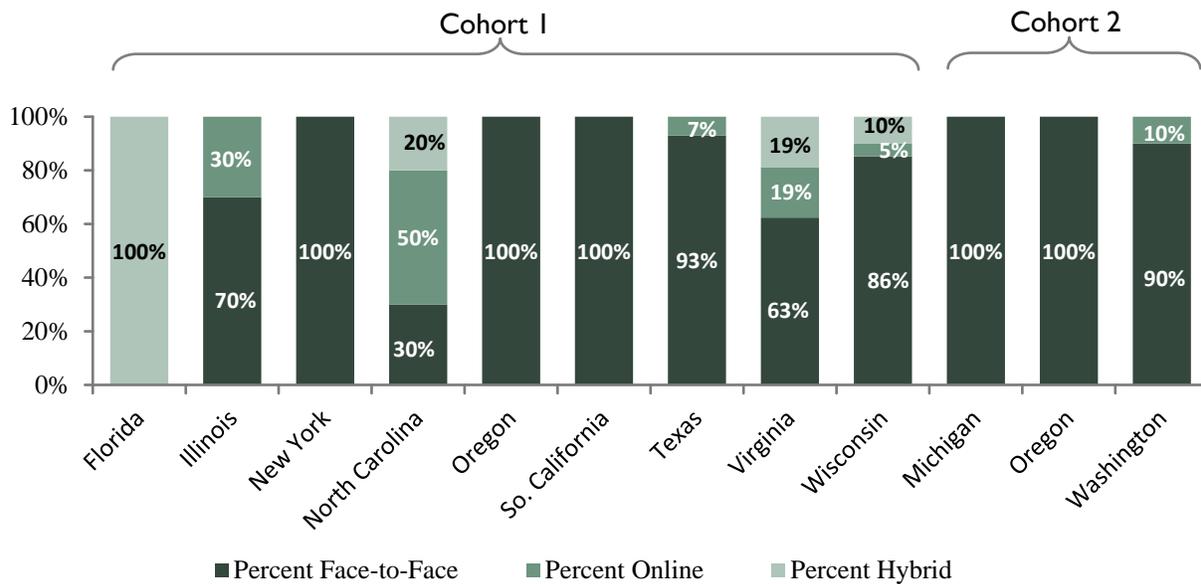
TYPE OF CHANGES MADE TO COURSE SECTIONS

The Excel template provided a drop down menu so that the CA teams could indicate the type of change that they made to each course section during the grant. These particular changes were identified from the first time a course section was entered into the template, with the option for CAs to indicate that the change was made prior to the grant or during the grant. Because of the necessity to gather these data consistently over the course of the entire project, the categories did not change and therefore did not reflect some types of changes that evolved later in the project, including topics related to equity, inclusion, and cultural-competency. However, the CAs could indicate an "other" change, and write that change into the template. We believe that the list of changes provided in the template was relevant through SAGE 2YC, but we do recognize that other changes not included in the template occurred and may be underreported because of the structured format to our approach.

The seven categories that the template provided follow:

- Engage students in group learning activities

- Incorporate active learning pedagogies

- Use metacognition strategies

- Introduce student learning supports (e.g., advising, tutoring)

- Connect course content to current events and community issues

- Set course learning outcomes that are communicated to students

- Discuss career pathways and transfer options

- Other (unspecified in the template but some CAs wrote "inclusive pedagogy" and issues pertaining to "diversity, equity and inclusion")

Figure 9-5 presents results on the percentage of cohort 1 and cohort 2 teams that report making each type of change to one or more course sections. Meta-cognition was reported by 100% of both cohort 1

and 2 teams, while 100% of cohort 1 reported group learning and 100% of cohort 2 reported course content connections. Other changes implemented by the majority of cohort 1 and cohort 2 teams are active learning and student learning supports.

Figure 9-5: Percentage of Cohort 1 and 2 Teams by Type of Change Made to Course Sections
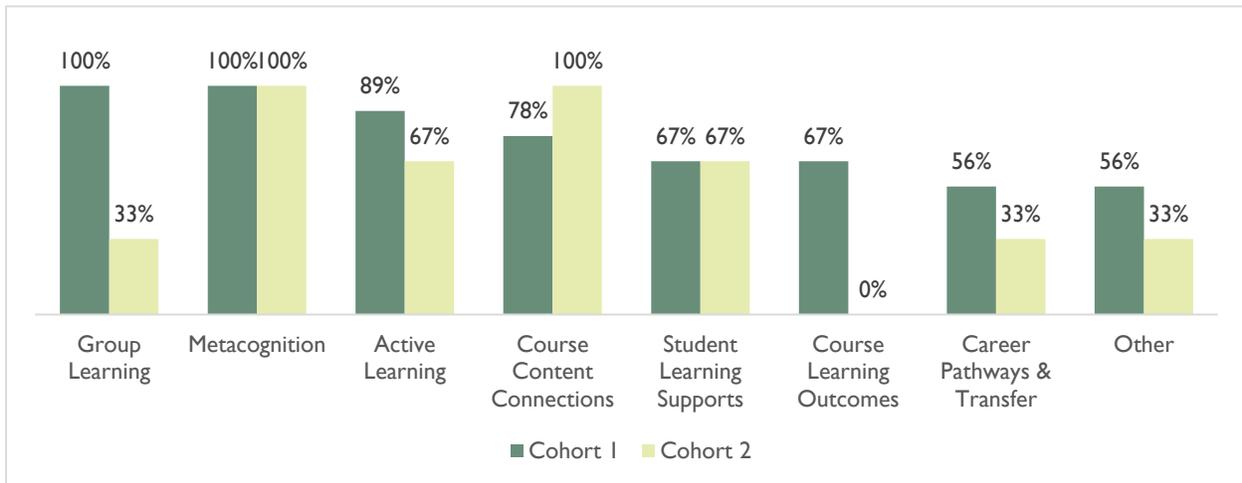
STUDENT PARTICIPATION, INCLUDING BROADENING PARTICIPATION

We begin our analysis of student participation by examining average enrollments in the course sections by the CA teams (cohort 1 and 2) to provide a sense of the scale of student enrollment in the changed courses. As noted previously, almost 90% percent course sections were changed by the cohort 1 teams during the grant, and over 60% of course sections taught by cohort 2 teams were changed. Logically, student enrollment grew in changed course over the course of the grant, with approximately 95% of student enrollments associated with changed courses taught by cohort 1 and 2 CAs by the fourth year of the grant (Figure 9.6).

Figure 9-6: Average Percentage of Enrollment in Changed Courses for Cohort 1 and Cohort 2 CAs
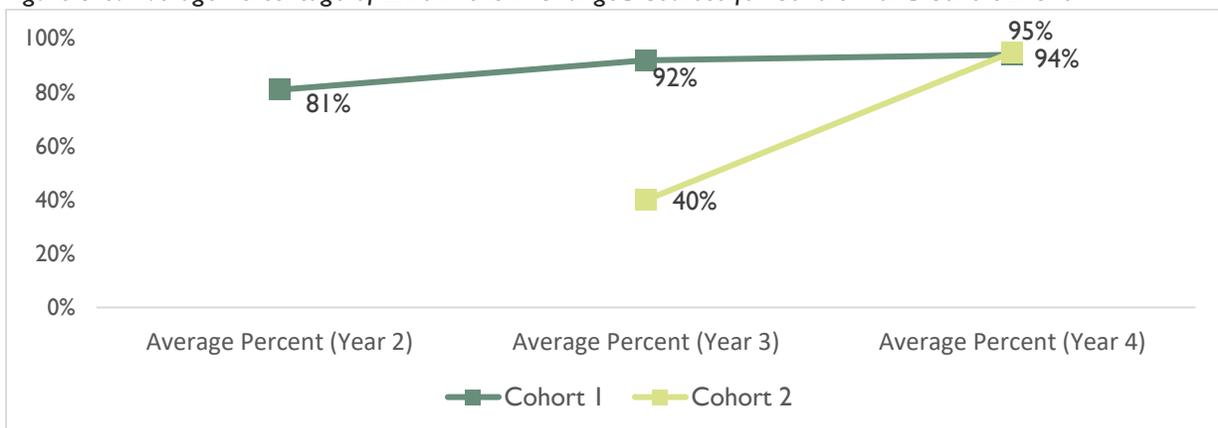
These results suggest about 5,000 enrollments were documented in changed course sections taught by CAs (cohort 1 and 2) during the grant. Slightly over 700 enrollments were logged in changed courses taught by the cohort 2 CAs, with the remainder being taught by the cohort 1 CAs.

Figure 9.7 also shows higher enrollment associated with larger number of changed course sections for the Illinois team, with the North Carolina, Southern California and Virginia teams reporting the next largest course sections and corresponding higher enrollment relative to other CA teams. The Washington team had the largest number of changed course sections of the cohort 2 teams, with higher enrollment corresponding to the larger number of changed course sections.

Figure 9-7: Total Enrollment in Changed Course Sections by Cohort 1 and Cohort 2 CAs
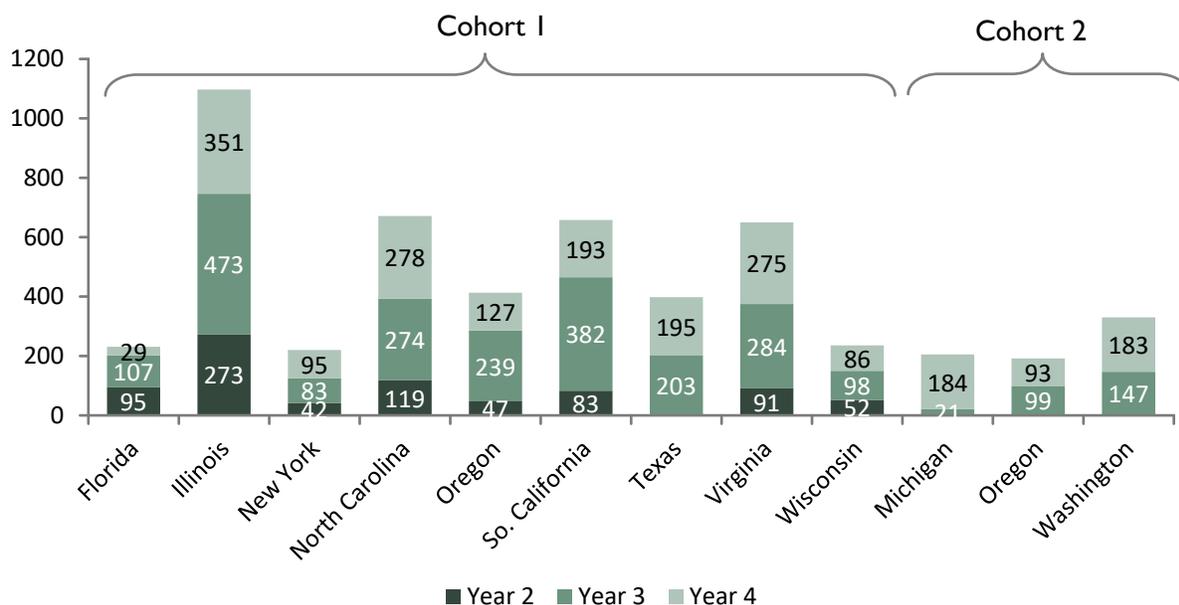
Broadening Participation

Figure 9.8 presents results on broadening participation in changed course sections for cohort 1 and cohort 2 CAs. This figure shows distinctive patterns of average course section enrollment by each sub-group. For example, in looking at female enrollment, we see a slight decline in average course section enrollment for cohort 1 but an increase for cohort 2 where female enrollment grew by 7%, from 45% to 52% in year 3 to year 4 of the grant. Looking at racially minoritized groups, we see a substantial increase in average enrollment of 13% for cohort 1, from 24% in year 2 to 37% in year 3, while the average enrollment of racially minoritized groups is similar cohort 2 in year 3 and year 4 of the grant.

Also, we see little change in average enrollment by non-traditional age in years 2, 3, and 4 for cohort 1, but we see an increase of 5% (from 19% to 24%) by non-traditional age students from year 3 to year 4 for cohort 1. Similarly, we see an average enrollment of Pell-eligible students for cohort 1 (from 39% in year 2 to 40% in year 3 and 41% in year 4), but we see an enormous increase in average enrollment for these students for cohort 2, from 17% to 32%. These results suggest broadening participation for racially minoritized students for cohort 1 and for females, non-traditional age, and Pell-eligible students for cohort 2.

Figure 9-8: Average Enrollment Rate of Student Sub-groups in Changed Course Sections
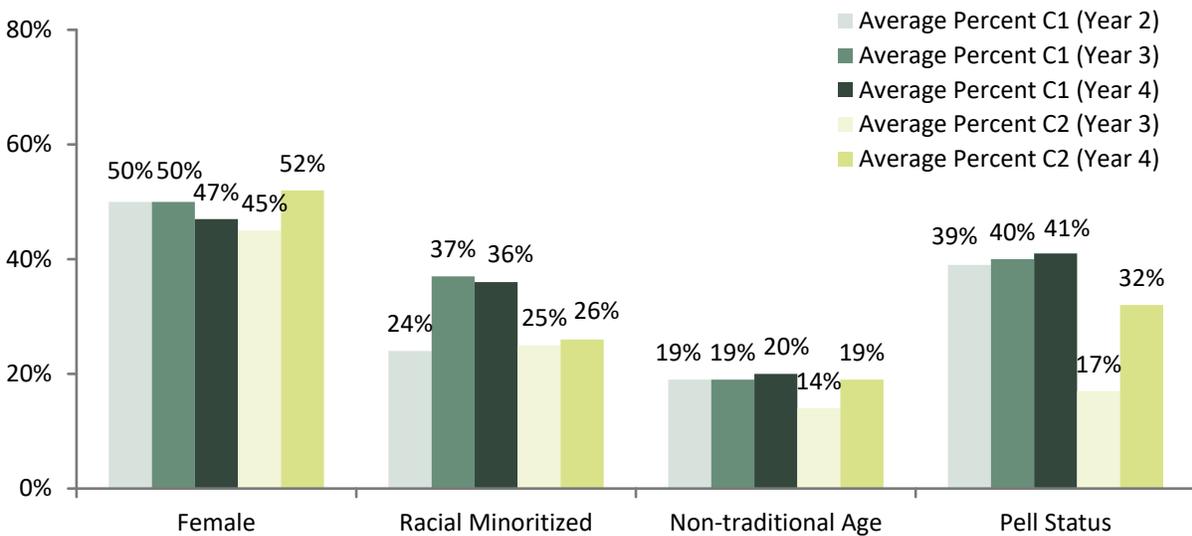
COURSE SUCCESS

An important goal of the SAGE 2YC grant was to examine the successful completion (with a C or higher grade) of students enrolled in changed geoscience courses, which we called "course success". To measure this outcome we computed a success rate for each course section that was changed by the cohort 1 and cohort 2 CAs, and we averaged these course success rates for the teams by year. These average course success rates were used to create an overall average by year of the grant (years 2, 3 and 4) and the grand total for all years. This approach was chosen to avoid the average course success rate being skewed toward the results of CA teams with more course sections. Given the wide range of college sizes, some CA teams taught only a few geoscience courses per year (e.g., 8-10) whereas other CA teams taught 40 or more. By using averaging success rates by course sections we avoided the larger CA teams dominating the results.

Figure 9.9 shows the average course success rate by year for the two cohorts. The figure shows the course success rate for cohort 1 CA teams rose five percentage points from year 2 to year 4 of the grant, increasing from 68% in year 2 to 73% in year 4. The overall course success rate is 71%, with the overall course success rate for all cohort 1 teams, ranging from 52% to 95%, and revealing considerable variation among the teams (standard deviation of .19)

For cohort 2, results are very similar for the two years of the grant, with an 86% course success rate in year 3 and 87% in year 4. The overall course success rate is 87%, ranging from 84% to 90%, and a standard deviation of .12. (Recall, the second cohort was not recruited until the third year of the grant, which explains why no results are reported for year 2 of the grant.)

Comparing the two cohorts, it is noteworthy that the overall average course success rate for cohort 2 is 16 percentage points greater than the overall average course success rate for cohort 1. The reasons for such a major difference are not clear from the quantitative data but worthy of further investigative to see if this pattern of improved outcomes continues with the third cohort of the SAGE 2YC grant. Drawing from other data gathered in this project, as well as anecdotal observations made the project leadership, there may be differences in the CA teams' experiences with using data and engaging in course and

program improvements prior and during the grant that may contribute to the difference in course success though additional research is needed to assess this hypothesis.

Figure 9-9: Average Course Success Rates for Cohort 1 and Cohort 2
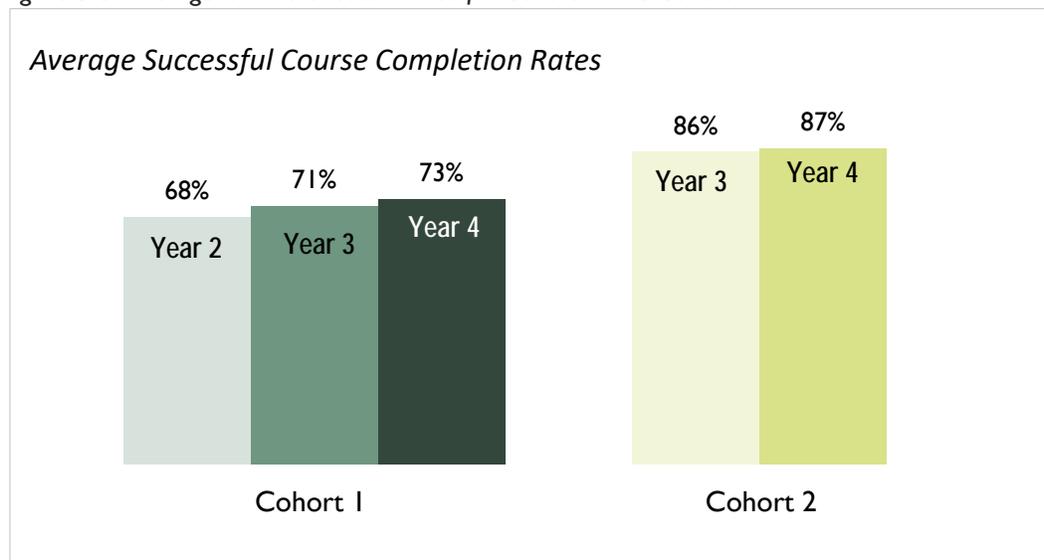
Lastly with respect to college success, Figure 9.10 displays disaggregated results for course success for the four student subgroups: females, racially minoritized groups, non-traditional age students, and Pell-eligible students. The figure displays the average course success rate for each group over the grant period, again showing a distinctive pattern of results for cohort 1 and 2. These results should be viewed cautiously because of considerable variation in course success rates within the sub-groups, with standard deviations ranging .12 to .35. For example, the average course success rates for racially minoritized groups have high standard deviations due to the modest number of students of color in relatively small class sizes. Caution should be used in generalizing results from these findings but we go ahead and include them to provide a baseline of information on sub-group completion rates for the purposes of comparing to future research results.

Looking at cohort 1, we see an increase in course success rates from year 2 to year 4 for all four sub-groups. Specifically, from year 2 to year 4, the course success rose 7% for females, 12% for racially minoritized students, 9% for non-traditional age students, and 8% for Pell-eligible students. For all groups except the racially minoritized group, the average course success rate approximated or exceeded the overall course completion rate by year 4 of the grant. For the racially minoritized students, there was a gap of 7% between course success rate of 64% in year 4 and the overall course success rate of 71%. These data show the gap in course success was closing but still present on some level at the end of the grant.

By comparison the cohort 2 results demonstrate fairly comparable results for years 3 to year 4 for females and Pell-eligible students. In both cases, the groups' course success rates are very close to the overall course success rate of 87%. However, the results for the other two sub-groups are worth noting because, despite already relatively high success rates are evident, the success rate increased. For racially minoritized students the course success rate increased 8% points from 82% to 90%, and for non-traditional age students the course success rate increased by 11% from 82% to 93%. In both cases, the results exceeded the overall average by the year 4 (the second year of the grant for cohort 2). Again,

these findings are noteworthy because they suggest the course success rates extended to sub-groups such that the gap for sub-groups closed to approximate or exceed the overall course completion rate. (Again, readers are referred to supplementary tables in Appendix C to see results by college team across sub-groups and years of the grant.)

Figure 9-10: Average Course Success Rate by Cohort, Year and Student Sub-group
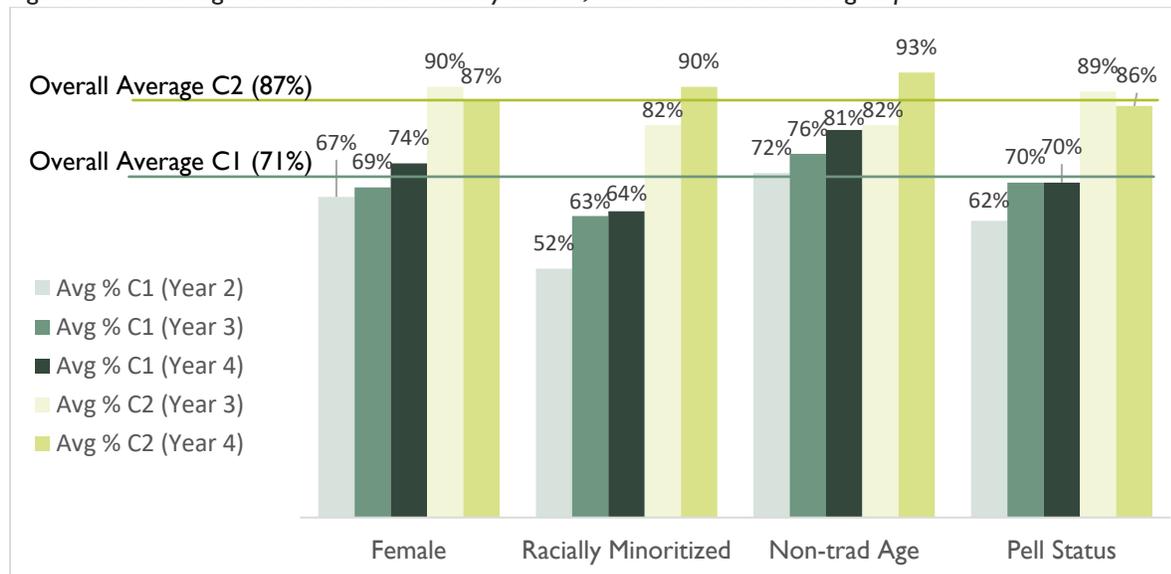
PATHWAY PROGRESSION

Gathering data on pathway progression is challenging for many colleges to collect and report accurately for a number of reasons. For one, most colleges do update student information on chosen college major on a regular basis, and college students in their first year or two are known to change college majors numerous times. Also, if colleges do keep track of progression they tend to focus courses (and course credits) toward blocks of general studies courses aligned to transfer agreements that are designed to enable students to matriculate to the university for upper division course work. For students seeking career-technical education (CTE) programs, the chosen major may be more clearly identifiable but even then, colleges may not maintain an up-to-date centralized database that enable the college major to be identified clearly and consistently.

Unfortunately, these previously documented challenges to the collection of valid and meaningful data on college major manifested in this study. To their credit, we did gather data from five cohort 1 teams and 2 cohort teams on college major, as well as multiple course-taking in the geosciences, but we found several files provided illogical information about college majors among the geoscience course enrollees. Given these findings, we elected to not present results on pathway progression. In the future, we plan to further develop the data collection process and template to ensure more accurate reporting. As more colleges adopt and improve transfer and career pathways, data collection systems will improve and create more opportunities to track enrollment and course success by college major.

SUMMARY

The quantitative analysis of course section changes made by faculty CAs and their non-CA counterparts shows the growing scale of reform taking place on the 2YC campuses involved in the SAGE 2YC project. Over the course of the grant, nearly 300 geoscience course sections were changed by CAs who implemented evidence-based instructional strategies designed to improve

student academic success, broaden participation, and enhance pathway progression. Most changes were made to course sections taught by CAs, with much less change reported for non-CAs, though more changed courses were reported for cohort 1 colleges than cohort 2 presumably because faculty in cohort 1 colleges had more time. Efforts to scale improved instructional practices, (meta-cognition, active learning, group learning, career connections, etc.) seemed to take root when CAs experimented, modified, and improved practices over time. Particularly cohort 1 had the lengthy commitment of four years of project support to enable this evolution to occur, but impressive changes were made by cohort 2 CAs as well.

With respect to course success,the data suggest a modest increase in course success rates over time for both cohort 1 and 2 though the changes are not substantial. Most important to note about average course success rates is the difference between cohort 1 and cohort 2, with the average completion rate for cohort 2 teams exceeding cohort 1 by nearly 20 percentage points. The reason for this sizable difference is unclear in the quantitative or qualitative data but anecdotal observations shared by members of the PI team suggest differences in the cohort 1 and cohort 2 use of data to make improvements. Cohort 2 CAs seemed to be especially attentive to variations in course success rates by gender, race/ethnicity, age, and Pell-eligibility and committed to making changes to increase student success.

10. STUDENT PERSPECTIVES

The comprehensive evaluation and research of SAGE 2YC focused on understanding the ways the SAGE 2YC project engaged and supported CAs in changing their practices. Student focus groups conducted during site visits to CA colleges enabled the ERI team to gather students' perspectives as recipients of these changes. Through these small group interviews, we learned about the changes that the students experienced in the CA classes, the sense of belonging they felt in classes (in various formats) and on campus, and better understood how they were thinking of their next steps on their transfer and/or career pathways.

Research questions that guided the study of student perspectives follow:

- How do students experience geoscience courses, and what recommendations do they have for additional improvement?
- What do students learn about academic choices, and do they feel more prepared for transfer and career pathways?
- How supported and connected do students feel toward their academic experiences, CA faculty, and other aspects of campus life?

METHODS

Site visits occurred for 10 of the teams [6 for cohort 1 (NY, TX, VA, SCA 1, SCA 3, and OR-Portland) and 4 for cohort 2 (VA, WA, SCA 3, OR-Willamette Valley)]. During these visits, focus groups were conducted with a total of 204 students. These students included current and past enrollees in geoscience courses taught by CAs and non-CAs, as well as 2YC alumni. The majority of students were traditional-aged college students (18-24), with a minority of returning adult learners. Not all students who participated in our focus groups had taken CA classes only as some had taken courses with non-CA instructors. Weather conditions complicated site visits for cohort 1 to OR-Portland and cohort 2 OR-Williamette Valley, and cohort 2 VA. To gather the missing data we conducted video calls with students (as well as the CAs and others). Details on the timing of the site visits and number of student participants follow in Table 10.1.

Table 10-1: Site Visit Student Participants

Site	Attending Colleges	Number of Students
Cohort 1		
Virginia *October 2017*	TNCC-Historic Triangle TNCC-Hampton Reynolds	11 30 9
New York *April 2018*	Suffolk CC	9
Southern California 1a *November 2018*	Pasadena	30
Southern California 1b *November 2018*	Mt. SAC	25
Portland OR *February 2019*	Portland-Rock Creek Portland-Southeast Campus	4 2

Site	Attending Colleges	Number of Students
	Mt. Hood	7
Texas *October 2019*	Lonestar-Tomball	7
	Lonestar-University Park	20
Cohort 2		
Western WA *October 2018*	Western	15
Southern California *November 2018*	Mt. SAC	7
Virginia *January 2019*	NOVA- Annandale	6
Willamette Valley *February 2019*	Linn-Benton	2
	Chemeketa	20

The student focus group interview protocol included the following questions:

1. What made you decide to take [XYZ] course this semester/term?
2. Can you describe a typical geoscience class period from this semester?
3. Can you describe a classroom activity or experience in which you felt you learned the most? What type of classroom community do you experience in this case?
4. If you could change anything about the course that would help improve your learning and engagement in geoscience, what would that be?
5. As you think of your next steps, what has helped you in thinking through your academic choices and path?
6. Are there offices or programs on campus that you found helpful in any aspect of your geoscience involvement?
7. Can you tell us what makes you feel most connected in your class?

FOUR THEMES ON STUDENT PERSPECTIVES

Four themes emerged during the student focus groups. The first theme centered on motivations for taking a geoscience class. The second theme noted how faculty passion and relatability translated into students' learning experiences. The third theme emerging from our conversation with students was the larger college context (e.g., how other professors taught their classes, out-of-class supports, career pathways). Finally, students shared how they felt to being "seen" by CA faculty as being a valued individual versus just another student.

Student Motivations

We found two main strands of motivations for students enrolled in geoscience courses. One strand pertains to geoscience classes fulfilling a science requirement for transfer that is viewed as more accessible than chemistry or physics. The second strand suggests students taking geoscience classes had a prior interest in the geosciences and intentionally sought out these classes. Also, many of the classes involved field trips, and students enjoyed these out-of-class experiences. Some perceived the ease of

taking geoscience classes to meet their graduation requirements as a welcome surprise. A sub-set of this group took more geoscience courses, and as a result, became a geoscience major. Some students specifically sought out CA faculty based on their reputation or information about instruction of prior courses. Those motivated by interest in taking particular CA faculty courses found their expectations fulfilled, but a minority of students noted that they did not like the course or material. The following quotes represent the range of student motivations.

Fulfills a Requirement:

> *Well, for me, I took it because one, it was a requirement. I had already took biology but I had ended up failing biology because I missed my finals because I was sick. So, I really didn't want to sit through biology again. And initially I kind of feel like geology was going to be kind of easy because it was rocks, to be totally honest. But, as I got further in depth into it, I realized that this is a lot different than just rocks. So, I liked it's interesting and things like that. So, that's why I took this class.*

> *I'm graduating this semester with Liberal Arts, but I'm getting more interested in Math and Science. That's why I'm here, I wanted to see Geo path and so on. It's very interesting stuff. It sounds awesome.*

> *After I took that [combined geology and astronomy class], I just dove into Geology and it was something that interested me a lot more than I thought it would.*

> *Didn't' know about geology. [CA] made me realize I did want to do it. I took 5 courses as well.*

> *I didn't know that I loved rocks until the class.*

> *I'm taking this class so I don't have to pay back my student loans yet.*

> *I needed to take a science because I'm in just my general studies right now. I looked at all the sciences, and I said to myself, "I don't want to do physics. I'm done with my math." I looked at biology and chemistry and said, "I didn't like them when I was in high school." And so I was like, "I'll go with geology. It seems pretty cool."*

> *I don't wanna go into chemistry but geology is something that is just the planet you live in and I remember doing rocks in eighth grade.*

> *I had to take it as a requirement, but the reason I ... because there were other options, to select, like biology, but the whole reason I ended up picking geology was because I now go out on hikes, to the mountains and I started getting curious about the formations, so I figured that would maybe help a little bit.*

Interest in material:

> *I wanted to finally be able to apply what I've been learning to its real world application. We get to go outside a lot which is nice.*

> *We've gone outside. We've identified rocks on campus. We have learned how to use certain surveying equipment. We've learned skills that we would need to know if we were working in the field, which is helpful. It's not just knowing vocabulary, it's knowing how to apply it.*

So, obviously most people take it because of requirements, but there's also interests as well. I was really into geology when I was younger. I actually spent a lot of time when I was younger at the geology lab at T hall, on campus, and so for me it was kind of like, oh, it's stuff I did when I was a kid, but now I get actual credit for it.

Well, I took it because it translates to what I do for hobbies as far as being outside, and hiking, and climbing, and I'm eventually going to the park service. I'm doing this and I retired last October, so I'm essentially doing this to kind of postpone getting another job. But I want the degree I started 20 something years ago.

I originally wanted to teach high school science and then I came here and found that there was a much broader thing I could be doing cause there aspect of that that I didn't really like and taking geology along with astronomy and figuring out that there are more options, I decided I was gonna be a professor of geology. And I would like to work at a community college the first 15 years of my career and then move on to a bigger university with a PhD be able to research and then teach my research and a big part of my goal is to be able to include students in what I do just like [CA] includes us in things that he does.….. It's their research and they're including us in it. I wanna be able to do that.

I've had a natural obsession with volcanoes, earthquakes, tsunamis, natural disasters, whatever the case may be. Rocks. Ever since I was a little kid.

Sought out faculty member:

I took another course with [CA] that I enjoyed and I needed more credits.

Because my friend had [CA] and said that she was the best teacher ever.

[CA] has amazing ratings on Rate My Professor.

And I'm the oddball. I'm an audit student. This is my fifth class with [CA] and the last of the geology classes. So, it doesn't fit into any program but my own personal interest.

I took her last term for 144 and I had found her originally through Rate My Professor as well. But I liked her, so I stayed with her and I don't like night classes because I have kids. And I pay for daycare so that I can take her specifically.

Passionate Faculty and Student Engagement

Students noted that their faculty members were passionate about the geosciences, and they explained how this enthusiasm translated into their classroom instruction. Faculty passion was attributed with more interesting classes, according to students, and our classroom observations corroborated how often active learning strategies were employed. For several CAs, their teaching shifted to more student-centered. The hands-on nature of associated lab sessions and integrated labs within classes provided fertile ground for active learning. CAs also made use of different technologies to engage students and included ready-references to relatable concepts (e.g., the ways in which layers are evident in a milkshake). We observed CAs getting students to engage with each other in a range of learning approaches that help them understand material. Praising a CA for her teaching, one student summed up by saying, *She is a rock star.*

Our observations also highlighted how the use of active learning did not always translate to student-centered pedagogy. For example, one CA used an active learning-oriented activity and students were not engaged (e.g., resting head on arm, on phone). This instructor prodded the students, saying "*Why is*

everyone so sleepy today?" in a tone that did not result in more engagement. In a follow-up focus group with this CA's students we did not hear about this aspect of the class but instead heard praise for a hands-on application of materials and enthusiasm for the class.

Supporting students:

The professors here are just unbelievable. Especially in this program, I know [CA] is like, I would not be where I am without him and he's helping so much and I was actually having a conversation with him a few days ago about whether or not I should go for my PHD. He was telling that I should definitely do it and I was like "I don't know," and he was completely supportive; he always is like so supportive and helped us keeps us involved in everything and he has done wonders for this department and individuals.

She genuinely geeks out over the stuff that she teaches.

He's passionate about geology. I don't think I've seen anybody that passionate about science.

That's how I learned because he's so passionate about what he teaches and stuff. That's really hard to say an instructor who is very passionate about it and wants to share that information with you, wants me to get it as just as much as he gets it. That just takes it up a whole different level.

Well, the teacher's enthusiasm for the subjects. The classmates can often make a class better, especially if they're engaged and not just sitting there like, just quiet, crickets chirping. They're asking questions; they're engaging. They're bringing up their own experiences and stuff like that. So, I think the students can bring just as much to a class as a teacher can.

It definitely helps when a professor themselves are passionate about what they teach, because that passion if you don't have it already like myself, it rubs off on you like she says. And it just makes you so much more interesting. So, instead of, "Damn it another morning class. Like, damn another morning class. Let's go!" I don't know how else to explain it.

Just overall passion of the professor like it's really important, I've only had a few professors that really are like that.

She just loves what she's talking about.

Yeah, I've always loved geology and rocks and stuff, and when I heard her talking about it, it just kind of lit that flame back up. Yeah, it's really nice to have passionate teachers.

[CA] is an, I guess, energetic and engaged teacher. I've never seen anybody that happy about rocks before in my life. It really helps with the class.

I just heard about [CA], from faculty. And they said that she's a great teacher and she's really enthusiastic. So then I took her and she is really enthusiastic about her work.

Approachable and open opportunities:

I just feel like, professor [CA] he's like the only professor I feel comfortable in talking to about anything and that made me understand geology more.

She writes down stuff, what we should've said. She even has checkups where she says, like the beginning of the year, she says, "What are your goals for the class? What would you like to learn? What would you do to improve it?" We did it right before the test, I think, our first test. She actually followed up on that. She asked more questions.

She actually offered us the opportunity to go to the geological convention thing that just happened over the weekend. I was the one from our class to go, and I feel like that really opened me up to the whole geological world. I'm really glad that she provided the opportunity, because I just really got to understand like, whoa there's so much more. I'm just at the tip of the iceberg here. What's metasedimentary thing. Oh my gosh, what is this? It was great.

And [CA] is the reason that I just got really into it and I started looking up jobs and there's a lot of stuff that I'd be interested in so.

That's kind of what I was going to say, if they're like engaging and it seems like they care, then you're motivated, or I am at least. To kind of get, if he gives a hundred percent, I'm more to give a hundred percent.

She will take time. I mean, I'm a 41-year old student, she's going to take an extra second, if you don't have a background in it, she does an excellent job.

For this class I think because the teacher is so friendly, I feel like I can't wait to see my teacher. It's like I'm connected to her as a teacher and as a student I like that. I remember all the times that she responds to emails, and she always says, "I'm in my office. Come see me if you have questions." And I always do that.

Engaged teaching practices:

We did a class and a half, two whole classes about learning how to study, how to retain information and things like that. So, that kind of helps, especially if you're new to college and you really don't know how to get into your personal group. I think it help out, and if you already have yours, it brings more ideas to you to where you can accelerate or-

Yeah, he puts a huge stress on the higher levels of Bloom's taxonomy. It's not just about regurgitation.

He makes us think and really have to assess why we think these things and try and figure out how we can improve our thinking and judgment to us finding out more than what we assumed in the beginning.

He enforces the whole, learn it, to the point that you can teach it to somebody else. Once you fully are able to teach it to somebody else, then you really know it.

He gives you something and tells you to play around with it. Then he's like, "Ah ha! You just solved this, this and this." And it makes him so happy to see us come to these conclusions by ourselves and then it makes us happy because we are like, "Wow! I can't believe that I figured that out."

There is a lot of interaction between the teacher and the classmates. He won't let us move on until we've come to our own conclusion about something, if we're not understanding.

Well, I'll say for me with this particular class, the fact that he uses examples like the shake and he does that often where he will bring something that you can relate to. To give you either visual or physical attachment to that versus just reading the book. I think he does a very good job of trying to break it down to something comparable and were alike to where you'll keep that in mind. So for now, like for the milkshake, you'll remember the milkshake when he's asking about the six layers.

You can't take a whole class outside. He's very creative. He came up with a new lab this semester that was almost all on paper. It involved the entire class. The entire class was up talking to each other and making inferences and writing on the board, planning things out and really just applying what they learned.

So he kind of puts you in an environment, even if you say something wrong, he'll explain to you why it's wrong versus no. When he was talking about inclusion or he'll be like, go fish or you know? Well what do you mean by that? One thing I like about him, as you can see when it seems like it's stuck, he'll ask the question a different way to try to garner a response.

I just love hands on work. It's the best.

I'm more lecture based

I found it much easier in her class to set up an outside study group with people because I was already so comfortable working with them, which was great.

I learn best, or remember things best, if I'm actually actively teaching others the things that we're learning.

Yeah and he's very enthusiastic about geology, it's never a boring lecture, he's always really passionate about what he's talking about.

Oh yeah, he always tries to tie it in to like real world things.

Every class he has something called a muddy point, where it has two questions on it, he's like what did you learn in this class that you better understand now? And the other one, what's a question that you still have? And so, every class we fill it out and give it to him, and at the end of the week he makes a video to answer all the questions for everyone

I'm not science minded at all and like I brought a rock today to show him, you know. So his, his, I missed the first part of this but like with this professor in general, his passion for geology is so apparent that it sort of permeates. You can't help but be, even if you're like me, nontraditional you know we turn into college mid forties, I'm here because I have to be here but I'm really excited about this year. Yeah, I was bummed we had a snow day Tuesday, because I missed lab.

I had this experience with, in general. I didn't really expect to learn a lot in this class because of it's science and I don't like it, but the way she teaches us, and she's so passionate about the subject. The hands on experiences, the videos she shows us, and the way she describes everything it helps me to learn without studying.

She's pretty good at picking up when there's a spot that a lot of groups are having trouble with and pulling it back to a full class setting.

Her lecture is different though than other lectures that I've had. Hers is really dynamic.

I'm pretty sure I've retained like close to like 80% of the stuff that we've talked about in this semester just because it's broken up and there's so many different examples given.

It's her creativeness to get hands on because it's not always easy. Some people don't know that that's how they learn. And so she'll try different stuff and she'll come back. Or if you ask for help and... She'll look at you and she feels like you're not getting it, she'll come back to you and try a different way. So, when there's other people or other faculty members, they shouldn't give up. They should just find another creative way. How else can I connect? What's the missing piece here?

He's very interactive, so he kind of explains you, gives you a couple of slides of what you are doing and then in between he asks you questions with the clicker. The clicker questions. We kind of just go through the questions. We do a lot of group discussions, so he always says think about yourselves, write it down, discuss it with your groups afterwards.

Honestly, I feel like we all talk to each other more. Maybe it's just the way that we have groups and the way our tables are laid out. I feel like I've gotten to know my classmates a lot more in this setting than I have in other classes.

But, she caters to an average level of knowledge. Like you can be the smartest kid in the class. You can be the dumbest. It doesn't matter. She's going to get the knowledge across one way or the other. And she does it as happy as any teacher I think I've ever seen.

For me, it really helps that the room is covered in like the subject matter that you're learning. There's rocks laying all over the place.

She's not teaching you, she's showing you.

Not too many teachers are gonna do that, for one. This, plus a couple of writing teachers that I've had, they really took the time to explain it and then model it before you, and then went step by step in how to do it. That's what separates those kinds of teachers from everyone else. Those also make the best teachers, in my opinion.

Having the, the regular class in the same room that you have the lab in. That kind of helps me because every time you go in there, you're kind of remembering stuff in the lab and putting stuff together.

So, you figure in camping you get intimate with ... not physically intimate, you get to know people as sort of a bonding, somewhat of a bonding experience.

I feel like it was our trip that we had, cause in our group, we were like, "Oh, this I kinda like a little test of what we learned, and how well do we know it." And then, since we were in groups, if we didn't understand one thing, we would confer with each other, and be like, "oh, is this rock, because of this." So, it kinda helped me a little more.

He makes me think - like on stuff that you don't think that you would even need to think about it. He makes you really sit there and like if we already went over it, he makes you have to go back and be, "What did we just learn?" A lot of times, a lot of classes that you have to study for, you kind of just memorize it for the test and that's it.

I think at the first, I was very, I would say upset, because his teaching style is not something that I'm used to. He's very much more challenging on every level. Now, I've learned to

appreciate that because that challenge is only making better in areas that I was weak and I didn't realize.

For me personally, I'm probably going to, more than likely, drop out. I'm on the back focus on the trade in school for welding. They have a really good welding program here, but I'm just not really good with schoolwork and all that. I can't really manage my time properly and I just ... I'm better at working than school. I've noticed that, just for me.

Last Thursday can be on there, especially with him, he was able to help me. I tend to do better when it's a student-on-student explain to me, to take time to learn and get the learning aspect of how the teacher is trying to explain it. A lot of times, I won't get it. The minute someone else explains it to me, I'm like, "Okay, I got it." When he was explaining me all the stuff, all the rocks, I'm actually starting to get it.

Usually she walks around the classroom. She observes and she sees that we're not quite getting it. She'll say try to remember these key points and she'll restate them and if we don't get the hint she's like, "All right, don't worry, we'll cover it again at the end."

I'm a visual learner, as well. For me it's kind of I like when she goes over it each day. We'll go over the notes and before we start a new chapter she'll go over it one more time, just kind of a run through of the main points and then sometimes she'll show, to be more specific, she'll draw out a map and say, "Oh, this is where it's happening," and explains why it is so she goes more in depth before she starts a new chapter.

You can literally see it happening. And it kinda clicked with something, I get it now.

And then the field trips too. The school paid for us, they rented two vans.

Pathways—Where Next?

Students noted a range of information levels and sources on career pathways, in part based on their own aspirations. One campus hosted a Science Night that provided an opportunity to meet professionals in science-based careers. One CA posted on her door a "career wheel" that showed students a range of the employment options open to them. Students referenced working with transfer advisors, and several pointed to gaps in the type of information available to them through these offices. Students noted that they spent hours researching transfer institutions as requirements were so different. Some students who showed interest in geoscience-specific careers commented on the CAs were a good source of information about transfer and career options. Campuses with high percentages of transfer students seemed to demonstrate more robust connections to nearby four-year universities.

Because many 2YCs did not offer a geoscience major, and many students were taking the course as an elective, students noted on a regular basis how much self-advising they did, and how they used the college's website to learn more about their options. The next section presents more information on the role of support offices on campus and students' perceptions of the help they received from those offices.

The best part about asking a professor for advice is that they know other professors. I had asked my professor for advise in choosing between astronomy and geology and he gave me a contact, he told me, "go visit this guy at [University]. He's doing what you want to do." He calls him up and says, "Hey, I'm sending one of my students over there." And they can help you network and they can give you resources that you wouldn't be able to get from a general advisor office.

There is a transfer guide, but my wife and I spent five hours going through each of my transfer options because it was so confusing. [non-geoscience major]

So, in my oceanography class, me and my professor developed a really good relationship, and because of her I was actually able to go on a research vessel, for STEM Seas, and met three scientists in the research vessel, and one geologist, and they gave a lot of presentations about options in the geoscience field, so I have a pretty wide range of information of where I would go if I wanted to pursue a career.

Overall College Experiences

In reflecting on their overall college experience and what supports student success, students provided ready examples of how faculty in other programs engaged them in learning, how support offices offering tutoring helped them do better in classes, and, alternatively, how some faculty on campus were not supportive or were unaware of on-campus resources to which they could connect students. Students' views on advising tended to be either positive or negative depending on the campus. Institutional context mattered for offices offering advising, transfer, and career services. However, students were often unaware of what support offices or programs were available to them, often relying on web-based programs to track their degree progress. Examples of these wider college experiences follow:

Support services:

In fact, they actually tried to tell me that the degree program that I was in was non-transferrable just two, five minutes later say, oh wait, never mind. It is. Yeah.

Yeah. I mean when I first started at [CC]. Honestly, I didn't know what I wanted to do or anything and I've gone into the, down there to talk to them [advising office] and I have walked out of there feeling like a complete idiot. They're pretty good at making it seem like you don't know where you're doing because I had no idea what I was doing and I'm like, I don't know where I want to go, I don't know what I want to do, and they were like, you need to know this. It just made me feel like an idiot. Sorry, I know I don't have it together.

I don't really know much. I know there's tutoring and stuff but I haven't tried that out, I haven't gone there, but I don't know any other offices down there.

I know for me, with math if I ever need help, I just go to the math learning center and they're great over there. Just explaining stuff. Super patient with you or what not.

We have the science service center also. Which is where all the ambassadors tutor.

Like [other student] was saying before, the ambassadors are the one who are teaching geology but there's other students who are teaching you and it is easy to communicate with a student then professor who has more knowledge because sometimes communicating with them and you say, "Oh, I don't know this." And then they ask questions according that subject and you still don't know the answers sometimes you feel a little bit down on yourself and that you don't want to be motivated but student go to tutoring lounge sometime they go to career services they are unsure about internships and they don't want to communicate with professor and if they wanna change their major sometimes they go career services ask them about "Oh, I'm interested in this. What can I do?" Sometime they give you a website to like oh if you're interested in this stuff type in your interest and they will tell you what type of career path or majors that you can go to career services.

So I think as far as the advising that, that's told, they also send you a lot of emails if you decide to look at them and read them. As far as the college itself, sometimes they have some good information in there about what's going on, but we all know that because they tell you it's a good thing you come in here because our credits would transfer to here.

I think it's really dependent on the student. Like there are counselors, and I met with one of the advisors that did help me, because I declared as a general studies major so I could get most credits transferred cheap, for geography. I had to a lot of research on my own to see what could transfer so I think it kind of depends on the student and how motivated they are to see what they want to do. I think [College] can get the ball rolling, but you kind of have to seek it out.

So they don't really understand the whole concept of you know like transferring, if you're thinking of transferring because my advisor, like I'm transferring but, she is still within this department, the science department, so she doesn't really understand like you know, transferring stuff so that can be kind of difficult as well.

Like I've had some friends who've lost two semesters because, like someone decided to put them into a course that they weren't ready for or that they did not need and that would not transfer.

Free tutoring. It's not really the best (laughs), Because I think it's students.

I think [CC] prepares you pretty well for where you want to go after. And when I started I didn't know what I wanted to do, I think I was business at the beginning, but then I changed to geography. I think [CC] is good because it gives you that, like two years or one year, however long you're here, that bit of time to figure out what you want to do. And have sometime in a class or college setting, and kind of figure out what you want to do and then you can move on to a four year.

Building 9 there's the career resource center. Careers and college and stuff. Haven't used it a lot though.

The advising office. I've been in once before. I need to go in again.

Disability resource center and I'm certain this is just a me problem but I felt a little intimidated going in there. I was going to see if my 504 plan would transfer over, to maybe see how that would work.

And so the first couple semesters you have to meet with an advisor before you can register and that was actually a really nice change.

They are always pushing you to see your advisors. That's one thing that I've noticed when I came here. My first term, they were just like "advisor, advisor, advisor". Okay, I got it. I'll go!

The veterans center here, because I used the GI bill, I use the post retirement, GI bill. They literally had one of their work study people walk me around campus and then they took me up to the admin students services and I told them I am geology and geography. So I literally didn't have to do anything but, but bring a pen and sign my name a few places and they, you know. I told multiple people, I was shocked at how easy this process was.

It's kind of useless. The counselors here are kinda useless, to be honest.

But, going to a counselor, it's more personalized, you can definitely ask more what if questions.

For me, til this day I still haven't even talked to a counselor, so what I do is, on the [College] Portal there's something called Map, and it tells you exactly what you need to take and what classes will fulfill that specific requirement, and I've been going off of that since I started.

They have a what-if clause. So what if I decide to change my major? What if I decide to go for a bachelor's degree? So you're able to see what various classes you would need to take, or if you have taken classes, would they count if you decide to change your major?

Co-curricular opportunities and student programming:

With your clubs on activities days there's 66 clubs and all the groups they have tables out so a lot of students are really interested in a lot of clubs but all the clubs happen at the same time so that's how they limited you to believe joining one club you kind of stay at that club.

I came to the freshman thing. The freshman orientation. I then met with someone, and they were like lets look at all the classes that you've taken, let's look at the ones you did bad in, let's look at the ones you did good in, and then we'll base your major off the classes that you did good in. So I was a psychology major at that point. I was like, okay sure. I don't want to be a psychology major. I've actually wanted to be in social work the whole time I've been in college but I've been fighting it because of the money that they don't make, but I figured my money is probably not the thing that is going to make me happy.

Well, from the orientation and then they regulate advising. When go on the portal, they usually have something to say about that there. There's flyers all over campus where they throw regular events.

Oh, well with me, I was in the summer bridge program here on campus, and I have a personal counselor that I see til this day, and she's helped me set up my education plan.

I think just the sense of community in general, because the campus, like for example during midterms, or finals, there'll be postings on the wall, like, "You can do it.", or in the library, you can go in, and get free snacks, and everybody, you feel really connected with everyone, and it's welcoming.

We had the science night where you could meet with a lot of different people last year, which was really cool. And they would talk to you about internships with the different programs.

COMMENTS ON OTHER 2YC FACULTY

How the students experienced CA courses was influenced by experiences with other faculty on campus. When asked what helped them learn best, the students often mentioned barriers to their learning.

I have been in environments where it's kind of like you can tell the teacher doesn't want to be there, so it's like there's really no connection to it. And if they don't want to be there, you don't want to be there. Nobody wants to be there.

My bio teacher was just like, "Here's the lab. Do it." And I was just like, "You didn't explain barely anything, and I'm just super confused." And it would be really bad.

[The other professors] are just so tired all the time. I wish they were just more enthusiastic or at least make a bit more sense, my philosophy professor before this is like seventy five, he's really old. Like he sounds like he's just mumbling all the time, he's a nice guy but ….

[use of Rate My Professor] But you can also tell based on the reviews, on who shows up completely apathetic, who shows up just to be the monkey and give the banana, who doesn't put in the effort.

Show up excited and teach, no really, there, you know, I've had some great teachers here at [CC] and I've had some that make me feel like an imposition on their time, and I don't know what the, you know the, tenure track is or isn't for [CC], but that's not my fault. I'm paying to be here, show up excited to teach.

Yeah, I had a really bad experience with psychology. The teacher just wanted to get answers and she didn't care if we learned them or not. It was too much material and too much exams. Home works. And we were rushing to finish a 700 page book, and I learned nothing. It was the last quarter and I learned nothing from that. For this exam, I studied nothing and it was about ... how many questions?

Just coming out of a test, I think what really makes a class for me, in tests-wise, is when the teachers aren't trying to trick you and aren't trying to make you fail.

And the best classes, that I think would be part of that magic sauce is the ability to rely on the professor for your base knowledge and not use mainly a textbook. In all my favorite classes, some of the classes just didn't have a textbook. My writing class we've never used a textbook, we've used novels, but you're relying on the teachers and the students around you. Your textbook is not the main source of learning.

Because I've had all three of those teachers and for me that what makes them my favorite, my best teachers is that they will put it into words that you understand.

Make sure that you are almost like nurturing. You're okay with them coming to you if they are having issues, if they are struggling. Some teachers are not approachable. They're not. They come off cold and hard to talk to. I'm thinking of our sociology teacher. He's a really good teacher, has a really good enthusiasm for sociology, but he's kind of an asshole. I don't want to come up to you and tell you that I am struggling because I feel like you're going to be condescending to me.

Cause some teachers are like, they teach but they're not super enthusiastic, they teach and they teach and then it's really hard to get intrigued in that and actually learn something.

Like I've had teachers who are just there to just to teach you, not really to interact with you as much as [CA] has. Or like my speech instructor, she made us sit all around the room getting to know people and we had to remember everyone's names and so was very interactive.

Like my best teachers here have been the people who are super into what they're teaching and then, not my worst teachers, but the teachers who were not as impactful were the ones who were just here for a job. Maybe reminding the teachers that their job is really important. Even if it's just community college. Like sometimes I feel it's like, "Oh they don't teach at university," but community college is super important too. And that their job is really important, so.

It seems like sometimes you can get an instructor that forgets what it's like to not know anything about the subject. You know? So when you have, we have an instructor that's really clearly explaining things and making sure that people understand stuff and just have that kind of compassion for somebody who's completely new. And you feel that that helps me.

I literally had one professor just a year ago when I was in this history class, he said, "I don't care what you do, whether you show up to my lectures or not, as long as you submit to me the information that I ask for, that's all I ask."

I know there's a stark difference between this class and my English class. My English class, the teacher just drones on and on and he just reads directly off the paper and it's more like just listening to him that interacting. It's like he's talking to us, not with us, and it's kind of irritating, but as long as we get our work done he just doesn't say anything.

Seeing Students: A Sense of Belonging

A sense of belonging (Strayhorn, 2018) was a strategy reviewed in the SAGE 2YC workshops for CAs. In looking for evidence from students on a sense of connection to the courses and campus, students noted their strongest sense of connections were associated with the little things CAs did in their classes. Knowing students' names, for example, meant a great deal to students. On one site visit, students discussed at length how attention to gender identity contributed to their sense of belonging, contrasting the CA to other faculty at their college. Speaking with CAs after class and taking advantage of their office hours also provided students with a way to connect with CAs. The following set of student quotes illustrate how students felt connected:

I think the classes here are smaller too. So your teacher's gonna remember your name and when you raise your hand you feel like you're learning and you wanna answer question, you wanna be involved it's a lot easier to be involved.

I think the way you can remember is that they don't look at us like we are, comparing it to animal size they are the shark and we are another smaller fish. They're not look at us, yes they are looking at us like we are still student, younger student, not knowing exactly what path they want to go to. But they putting themselves at our level that we are at so that we can communicate with them easier and that we don't have to feel scared and be nice to them.

There's never been a time that I've thought there was ever anyone that he was ignoring to any degree.

From my perspective, honestly there's not too much connected like socializing, I'd say or anything within [CC]. Everybody just drives in and goes to class and goes home and that's it. I don't know, each class or whatever. I mean that's a good one that I did feel connected because he's good at everybody work together and stuff.

The professor, honestly, She is almost ... She's really good at teaching, honestly, because she gets those differences. Like how, I'm a bit slow at learning. Whatever I'm weak on, she definitely gets help with what that.

And she's actually really good with it. And not only just knowing your name, but understanding your work that you turn in. She kind of is good about knowing that stuff too. She's the reason why I actually applied and entered the honors program, because she saw my work and thought I would be a good fit for the program.

Yeah, she kind of let's you discover the answers for yourself while guiding you in the right direction making sure that "Oh okay. Alright, this the path I need to take, and I'm out here in the woods." So, she'll bring you back onto the path in case you get a little lost.

I think having a good, I guess, social aspect too. You know, make sure that everyone, you know, everyone's in the same boat when they show up, so kind of have them know that and that everyone's here for each other and stuff, that really helps people out too.

Sometimes I come in, I'm not that excited but glad that I went. He creates a very exciting atmosphere. It's never a chore to be learning in here. Always doing something and learning something new that I enjoy.

First day we get in a circle, we do some ice-breaker stuff and one of the things she asked is pronouns. It can be really ... I'm in the LGBT community. It can be really difficult to try and get into those conversations with pronouns and say to each individual person. She went and she has passed around the roster the first day to everyone and if there's a nickname you want her to call you instead, write it in. Only professor I've ever had that she's never gone back to that other name. Immediately she started using it.

Like she gives you something visual and if you listen to her when we do our worksheets she knows us a little bit better. So, she'll talk to Hank about motor oil, but I don't know the difference between motor oils. So, she's putting [the rock] in honey and I'm like okay, now I get it.

On a personal level too. Real lecturers don't even feel like a lecture sometimes because I feel like she's just talking to us or relating to us.

Well, and the weird thing is, I don't know how she knows her names. She didn't do a seating chart at the beginning, not to my knowledge. And then all of a sudden one day I never raised my hand or anything and then she just came up to me. She's like, "oh here you go," and hands me back a paper with my name. I'm like, how'd you know that was me?

So, she just acknowledges your strengths.

I literally hate science and on my midterms she wrote "Whoa" with an exclamation point at the top. And I was like, oh, thank you.

She just makes you feel loved in a non-weird way.

I really, really liked [CA] as a teacher. He was really interactive with us. It was my first term back after taking nine months off. I was really struggling and learning how to be in school again, and he was really, really helpful with that and boosted my confidence. There were times when I would go to his office and just sob, because I was just oh my "Gosh, this sucks!" But yeah, that's the reason that I took [this class]. It wasn't solely because of Geology. It was mainly for him, to be honest.

He's like "what are your expectations of me" and "I'll let you know what I expect from you."

I feel like in geology you're allowed to be curious about things.

Oh yeah, they take the time to learn names. They know everyone's name. And then, in the science program. I've had other classes where they don't know students' names. And don't take roll.

So, coming in and having 30 people, where the teacher kinda cares about you, and knows your name.

So a lot of times, like even our Geology 1 professor, I'm taking an environmental studies class with him, and he's told me like, if you ever need help in your Historical Geology class, you know I can always help you during my office hours as well, so, a lot of them, I feel like a lot of professors, like if they've had former students, they'll still want to work with them, because they want all the geology students to be successful and to do well.

SUMMARY

The focus of the SAGE 2YC project was on PD for geoscience faculty, and to this end, this evaluation assessed the ways CAs changed their practice. Classroom observations provided an opportunity for the ERI team to gather data on how the CAs applied strategies learned in SAGE 2YC workshops and focus groups with students provided a means of obtaining insights into students' perspectives. The opportunity to conduct focus groups with over 200 students during the site visits provided firsthand information about how they experienced CA classes and how their learning was changed. We also learned about students' sense of belonging in their classes and on the campus, and we gained greater understanding of how they thought out next steps on their transfer and career pathways.

We learned that students take geoscience classes for a range of reasons, including fulfilling a science requirement to transfer, including hearing how initial exposure to a geoscience glass translated into the declaration of geoscience as a college major. Field trips and hands-on learning provided opportunities for engaged learning that facilitated students' seeing how the knowledge they learned in the class applied to the field, and vice versa. Students appreciated faculty who offered knew their names and made themselves available for meetings during office hours. They praised CA words of encouragement and contrasted these experiences with interactions with other faculty who stifled their motivation to learn. Advising was mentioned on multiple occasions as a barrier to figuring out graduation requirements and transfer options, adding to concern about wasted time and cost in taking unnecessary classes. Several of these issues are beyond the purview of a single faculty member but highlight struggles that students experience when they are not taught by knowledgeable and skilled instructors.

11. REGIONAL WORKSHOPS

Faculty CAs teams were tasked with delivering regional workshops to capitalize on their own professional experience and spread what they learn through SAGE 2YC to other geoscience faculty in 2YCs and also 4YCs and other settings.

The questions this section addresses are:

- What contextual understandings do CAs develop through implementing regional workshops that support their learning and growth?
- How do team dynamics associated with the planning and delivery of regional workshops reinforce and enhance CA learning and growth?

METHODS

The regional workshops were evaluated by the CAs with support of the project leaders and SERC personnel. Registration information and surveys were used to gather data on participant experiences and satisfaction with the workshops. These data were analyzed and reported in annual reports of the external evaluation as well as the principal investigator, providing a rich source of information for this section of the report.

REGIONAL WORKSHOP DELIVERY

Typically, the regional workshops were a single day in-person event offered in the fall of each year, with some workshops extending into the spring term. Early in the SAGE 2YC project, the project leaders anticipated that these workshops would be offered in a virtual format in the spring but the end result was a variety of modalities. In their initial offerings in spring 2017, some workshops were not especially successful due to low enrollment but over time, the workshops gained in participant enrollment.

Tables 11.1 and 11.2 summarize the regional workshops by year, number of workshops delivered, and number of registrants by role type and institutional type. These data reveal over 50 regional workshops were delivered by the CAs over the four years of the grant. Table 11.1 suggests over 600 workshop registrants were employed in faculty roles, with about three quarters being full-time faculty and about one-quarter being part-time. Table 11.2 shows a larger number of workshop registrants, just over 650 total, who are primarily employed in 2YCs. Other registrants included persons who were employed in professional and occupational roles associated with the geosciences. Also, a few CAs also reported the registration of K-12 teachers and graduate students in their regional workshops.

Table 11-1: Number of Regional Workshops and Registrants by Registrant Role Type

Year	Number of workshops	Total Number of Registrants*	Registrant Role Type			
			Part-Time Faculty	Full-Time Faculty	Non-instructional Roles	No Response / Other
2016-17	10	148	50	79	3	16
2017-18	10	188	38	104	15	31
2018-19	17	149	28	54	4	63
2019-20	16	179	44	107	6	22
Total	53	664	160 (24%)	344 (52%)	28 (4%)	132 (20%)

Note: One regional workshop offered in 2019-2020 did not provide registration or participant data. Some, but not all, regional workshops included CAs who led the workshops in the registrant count.

Table 11-2: Number of Regional Registrants by Institutional Type

Workshop Year	Total Number of Registrants	Institutional Type			
		2YC	4YC/U	Other	No Response
2016-17	148	127	7	3	11
2017-18	188	136	33	2	17
2018-19	149	113	20	3	13
2019-20	179	137	28	8	5
Total	664	514 (77%)	88 (13%)	17 (2%)	46 (17%)

The content offered in most regional workshops closely reflected the ways CAs adapted SAGE 2YC practices to their institutional and regional contexts. As the CAs learned and grew in their understanding and experience with delivering new practices through these workshops, more connections were made with 2YC, 4YC and other regional groups, and the workshops strengthened to become more successful. Table 11.3 shows the content of the regional workshops by year, cohort and team and also reveals strong parallels between the workshop content and the three main themes of the SAGE 2YC project: broadening participation, increasing student success, and improving transfer and career pathways.

Table 11-3: Regional Workshop Topics for Cohort 1 and 2

Team	Regional Workshop			
	2016-17	**2017-18**	**2018-19**	**2019-20**
Cohort 1				
Southern California 1	Supporting Academic Success In The Geosciences At Two-year Colleges In Southern California* Geoscience Retreat For Southern California 2YC Geology, Geography, And Environmental Science Faculty		Strong Starts And Transitions: Supporting Present And Future Geoscience Educators At 2YCs In Southern California	Developing your identity as a 2YC faculty member: a workshop for geoscience graduate students *(societal relevant teaching activities, professional pathways, and teaching)*
Southern California 2 *(Single team with So. Cal. 1 in 2016 and 2017)*			Welcome To Geosciences: Removing Barriers To Engagement, Success, And Persistence	Creating a sense of belonging using hands-on strategies in our geoscience courses
Florida	Passage To Student Success In Florida 2YCs	Passage To Student Success In Florida 2YCs: Developing Strategies To Increase Student Recruitment And Retention In Geoscience Courses, Majors, And Programs	Passage To Student Success In Florida 2YCs: Welcome To The 21st Century: Developing Successful Strategies For Online/Hybrid Geoscience Courses	Putting the pieces together: identifying and engaging with resources to successfully build your diverse geoscience program
Illinois	Cultivating Geoscience Students	Diversity Is More Than Ethnicity	Geoscience Connections: Helping Students Connect To Their Science Identity	Transferring Into Your Geoscience Career
New York	Student Success In The Geosciences: Why Can't They Do That? Overcoming Learned Helplessness, Change Mindset And Teach For Mastery	Collaborating For Success: Building Communities To Increase Success And Participation Within Our Programs	From Design To Assessment: Developing Successful Science Courses And Programs	Working together to increase success and participation within our programs *(regional network, develop institutional plans to broaden participation in sciences)*
North Carolina	Empowering 2YC Geoscience Faculty To Improve Student Learning: If You Can't Have The Student With Skills You Want, Then Engage The Ones You Have.	Pathways To Success: Course Design, Improving Diversity, And Transfer Opportunities In Geoscience	Take The Leap From Studying Best Practices To Action: Propelling Our 2YC Geoscience Students To Success	Education Showcase: Sharing Best Practices and Strategies for Teaching Geoscience *(Share successful strategies, plan for sustainability post-SAGE, build regional network)*

Team	Regional Workshop			
	2016-17	**2017-18**	**2018-19**	**2019-20**
Oregon (Portland)	Active Learning: Hood To Coast	Floods Of Change: The Vanport Floods, Stereotype Threat, And 2YC-4YC Transfer	CASCADES "Creating Academic Success & Cognitive Awareness Developing Exemplar Students"	METACOGNITIONS: Making Every Teaching Activity Centered on Giving New Instructional Tools Inspiring Our Nation's Students *(Oregon C1 and C2, Western Wash)*
Texas	Supporting Geoscience Student Success Through Active Learning, Metacognition, And GRIT	Improving Student Success And Broadening Participation Of Underrepresented Minorities In The Geosciences	Unseen Barriers In Our Geology Classes And Helping Our Students Prepare For Transfer	From Recruiting to Transfer: Supporting Geoscience Students Through a Regional Faculty Community
Virginia	Revitalizing Connections With Geoscientists Within The VCCS Through The Science Peer Group: Sharing Best Practices For Engaging Our Students	Fostering A Network Of Virginia Geoscientists	Geoscience Career Mentoring	Active learning across the disciplines: introduction, implementation, and assessment of high-impact strategies to encourage student success
Wisconsin	Not Just Rocks! We Know Other Stuff, Too! Geosciences In The Modern World	What Does The Geoscience Landscape Look Like In The Badger State?	Re-imagining Geoscience Education In Wisconsin	Re-Imagining Geography and Geoscience Education in a Post-Merger Environment *(Fostering student success, professional pathways, eliminating barriers to broadening participation of all ethnicities and gender identities)*
No California	Improving Instruction And Supporting Transfer Opportunities In The Geosciences In The San Francisco Bay Area	Exploring The Geoscience Landscape 2018: Opportunities For Undergraduate Education In The Geosciences	Improving Instruction, Broadening Participation And Supporting Transfer Opportunities In The Earth Sciences Within The S.F. Bay Area	Supporting Student Success: Future directions for the Earth and Space Sciences Program at De Anza College *(instructional initiatives, new curricula and degree programs, department needs)*

Team	Regional Workshop			
	2016-17	2017-18	2018-19	2019-20
Cohort 2				
So California			PathWaves To success: Building bridges between 2YC And 4YC ocean sciences programs	PathWaves to Success: Student Engagement Beyond the Classroom – Gearing Up for the U.N. decade of Ocean Sciences
Massachusetts			Science by the Sea	Fun Science for Everyone *(Evidence based practices to improve learning, broaden participation, and encourage STEM career paths. Create a sense of identity and belonging. Use metacognition)*
Michigan			Building community and supporting student success in environmentally-related science courses at 2YCs	[postponed due to COVID-19]
DC Metro area			Field trips to engage students in science	MSTB Division professional development workshop *(Metacognition, 5E lesson planning, intentional inclusivity through active learning)*
Oregon (Willamett Valley)			Supporting the success of all students in introductory 2YC geoscience courses	METACOGNITIONS: Making Every Teaching Activity Centered on Giving New Instructional Tools Inspiring Our Nation's Students [Oregon C1 and C2, Western Wash]
Western Washington			Build community for student success	Pacific Northwest Marine Sciences Community College Faculty Conference *(Bloom's Taxonomy, support student success, inspiration and motivation relevant for all students, build regional community)*

CONTEXTUAL UNDERSTANDINGS

The regional workshops provided a means to foster change beyond the CAs but also served as a mechanism for CA learning and growth about how PD could work in their region. Through the project CAs gained content knowledge that they put into their own practices. Determining how to attract and recruit participants from their campus and beyond provided a new challenge. The following quotes collected from interviews and focus groups demonstrate the reflective understanding of the CAs related to addressing these challenges.

> *The other thing that I always find challenging is getting people to participate, like outside. Finding outside people and saying, "Come to this workshop. It's gonna be great." Because when we get the people there, they say, "Yeah. This was great," but it's really hard to convince people. I think, especially, because it's two-year college faculty. So, sometimes two-year college faculty are like, "Well, I do my work, I got to my job, and that's it. I don't have to do research. I don't have to do professional development."*

> *But again, it's hard to go beyond the "once and dones," except you make a connection here. Somebody is an adjunct here and an adjunct there for the school. We're a very strange higher ed ecosystem . . . because most adjuncts teach at more than one community college, and students often go to more than one community college. They'll often go where they like the programs the most, so I have students that will drive past three community colleges to get here to take a class.*

> *I kind of struggle to get adjunct or part time instructors involved at my campus specifically. And again, I think a big part of that is me being new and them probably having been there for a long time, they're happy with the way they do things. They're great at what they do, students love them, so I mean, how do you nudge them or inspire them to get involved in something when they're already doing a fabulous job.*

> *And I also think the LISTSERV thing is not effective. What was effective is seriously me sending. I mean it was the same email every time but I mean I sent out 250. "Hi Pam. Hi Ella."*

> *But it's always that classic are you getting the perfect mix of timing, availability, topic, all that coming together.*

> *Although, the Spring follow-on was really disappointing, the feedback that we received at the initial regional workshop and the response that we're getting for the workshop we're doing next weekend is really encouraging. In the sense that, there's obviously a desire for these types of workshops and meetings. You know, you just have to find that sweet spot, that timing and all of that stuff together. Certainly the encouragement is there to keep at it, for sure.*

Over the course of the project, some CA teams adjusted their format, content, and recruiting mechanisms. Following are some case examples of the CAs' work with regional workshops.

Case Example 1 - Continuing to Evolve

As part of their commitment to the project CA teams lead in-person workshops in the fall and tried virtual events in the spring.

When their virtual event fell flat, the CA team member wondered aloud, *"What was the holdup there? I*

mean, we had a few people participate. I don't know. Maybe people didn't feel that it would be a good use of their time. I don't know. It's not like it has a reputation. Like, oh, it's gonna be one of those. Right?"

The CA team had also tried several formats for face-to-face workshops in the region, including bringing in a national traveling workshop program. These workshop focused on facilitating transfer, active learning, science identity, and metacognition. These workshops drew faculty that included full-time, contingency, and counseling faculty from 15 different community colleges. Nevertheless, the CA team realized that even with their success, they couldn't meet the needs of all individuals from so many different institutions. They shifted their focus to their own campus.

> *. . . we're kind of a little more energized to do something program-wide, which certainly is needed. Regionally, I think I got a lot of interesting feedback from people at other schools. They said, "It was really great to do this, but I brought it back to my colleagues and they were very negative about it and . . . They were like, "Yeah, we all do that already." They were very dismissive about it. At least one or two people said that.*

The team went on to host two more campus-focused events that draw from their large program. First, they organized a five-part project in courses across the program involving geoscience, geography, and environmental science and a civic engagement clean-up day that included campus faculty and nearly 500 students. And in the winter they facilitated a program-wide retreat that brought together full-time and contingent faculty from across the program for a 3-day campus retreat where they explored classroom strategies to broaden participation for their courses to populations that were underrepresented.

Case Example 2- Starting local sometimes works

Another CA reported that their CA team gained confidence by disseminating about teaching strategies at their campus.

> *I think for us it wasn't reaching out regionally but it was reaching out at our college and department level to start a discussion about teaching styles and things you can do in the classroom for professional development, because we have a very resistant department. So, leading that first discussion was definitely very apprehensive. [and then] It went amazing. The administrator was floored, because our administrator that was here actually came. Our department doesn't talk about professional development, they think it's a waste of time and they actually were all participating. You could have knocked me over with a feather.*

In contrast, another CA team had also intended to offer professional development on their campus but with less success.

> *We felt the same way, I think, with sharing we learned with the department. For our structure it's not a department it's a program, and it didn't turn out well. [But] there was no interest or reciprocation. And knowing that we were going to keep offering these opportunities, says a little ... takes the wind out of your sails.*

TEAM DYNAMICS

Working toward a regional workshop brought CA team members together to develop a shared vision. The meetings with each other allowed them to realize their own strengths and those of their team members. These meetings also afforded the CAs an opportunity to discuss their own implementation of practices.

> We just sit around and pow-wow a lot, which I never really had a chance to do with colleagues that weren't on campus. We talk about what we wanna focus on, classroom techniques that we wanna share. Every other week we have a faculty interest group meeting, which is with all the geo-science faculty. . . Every other week on Tuesdays at lunch. The three of us are kind of like the foundation and then we ... most of the other people show up, sometimes people don't, but we're trying to establish regular meetings and regular communications. Then we kind of, all of us, not just the three of us, all of us spearheaded this project that we did [regional event].

> I think that my primary role in the regional implementation, I think that I'm pretty good in my teaching and in logistical stuff like this. In assessing accurately how long things are going to take and what some of the potential pitfalls could be.

REGIONAL WORKSHOPS AS LEADERSHIP DEVELOPMENT

As CAs gained confidence in delivering regional workshops, they also acquired knowledge and skills useful to developing leadership competencies. Regional workshops afforded the CAs a structure and support through their teams and tools to develop as leaders, and the CAs spoke about the value of this experience to advancing their ability to lead. The CAs recognized what each CA brought individual talent to planning and facilitating the workshops, also shaping their collegial leadership approaches. One CA described how their experience with regional workshops transferred to work in their department, saying they were "*more effective at working with the department. . . being more assertive.*"

Another CA reported how s/he would had little confidence to present at a campus faculty development meeting "*but doing the regional workshop twice has positioned me to think about it.*" The ability to see the bigger picture of campus operations evolved for some, providing them with a perspective that is conducive to leadership roles. Observing their personal growth as a leader situated in the community college context, one CA said,

> One other thing I wanted to add is I feel more of a sense of fulfilling a mission of community colleges. The mission of community colleges. I know each community college has its own unique mission, but there's kind of a general mission, right? Of community colleges, and it's helped me really align my kind of personal values with the mission of community college.

SUMMARY

The regional workshops drew participants from other community colleges in their regions and also included some registrants from 4YCUs and other organizations affiliated with the geosciences. The majority of CA teams (11 of 17) reported that they used at least one of their regional workshops as a means of strengthening 4YCU connections. The CAs also reported that these 2YC to 4YCU connections were important in strengthening their ability to illuminate transfer and career pathways to students. For example, one CA team reported that four-year faculty involvement was essential, including providing a site for one of the workshops where undergraduate students presented their research to two-year college students. Other CAs used the four-year connections to later tap 4YCU faculty as guest speakers on their campus or to consult on course student learning outcomes to strengthen transfer. Half of the CA teams (9 of 17) reported the inclusion of industry professionals, or they highlighted specific professional methods. For example, one CA included industry professionals and community college students to enhance their career mentoring. For a smaller set of the CA teams (3 of 17), high school instructors were included as part of their reach to strengthen secondary to postsecondary geoscience connections. The adaptations for the regional workshops allowed the CAs to spread their new knowledge in ways that supported the contextual needs of the region, strengthened their team relationships, and afforded them opportunities to reflect and grow as leaders.

12. THE SAGE 2YC NETWORK

An important aspect of the SAGE 2YC project is to encourage the "cycle of innovation", suggesting change in geoscience education starts with CAs who change instructional and related practice that continue to deepen and spread through relationships with CAs who are part of the SAGE 2YC project, through regional workshops, and through other professional associations. The SAGE 2YC project leadership promotes and helps to nurture these relationships, fostering bonds that strengthen over time to promote the sharing of knowledge and practice experience. With the implementation of regional workshops and various opportunities to participate in professional and organizational networks, the project may encourage additional connections that bring about improvements in geoscience education in the community college context.

With respect to this aspect of the evaluation we asked the following question:

- What do the social network analysis (SNA) maps of the SAGE 2YC participants including CAs (cohort 1 and 2), principal investigators, project managers, and/or evaluators/ researchers look like?
- How do SNA maps illustrating the relationships among participants, particularly cohorts 1 and 2, change over time as the SAGE 2YC project unfolds?

METHODS

Social Network Analysis (SNA) is a method that is growing in social science research and development, including program evaluation. Conducted to show what networks look like based on relationships among members of the network, SNA tells us the proximity of people to each other and strength of relationships between people based on the centrality of location of people. This quantitative approach helps us visualize the complex patterns of relationships that are difficult to see without the use of specialized software designed to visually display these patterns. Within social networks, "nodes" typically consist of people or organizations that represent units that may be connected to other units within the network, and "ties" illustrate relationships between nodes. This methodology focuses on categorizing "nodes" and "ties" within a network map, as well as the structure of the network as a whole (Scott & Carrington, 2011).

In the case of SAGE 2YC, SNA offers a way to visualize relationships between the SAGE 2YC network members in terms of their proximity to one another over the period of the grant, from summer 2017 to summer 2019 for cohort 1 and summer 2018 to summer 2019 for cohort 2. Specifically, in fall 2017, the second cohort of CAs was added to the SAGE 2YC project so in summer 2018 we see the network grow to include both CA cohorts, and all network members were surveyed again in summer 2019. Also included in some of the SNA maps is the team of individuals leading the SAGE 2YC project, including the principal investigators, project managers, and evaluation and research team members. However, because of the necessity for these individuals to be connected to most or all of the CAs we also map the relationships between cohort 1 and cohort 2 CAs without the project leadership team. We look at the two cohorts together and apart for the two years that we have SNA data (summer 2018 and summer 2019).

To gather the data for the SNA mapping, we used online Qualtrics survey software. The survey provided the names of all SAGE 2YC network members and asked individuals to indicate who they had made intentional connections with during the previous year. The survey instructions recommended that

individuals not indicate casual connections for the purposes of the SAGE 2YC mapping with SNA but rather report connections that are intentional and substantive related to the project (goals and intended outcomes). Through Qualtrics, quantitative data on the relationships of SAGE 2YC participants (network members) were collected for the purposes of producing SNA maps. In addition the Qualtrics survey offered five open-ended questions that asked participants to comment on their connections to other members of the SAGE 2YC project. The purpose of these open-ended questions was to understand how participants viewed their own involvement in the SAGE 2YC social network in relationship to others, including value they placed on networking.

In terms of coding, we coded 1 if one or both individuals indicated they connected in a formal way, and we coded 0 when neither individual indicated they had connected, creating a symmetrical matrix. We used 0 on the diagonal of the matrix where an individual intersections with self. This approach to data entry created simple, one-node matrices that were used to create the SNA maps.

SNA Map in Summer 2017

This initial SNA map clearly shows that the project leadership team is central to the relationships among members of the SAGE 2YC project in summer 2017. Recall, at this point, the SAGE 2YC project consisted of the project leadership team and the cohort 1 CAs. In this map, we designate teams by their state abbreviation (IL, OR, etc.), and we also use an abbreviation for the project leadership team that indicates principal investigators (PI) from 1-4 for the four PIs, project manager (PM) 2-1 for the two individuals serving in this role, and ER for the evaluation/research team members, numbering 1-5 for the five members of this group. (Note, we modify this coding system in summer 2018 when we add data from the cohort 2 CAs to the SNA analysis. In summer 2018, we designate teams by cohort 1 or 2, then we assigned the cohort 1 teams a number ranging from T1 to T10, with team 2 having an a and b group to designate the two distinct teams formed mid-way through the grant. Cohort 2 had six teams coded T1 to T6. Finally, we assigned a number for each member of the team using a dash and digit (e.g., -1, -2, and -3). This coding scheme is used consistently throughout the project to give the teams a clear identity while also providing anonymity in the SNA maps.

Figure 12.1 displays the overall SNA map for all network members in summer 2017, showing the centrality of most members of the project leadership [PIs, PMs, and evaluation/research (ER) team members] to the faculty CAs (PIs are assigned a black square, PMs are assigned a light gray square, ER members are assigned a medium gray square, and faculty change agents and their teams are assigned a blue square). What is apparent in the map about the CA teams is that their members tend to cluster together in similar regions of the map. So, for example, C1T10-1, -2, and 13 are three members of the same team and they are clustered in a triangle at the top of the map. Similarly, C1T1-1 and -2 are located at the bottom center of the map, with C9T-1 and -2 located to the left of the C1T1 team members. There are exceptions to this pattern; however, as C1T3 team members are in relatively close proximity but separated from one another by the C1T1-1 faculty CA. This map configuration seems to suggest most CAs are most strongly connected with other members of their own team but some CAs do have relationships with other team members, particularly when individuals associated with project leadership serve as connectors. This result is not unexpected as the time this SNA map was created approximately two years into the project, in summer 2017, when CAs were still in the process of getting acquainted with one another and engaging in the SAGE 2YC project activities.

*Figure 12-1: Overall SAGE 2YC Network in Summer 2017*
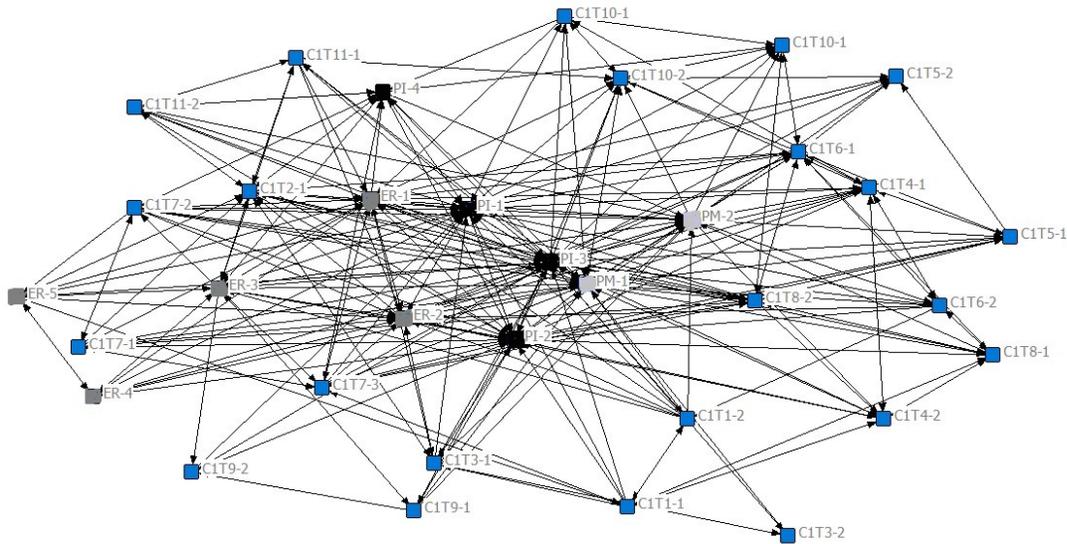
In addition to creating the overall SNA map in summer 2017, we created a map showing the cohort 1 CAs without the project leadership team. This map shows that when the project leadership team members are removed, a large cluster of CAs are located in close proximity to one another but one team disconnected from the rest of the group. These results suggest the majority of CAs had some connections to other CAs in the network but one team did not report connections to other teams independent of the project leadership team. Because of the need to maintain anonymity, we omit this map from this final report.

OVERALL SNA MAP IN SUMMER 2018

This section discusses the overall SNA map created in summer 2018, beginning with the map that shows the cohort 1 and 2 CAs and all members the project leadership team. Similar to Figure 12.2 shown in the previous section, the map shown in Figure X below shows most of the project leadership group consisting of the PIs, PMs and ERs located at or near the center of the map, with cohort 1 and cohort 2 CAs around the perimeter of the map. In this map, the nodes representing members of the project leadership team are gray, the nodes representing cohort 1 CAs are blue, and the nodes representing cohort 2 CAs are green. What this color scheme makes clear is that the cohort 1 and cohort 1 CA groups occupy distinct sections of the map. Without the exception of only one person affiliated with the cohort 1 CA group, all the cohort 1 faculty CAs are located on the right side of the map and all the cohort 2 CAs are located on the left of the map. This map suggests at this point in time, the CAs were not especially well connected with the other cohort and that the project leadership team members acted as the connecting point for the two cohorts. This finding makes sense because in the summer of 2018, the two cohorts were operating fairly independently from one another and most CAs were not familiar with members of the other group.

Figure 12-2: Overall SAGE 2YC Network in Summer 2018


Figure 12-2: Overall SAGE 2YC Network in Summer 2018
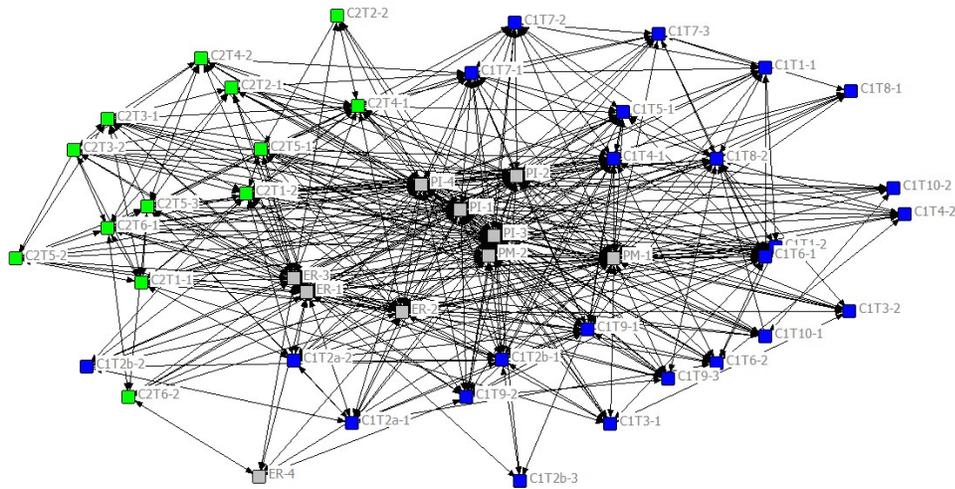
The next map shows both cohorts of CAs in the summer of 2018, the first time the cohort 2 CAs were involved in the SNA project (see Figure 12.3). This map does not include the project leadership team so that we focus on the relationships among the teams and individual members of the two cohorts. Also, because the project leadership team occupies the center of all SNA maps, we elected to show maps without project leadership in the remainder of this report to focus on the CA teams. Clearly shown in this map is the clustering of cohort 1 CA teams in the center to right of the map and the clustering of the smaller cohort 2 CA teams to the left and bottom of the map. There is no intermingling of the two cohorts of CA teams. In this map, we also see the close proximity of CAs in some teams but we see some teams with members farther apart in the map, especially in cohort 1 (see C1T8-1 and C1T8-2, for example).

Figure 12-3: SAGE 2YC Network of Cohort 1 and 2 CAs in Summer 2018
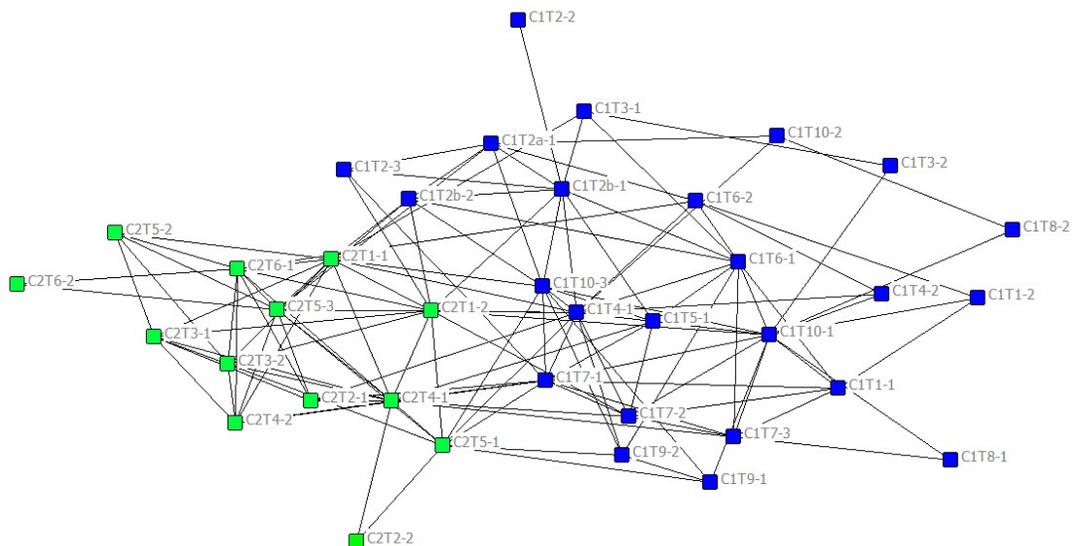
In the last map we present findings for CAs in cohort 1 and cohort 2 in summer, 2019, the last time the SNA survey was conducted (see Figure 12.4). In this map, we see slightly more co-mingling of the CA teams from across the two cohorts. We see some faculty CAs in cohort 1 moving into the space occupied solely by cohort 2 CAs, and we also see this same movement by some CAs cohort 2. For example, C1T7-1 is located within the cluster of cohort 2 CA teams, and C2T6-2 is located within the cluster of cohort 1 CA teams. These results suggest that these particular CAs have substantial ties to CAs in the other cohort, and based on other results, we know this to be the case. For example, C1T7-1 played a major role in organizing regional workshops that involved the cohort 1 and cohort 2 CA teams in the same geographic area of the United States. The reasons for other proximal locations are not as immediately evident except that some CAs in both teams demonstrate a stronger proclivity to connect with others for numerous reasons, often having to do with getting advice, support, and resources to improve their instructional practice. These findings are interesting as they emerged despite there being limited promotion of connections between the two cohorts. Besides, one semester of virtual activities and the final workshop, the connections that CAs formed would have been done independently of project leadership, but it is possible that the academic programming in the 2018/2019 academic year may have created opportunities for unexpected or unpredicted connections between the groups that evolved into meaningful and welcome connections over time.

Figure 12-4: SAGE 2YC Network of Cohort 1 and 2 CAs in Summer 2019
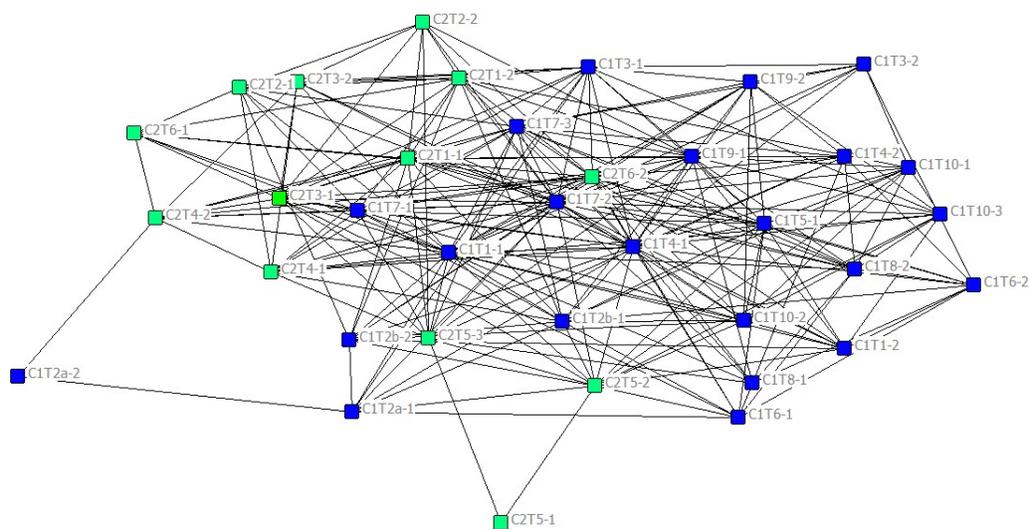
QUALITATIVE FINDINGS

This section of the report presents a thematic analysis and illustrative quotes presenting a representative range of responses to five open-ended questions in the SNA survey. These questions are:

- How has your professional network changed since you last completed the SNA survey?
- How has your network helped you with change during your involvement with the project?
- Describe the type of regional network that has developed for you over the course of the project.
- How has the SAGE 2YC project changed your professional network?

- Looking forward, how important is networking to you in supporting your action plan and personal goals?

Survey responses were received from all SAGE 2YC participants, including all CAs (cohort 1 and cohort 2), as well as members of the professional leadership team. In all, 39 responses were received to these open-ended questions, and these data provide the basis for the following analysis.

How has your professional network changed since you last completed the SNA survey?

The most frequent response from the CAs who are the primary focus of this section of the report was that their professional network had grown or expanded, and they often also mentioned that their network had deepened with stronger connections. Many respondents mentioned they met people inside and outside of the geosciences that they had not known before and had they not participated in SAGE 2YC, these connections would never have been made. Included among the people in the expanded network are individuals representing other groups, such as high school teachers; 2YC faculty from their own and other colleges, including 4YC faculty; professional scientists; and others. An example of a comment from one CA that illustrates this finding follows:

> *I have been more open to networking with high school faculty/students to establish stronger pathways for transfer into our geoscience program.*

Many respondents mentioned increased communications with others as their network expanded and strengthened. These communications involved the sharing of ideas and offering of support and resources that would not have happened prior to the project, including with other faculty on the change agents' own campuses. An example of a quote illustrating this idea comes from one CA who said:

> *I have begun to interact way more with faculty at my own college, principally my team members who I almost never spoke with prior to the project. I still wish we had more interactions, and that there was more of a desire for a real exchange of ideas.*

Several CAs mentioned that the virtual activities sponsored by the SAGE 2YC project, including regional workshops, were the stimulus for network expansion and deepening. The face-to-face meetings were mentioned as important to establishing personal relationships with other change agents, and these venues were appreciated by cohort 1 CAs and especially noted as important to cohort 2 CAs whose experience in SAGE 2YC was virtual until the summer 2019 workshop that they attended in person with cohort 1 CAs.

The survey results also portray the complexity of professional networks and the difficulty some individuals have engaging in network activities. While not the predominant response, almost one-fifth of the respondents mentioned that their networks had not changed substantially over the last year of the project. Sometimes they expressed appreciation for the networking they had done and directed their attention to deepening their relationships with individuals they had met through the project, as is apparent in the following comment from one CA:

> *I don't think I have expanded my professional network considerably in terms of number of human beings, but I have identified the core group of people in the network with whom I have the richest professional connections and where the relationship is mutualistic…*

Illustrative of other CAs is the following comment from an individual who, upon reflection on the project, wished they had taken more advantage of the SAGE 2YC project's focus on networking.

I'm not sure it has changed too much… When I go back to my box it is local stuff/work, hoops, conferences that get me out and about talking to others. Planning with [two colleagues named] is a common event. However, I haven't utilized the national network like I would like to.

Another faculty CA expressed a similar sentiment with respect to balancing networking with the daily tasks that fill the days of faculty, saying,

Unfortunately, it [professional network] really hasn't. I need to work on communicating more. I really do want to but it slips my mind when I actually have a computer in front of me.

How has your network helped you with change during your involvement with the project?

This question asked respondents to link their networks to the act of changing as part of the SAGE 2YC project. Though some respondents didn't focus on change specifically, some did, and their comments are illuminating in terms of understanding how a project like SAGE 2YC can play a role in helping faculty to bring about change on their campuses and potentially through their networks, bring about change on other 2YC and 4YC campuses, and beyond in high schools, for example. One faculty CA described their experience with change through the SAGE 2YC project as follows:

The project has helped me think about change in contexts I don't know very much about. I have learned how change in the sciences is more complex and challenging than in other areas of the CC [community college] curriculum that I know more about.

This notion of learning about change in their own institutional context but also gaining a deeper understanding of change because of learning about other institutional contexts was expressed by other CAs as well. This learning is connected to planning, brainstorming, problem solving, resource sharing, and collaboration. Over and over again, the respondents mentioned the importance of providing resources, getting advice, giving and receiving ideas that could be tried out in their classrooms. They also mentioned that others in the network helped to reinforce the importance of change and to build confidence, motivation, and patience to bring about change. This human (social) aspect of the SAGE 2YC network should not be under-estimated as it what many individuals found most valuable about the deliberate networking aspects of the project. The following statements reflect this critical aspect of the SAGE 2YC network:

The network has helped me find answers or given me ideas in a much more efficient way.

The network connections made through the SAGE 2YC project have both expanded and deepened. With the additional year spent on the project, people have gone from just-met to known colleagues.

I historically loathe networking but it's palatable for me in SAGE 2YC because we all have something in common.

I have more interactions on more levels, and that has helped me broaden the scope of what I do in my classrooms as well as with professional development with my students (giving them better ideas about what geologists do after college).

I feel more confident about my role with the greater and more diverse feedback from others.

I felt supported in my efforts knowing that others are doing the same work and facing the same challenges I am.

The leaders of the project have all been instrumental in helping to flesh out the changes I wanted to make.

Growing and learning with other instructors has been incredibly formative to help me to feel vulnerable and [know] how to improve. This network is something I can now rely on moving forward and has helped me become more of a part of the geoscience community.

I know so many more people and feel a real sense of belonging since joining SAGE 2YC. I have much more confidence in reaching out to others.

I have people I can tap across the country. Can connect faculty to faculty and help [other] CAs see opportunities for leadership.

Lastly, this insightful statement from one faculty CA summarizes what numerous respondents said about their experience with the SAGE 2YC network and change:

The network has been a huge resource for change in two areas: 1) building confidence in my ability to try new things and my ability to fail safely, and 2) generating ideas for my own teaching and developing interactions at the department level…

Describe the type of regional network that has developed for you over the course of the project.

The responses to how the CAs' regional networks have developed varied widely, with some respondents saying their regional networks had not changed much and others saying their networks were more extensive than they expected and continuing to grow and flourish. Thus, while a minority of respondents mentioned that their regional workshops tapped a small group of people, sometimes the same group over and over during the project, others brought together new constituents (high school teachers, graduate students, geoscientists, 2YC and 4YC faculty and administrators) and continue to nurture these relationships over time. As experience with the regional workshops deepened, the CAs also noted their own sense of accomplishment and professional growth, as is evidenced in the following statement from one CA:

I think my regional network has expanded and as it expands it allows me to have the confidence to seek out more people and to ask more questions. It has also showed me what I was lacking in terms of community when I began as a part-time instructor.

An important area of the SAGE 2YC project that was facilitated through networks created and supported by regional workshops was increased connections to adjunct faculty. Numerous CAs mentioned that it was their work with the regional workshops that allowed them to develop relationships with adjunct faculty, including adjunct faculty on other campuses within their college system and with neighboring community colleges. Some CA teams deliberately interacted with others from within the state or region of the country. This evolutionary approach to networking through the regional workshops was best illustrated by a CA who explained the deliberate approach they had taken was to start with their own department, then add other departments from within the college and then expand to nearby 2YC and 4YC campuses.

A theme mentioned earlier with respect to expanding professional networks was that several CAs thought their work on regional workshops had helped them develop confidence to reach out to gather

information and also to bring people together, both critical aspects of professional networking. As a result, they reported stronger connections within their institution and with other geoscience instructors at other institutions. Some of the observations made by the respondents to this point include:

> It [regional workshops and networking] has expanded to faculty outside of geosciences and included faculty from 4YC institutions (which I didn't quite expect) and professional geoscientists.

> Over the course of the project my regional network has expanded to include professionals in industry, government agencies, and faculty at multiple institutions and from different disciplines.

> The regional network is focused intentionally and has helped keep us on track to accomplish [our] goals.

> Regionally, I am better connected with geoscience colleagues in the state (although it is still a small cohort that is most involved), I have bridged connections with some 4YC colleagues that likely would not have happened otherwise, and I am much better connected…

Finally, several respondents mention the importance of follow-up and communications after workshops in order to maintain active networking, and often they have struggled with this aspect of the work. It takes time and resources to engage in on-going communication that many CAs don't have available given their heavy teaching loads. The challenges that this aspect of the regional workshops and networking present to the CAs are reflected in the following comments:

> Through our regional workshops, I've met individuals at both 2YC and 4YC in our state but I haven't made much of an effort to stay in contact with them after the workshops I realize this is an area that I need to improve upon.

> I have not experienced continued interaction with people from other campuses in the [state] area. However, I do have a decent list of their names to contact for future endeavors, such as our last regional workshop…

How has the SAGE 2YC project changed your professional network?

Most compelling of all the open-ended survey responses was statements about how the CAs' professional networks have changed as a result of SAGE 2YC. In this respect, the CAs spoke about expanding and deepening their relationships with others, including engaging in national professional organizations for the first time. They used other words to describe their networks, including have an "enriched network" and "increased collaborators." Many contrasted their current circumstances with feeling alone on their campuses, as is clear in these two heartfelt quotes:

> I feel more connected to other geoscientists, significantly reducing my "lone wolf" sensibilities. I know who I can contact with questions for advice. I am more willing to reach out because of relationships fostered by in-person interactions and the sense of belonging among cohort 1 [faculty CAs].

> I used to be isolated as an instructor, so the growth of my network is the biggest change… I feel like I have a much bigger impact in my community now than before I started this project. Thank you!

Other statements providing insights into the importance of networking as a means of expanding and

deepening professional networks include the following:

> *I came into my position knowing no 2YC geology faculty. I have not habitually reached out to find others, but now I know I have a larger network of peers who are supportive and knowledgeable and will be resource for me in the future… This project has helped me be much more confident in engaging with colleagues. I struggle with this.*

> *It's amazing how quickly I get wrapped up in the particular concerns of my department and college and forget that I have a nationwide support network that is but a phone call or mouse click away.*

> *It [professional network] has broadened to include pedologic experts in multiple disciplines as well as professionals in fields I would never had the opportunity to be exposed to (diversity, equity, etc.)*

Possibly the highest compliment of all, one faculty CA wrote about how the SAGE 2YC project has provided a model for creating a STEM faculty community on their own campus:

> *The SAGE 2YC community serves as a model for an inclusive network I am trying to build within my department and institution, i.e., as faculty learning community or community of practice centered around teaching and innovation in teaching in STEM.*

Looking forward, how important is networking to you in supporting your action plan and personal goals?

This survey item asked respondents to rate the level of importance of networking on their action planning and personal goals. Figure 12-5 provides the overwhelmingly positive responses to this question, with 37 of the 39 respondents indicating that networking is important or very important to their action planning and personal goals. Only two respondents said networking was somewhat important and no respondent rated networking as not important. These results provide strong support for the deliberate approach that the SAGE 2YC project leadership took to networking, including engaging the CAs in developing and delivering regional workshops as a structured means of encouraging and supporting networking.

Figure 12-5: Level of Importance of Networking to the SAGE 2YC Project

95% of respondents rate networking important or very important

Values: Not Important: 0, Somewhat important: 2, Important: 12, Very Important: 25
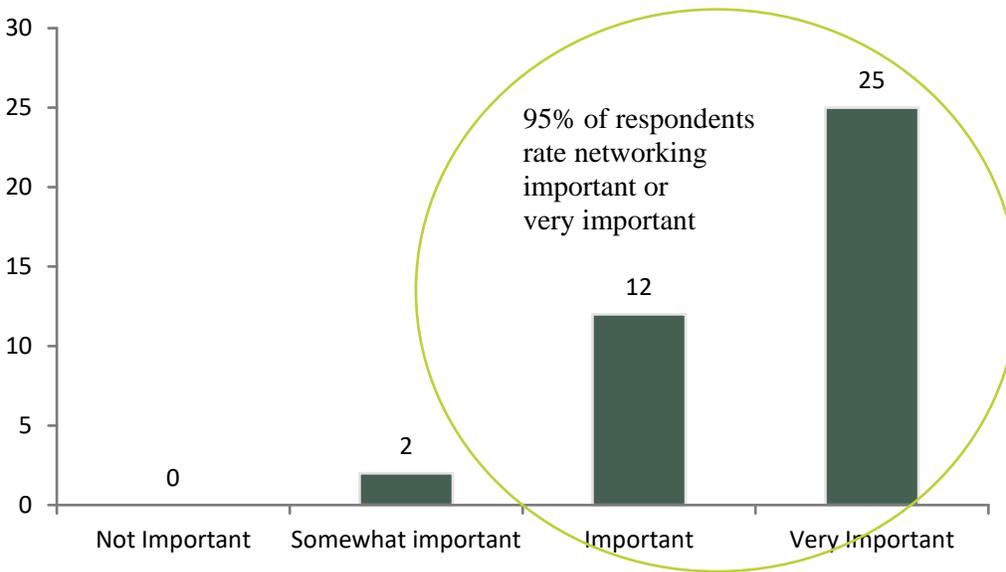
SUMMARY

The SNA component of the evaluation revealed that connections did flourish and evolve over the course of the SAGE 2YC project. The CAs tended to connect most intentionally and extensively with members of their own cohort, with cohort 1 having more time to develop relationships than cohort 2. The PIs and other members of the project leadership team remained an integral part of network from start to finish, encouraging and supporting connections in a wide variety of ways, as CA observations portray in quotes highlighted and summarized in this section. Most importantly, it seems clear that the SAGE 2YC project benefited from a dedicated approach to networking by recognizing from the start that the forces for change would benefit if individuals could see themselves as part of a larger group with capacity to support change. The qualitative evidence that individuals in the network paired up and formed alliances within to help supply knowledge, resources, and support is indisputable. The value of these connections is also without question as the responses of nearly all CAs confirmed that the network made a difference to the actions they took. These results hold true regardless of the extent to which the CAs sought to grow their network, an impressive finding that demonstrates the importance for change agents to be empowered to not only operate alone (as often occurs in classrooms) but as part of a larger, shared commitment to bring about change.

13.   LESSONS LEARNED AND RECOMMENDATION

The SAGE 2YC project sought to engage faculty in changing and improving geoscience education to increase student success in community colleges. Faculty CAs implement and lead change through their own efforts and through networking with other CAs who form CoPs dedicated to changing practice. The SAGE 2YC project focused on developing CA faculty leadership, implementing and scaling evidence-based educational practices, and building a national network of 2YC geoscience faculty. The three goals guiding the project are:

1. build a sustainable national network of 2YC faculty CAs who catalyze change at multiple levels, from the micro level of their courses to the mid-level program/departments to the macro-level of colleges and regions, as well as the profession;

2. implement high-impact practices aligned with three main areas of change (supporting student success, broadening participation, and facilitating students' pathways); and

3. investigate PD models for 2YC geoscience faculty that promote a reflective cycle of innovation.

The SAGE 2YC project promoted evidence-based change in practice through a comprehensive professional development (PD) model that took into account the development of faculty as instructional change agents; program, campus and regional leaders; and community (professional) service providers. Engagement of campus administrators was designed to cultivate support for the practice changes that CAs intentionally planned to 1) improve teaching and learning to increase student academic success, 2) broaden participation in geoscience education (as integral to STEM education), and 3) enhance pathways to transfer and career opportunities in the geosciences.

The SAGE 2YC PD model for SAGE 2YC evolved through a continuous cycle of planning, implementing, learning, and improving. This iterative process relied on feedback loops, fueled by qualitative and quantitative data, to bring about change in practice. The scaffolding of evidence-based strategies was explicit in the efforts of the SAGE 2YC project leadership team's actions, especially in supporting change in instructional practice. The CAs were also encouraged to gather and use data to better understand how evidence-based strategies were working for students, including measuring the course success rates of student sub-groups and using these data to close equity gaps. In addition, the project encouraged the formation CoPs and the evolution of the SAGE 2YC network through regional workshops, annual workshops, and professional association meetings where the CAs could connect with one another to share what they were doing to implement and scale change.

Lessons Learned

Looking at the totality of the SAGE 2YC project, we present six lessons learned that are supported by the comprehensive, multiple-methods research and evaluation design used by the ERI team.

Lesson #1: Intentional project leadership strengthens faculty engagement. From the beginning, the PI team envisioned major elements of the PD model (e.g., clear goals, single and multi-college teams, regional workshops) that became the backbone and connective tissue for the project. Envisioned from the start, two CA cohorts of geoscience faculty provided the test bed for additional cohorts of CAs who could learn through others'

experiences, as well as their own. Coupling deliberate elements of the PD model to CA learning, leading and improving over time created momentum for even more change.

Lesson #2: Change takes time. When asked what factor made the most difference in the success of SAGE 2YC, participants pointed to a range of very meaningful factors but one factor stood out. Almost everyone said the extended length of time that they had to engage in SAGE 2YC made the most difference in their ability to change. The four years of funding that was extended to five with a no-cost extension was important to the overall accomplishments of the CAs, giving them time to execute the changes they sought to make and then seeing the fruits of their labor come to pass.

Lesson #3: No one changes alone. CoPs were integral to the CA change effort happening on and across college campuses affiliated with SAGE 2YC. The evolving SAGE 2YC network provided support for changes in practice, using collaborative learning and peer mentoring to support evidence-based reform. The PD model fostered community through virtual activities that brought the CAs together to learn, complementing in-person PD. Encouraging CAs to facilitate the learning of other geoscience faculty through regional workshops that extended social networking helped to grow impact even more widely.

Lessons #4: Learning by doing is as powerful for faculty as it is for students. SAGE 2YC project leaders practiced what they preached. They modeled evidence-based practices, and they supported CAs in engaging in similar practices. They encouraged the use of data-driven Implementation so that the CAs could know what was happening to their practice and to their students and use that knowledge to make even more improvements. Administrator involvement in the action planning of CA teams gave them a window into faculty work, which allowed CAs to see their colleges from a larger, institutional perspective. Through these experiences, faculty leadership developed and grew.

Lesson #5: Faculty leadership is developed through opportunity to practice. The SAGE 2YC PD model offered a variety of opportunities for faculty to practice leadership. Leading regional workshops gave the CAs the chance to cultivate new leadership skills (i.e., multi-framed leadership approaches), including seeing themselves as leading evidence-based practice on their campuses. These empowering experiences were instrumental to other faculty leadership changes occurring on campuses. Reflection of participants on their own leadership frames strengthened their knowledge of how to lead, and built self-efficacy that is essential to bringing about larger and more transformational change.

Lesson #6: Grounding changes in practice in the cycle of Innovation is imperative to scaling even larger change. The SAGE 2YC project was intentional about scaling change from beginning to end. Using multiple methods to achieve this goal, including team- and college-based action planning, regional workshops, professional affiliations, virtual modalities, and social media, the SAGE 2YC project kept an eye on what was happening within the project while also looking to the larger context to gain insights into what more could be done to improve 2YC geoscience education.

RECOMMENDATIONS

The ERI team offers three recommendations for practitioners, researchers, and the National Science Foundation (NSF).

1. **Focus on faculty:** The explicit, intentional and consistent focus on faculty in SAGE 2YC provides a model for how to reform community college geoscience education, and we suspect this model will work well in other areas of STEM and other disciplines as well. We begin with this recommendation about the centrality of the SAGE 2YC project's focus on faculty because it contrasts so vividly from other reform agendas associated with career, academic, and guided pathways that tend to concentrate on what administrators do more than what faculty do. SAGE 2YC provides a tangible example of change that can happen when college faculty is spotlighted, encouraged, and supported to bring about changes in practice. Other reforms of community college education would do well to examine closely the ways in with SAGE 2YC nurtured and grew faculty leaders who were instrumental to improving practice and student success on their campuses.

2. **Encourage and grow intentional change:** In SAGE 2YC, the project leadership identified a range of evidence-based practices that were introduced, modeled, scaffolded, and evaluated as they unfolded as the CAs implemented change on their campuses and in their regions of the country. Whereas many changes in practice were identified and encouraged up front, many others evolved as the CAs, as well as project leaders, learned collectively over time about what kinds of changes were being employed by CAs and how these reforms were going. Recognizing how nuanced contexts influenced the actions CAs took in their work, future reformers of geoscience education would do well to take a page from the SAGE 2YC playbook to learn how to improve practice. These lessons begin with being sure change strategies are defined clearly so they can be documented and assessed, and so they can be shared with others to promote learning and on-going improvement.

3. **Use rigorous evaluation and research designs to measure change**. The SAGE 2YC leadership introduced data-based approaches to documenting change and student success as the grant unfolded. These approaches enriched the CAs' and others' understanding of what was changing and how change was experienced by students, and it was foundational to telling the story of SAGE 2YC. Future iterations of the PD model will benefit from even more rigorous designs that enable the measurement of the impact of the SAGE 2YC PD model. Using more sophisticated designs including experimental and quasi-experimental designs will produce results on what works that others can replicate as the journey to scale change in 2YC geoscience education continues.

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Appendix A: Publications and presentations of ERI team members

Iverson, E., Bragg, D. D., & Eddy, P.L. (2020). How faculty change agents enact mid-level leadership in STEM. *New Directions for Community Colleges, Issue 191*, pp. 67-79.

Eddy, P., Hao, Y., & Bragg, D. (2019, April). *Exploring theoretical perspectives on change agent roles enacted by two-year college geoscience faculty.* Research paper presented at the 2019 Annual Meeting of the American Educational Research Association, Toronto, Canada.

Eddy, P., Iverson, E., Hao, Y., Bragg, D., & O'Connell, K. (2019, April). *Faculty as leaders: Building innovative and sustainable change in community colleges.* Research symposium at the 61st Annual Council for the Study of Community Colleges Conference, San Diego, CA (equal contribution among the presenters).

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.

Ormand, C.J., Baer, E.M.D., Bragg, D., Eddy, P., Emerson, N.R., Hao, Y., Hodder, J., Iverson, E. and Macdonald, R.H., (2017, October). The Inventory Of Educational Practices And The Inventory Of Geoscience Department And Program Practices: Two New Instruments In Development From The SAGE 2YC Project. Geological Society of America Abstracts with Programs, 49(6). doi: 10.1130/abs/2017AM-304154 Poster

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.

APPENDIX B: COHORT 1 AND 2 TEAMS BY STATE AND 2YC

State	Cohort	Number Team Members	Community Colleges
Cohort 1			
Florida	1	2	Daytona College
Illinois	1	2	Illinois Central College Waubonsee Community College
New York	1	1	Suffolk County Community College
North Carolina	1	2	Wake Technical Community College
Northern California	1		De Anza College
Oregon	1	3	Portland Community College – Rock Creek Portland Community College – Southeast Mt. Hood Community College
Southern California 1	1	2	Mt. San Antonio College
Southern California 2	1	2	Pasadena City College
Texas	1	2	Lone Star College – University Park Lone Star College – Tomball
Virginia	1	3	Thomas Nelson Community College Reynolds Community College
Wisconsin	1		University of Wisconsin-Manitowoc University of Wisconsin-Marinette
Cohort 2			
DC Metro	11	3	Northern Virginia Community College
Massachusetts	11	2	Cape Cod Community College
Michigan	11	2	Delta College
Oregon 2	11	2	Chemeketa Community College Linn Benton Community College
Southern California 3	11	2	Mt. San Antonio College
Washington	1	2	Bellevue College

APPENDIX C: SUPPORTING TABLES ON COURSE CHANGES

Table C.1. *Total Course Sections Taught and Changed by Faculty CAs and non-CAs*

Team (Cohort 1 & 2)	Year 2		Year 3		Year 4		Total	
	Number Course Sections Taught	Percent Course Sections Changed	Number Course Sections Taught	Percent Course Sections Changed	Number Course Sections Taught	Percent Course Sections Changed	Number Course Sections Taught	Percent Course Sections Changed
Cohort 1								
Florida								
Faculty CA	6	50%	9	67%	6	33%	21	52%
Non-CA	3	33%	7	14%	5	0%	15	13%
Illinois								
Faculty CA	10	90%	21	90%	11	88%	42	82%
Non-CA	26	4%	38	0%	31	0%	95	1%
New York								
Faculty CA	2	100%	4	100%	4	100%	10	100%
Non-CA	20	0%	44	11%	41	12%	105	10%
North Carolina								
Faculty CA	5	80%	9	89%	9	89%	23	87%
Non-CA	8	25%	15	53%	17	71%	40	55%
Oregon								
Faculty CA	3	67%	21	75%	6	100%	21	81%
Non-CA	20	0%	63	2%	32	0%	97	1%
So. California								
Faculty CA	3	100%	15	100%	6	100%	24	100%
Non-CA	27	0%	49	0%	11	0%	97	0%
Texas								
Faculty CA	n/a	n/a	8	88%	77	100%	15	93%
Non-CA	n/a	n/a	93	8%	97	7%	190	7%
Virginia								
Faculty CA	10	40%	15	93%	14	100%	39	82%
Non-CA	7	0%	10	0%	11	0%	28	0%
Wisconsin								
Faculty CA	5	100%	9	100%	7	100%	21	100%
Non-CA	27	0%	56	11%	48	19%	131	11%
Total								
Faculty CA	44	73%	102	89%	70	90%	216	86%
Non-CA	138	3%	387	7%	303	11%	816	8%
Grand Total	***182***	***20%***	***477***	***25%***	***373***	***26%***	***1032***	***24%***

Team (Cohort 1 & 2)	Year 2		Year 3		Year 4		Total	
	Number Course Sections Taught	Percent Course Sections Changed	Number Course Sections Taught	Percent Course Sections Changed	Number Course Sections Taught	Percent Course Sections Changed	Number Course Sections Taught	Percent Course Sections Changed
Cohort 2								
Michigan								
Faculty CA	n/a	n/a	10	10%	9	100%	19	53%
Non-CA	n/a	n/a	8	0%	2	0%	10	0%
Oregon								
Faculty CA	n/a	n/a	6	67%	4	100%	10	80%
Non-CA	n/a	n/a	18	0%	5	13%	33	6%
Washington								
Faculty CA	n/a	n/a	11	45%	6	83%	17	59%
Non-CA	n/a	n/a	22	0%	10	0%	32	0%
Total								
Faculty CAs	n/a	n/a	27	37%	19	95%	46	61%
Non-CAs	n/a	n/a	48	0%	27	7%	75	3%
Grand Total	*n/a*	*n/a*	*75*	*13%*	*46*	*43%*	*121*	*25%*

Table C.2. *Course Sections Taught and Changed by Faculty CAs by Format (Face-to-Face, Online & Hybrid)*

Teams	Number Course Sections Taught	Percent Face-to-Face	Percent Online	Percent Hybrid	Percent Course Sections Changed	Percent Face-to-Face	Percent Online	Percent Hybrid
Cohort 1								
Florida	21	14%	0%	86%	52%	0%	0%	100%
Illinois	42	64%	26%	10%	88%	70%	30%	0%
New York	10	100%	0%	0%	100%	100%	0%	0%
North Carolina	23	39%	43%	17%	87%	30%	50%	20%
Oregon	21	95%	5%	0%	81%	100%	0%	0%
So. California	24	100%	0%	0%	100%	100%	0%	0%
Texas	15	93%	7%	0%	93%	93%	7%	0%
Virginia	39	67%	18%	15%	82%	63%	19%	19%
Wisconsin	21	86%	5%	10%	100%	86%	5%	10%
Total	*216*	*70%*	*14%*	*16%*	*86%*	*72%*	*16%*	*12%*
Cohort 2								
Michigan	19	100%	0%	0%	53%	100%	0%	0%
Oregon	10	100%	0%	0%	80%	100%	0%	0%
Washington	17	76%	6%	18%	59%	90%	10%	0%
Total	*46*	*91%*	*2%*	*7%*	*61%*	*96%*	*4%*	*0%*

Table C.3. *Number of Types of Changes Made to Faculty CA Course Sections*

Teams	Number Teams Group Learning	Number Teams Active Learning	Number of Teams Meta-Cognition	Number of Teams Student Learning Supports	Number of Teams Course Content Connections	Number Teams Course Learning Outcomes	Number Teams Career Pathways & Transfer	Numb Teams Other
Cohort 1								
Florida	5	5	1	1	5	0	0	7
Illinois	3	1	2	4	4	5	0	0
New York	4	0	10	6	0	0	2	0
North Carolina	7	4	5	3	5	10	1	3
Oregon	1	1	1	0	0	2	0	0
So. California	13	12	8	1	6	0	7	0
Texas	7	10	12	0	8	10	0	1
Virginia	6	7	12	4	5	3	9	5
Wisconsin	5	6	2	0	3	5	2	0
Total	*51*	*46*	*53*	*19*	*36*	*35*	*21*	*16*
Cohort 2								
Michigan	0	0	6	6	2	0	0	0
Oregon	0	9	6	3	3	0	0	0
Washington	4	4	2	0	4	0	1	1
Total	*4*	*13*	*14*	*9*	*9*	*0*	*1*	*1*

Note: This table does not show types of changes for non-CAs as very few courses were changed by this group; when course sections were flagged as changed too limited information was provided to include in this analysis.

Table C.4. *Average Enrollment in Courses Taught and Changed by Faculty CAs*

Teams (Faculty CAs Only)	Year 2		Year 3		Year 4		Total	
	Number Enrolled in Total Course Sections	Percent Enrolled in Changed Course Sections	Number Enrolled in Total Course Sections	Percent Enrolled in Changed Course Sections	Number Enrolled in Total Course Sections	Percent Enrolled in Changed Course Sections	Number Enrolled in Total Course Sections	Percent Enrolled in Changed Course Sections
Cohort 1								
Florida	111	86%	126	85%	80	36%	317	73%
Illinois	290	94%	509	93%	400	88%	1199	91%
New York	42	100%	83	100%	95	100%	220	100%
North Carolina	125	95%	278	99%	286	97%	689	97%
Oregon	71	66%	326	73%	127	100%	524	79%
So. California	83	100%	382	100%	193	100%	658	100%
Texas	n/a	n/a	219	93%	195	100%	414	96%
Virginia	222	41%	302	94%	275	100%	799	81%
Wisconsin	52	100%	98	100%	86	100%	236	100%
Total	*996*	*81%*	*2323*	*92%*	*1737*	*94%*	*5056*	*90%*
Cohort 2								
Michigan	n/a	n/a	185	11%	184	100%	369	56%
Oregon	n/a	n/a	146	68%	93	100%	239	80%
Washington	n/a	n/a	340	43%	207	88%	547	60%
Total	*n/a*	*n/a*	*671*	*40%*	*484*	*95%*	*1155*	*63%*

Note: The Texas team did not submit data for year 2, and one of the Virginia colleges did not report changed courses for year 2.

Table C.5. *Average Percentage Female Enrollment in Changed Course Sections*

Teams (Faculty CAs Only)	Year 2		Year 3		Year 4		Total	
	Number Changed Course Sections	Average Percent Female of Changed Course Sections	Number Changed Course Sections	Average Percent Female of Changed Course Sections	Number Changed Course Sections	Average Percent Female of Changed Course Sections	Number Changed Course Sections	Average Percent Female of All Changed Course Sections
Cohort 1								
Florida	3	51%	5	57%	2	66%	10	57%
Illinois	9	48%	19	49%	9	48%	37	48%
New York	2	45%	4	39%	4	34%	10	38%
North Carolina	4	48%	8	60%	8	49%	20	53%
Oregon	2	54%	9	52%	6	51%	17	52%
So. California	3	51%	15	54%	6	47%	24	52%
Texas	n/a	n/a	7	58%	7	47%	14	52%
Virginia	4	46%	14	48%	14	53%	32	50%
Wisconsin	5	60%	9	39%	6	34%	20	43%
Total	*32*	*50%*	*90*	*51%*	*62*	*47%*	*184*	*49%*
Cohort 2								
Michigan	n/a	n/a	1	62%	9	61%	10	61%
Oregon	n/a	n/a	4	44%	4	43%	8	44%
Washington	n/a	n/a	5	43%	5	42%	10	43%
Total	*n/a*	*n/a*	*10*	*45%*	*18*	*52%*	*28*	*49%*

Note: The Texas team did not submit data for year 2, and one of the Virginia colleges did not report changed courses for year 2 in the updated template.

Table C.6. *Average Percentage Racially Minoritized Enrollment in Changed Course Sections*

Teams (Cohort 1 & 2)	Year 2		Year 3		Year 4		Total	
	Number Changed Course Sections	Average Percent Racially Minoritized of Changed Course Sections	Number Changed Course Sections	Average Percent Racially Minoritized of Changed Course Sections	Number Changed Course Sections	Average Percent Racially Minoritized of Changed Course Sections	Number Changed Course Sections	Average Percent Racially Minoritized of All Changed Course Sections
Cohort 1								
Florida	3	23%	6	18%	2	7%	11	17%
Illinois	5	23%	13	27%	9	40%	27	31%
New York	2	15%	4	19%	4	20%	10	19%
Oregon	n/a	n/a	8	33%	6	31%	14	32%
So. California	3	80%	15	82%	6	82%	24	82%
Texas	n/a	n/a	7	44%	6	49%	13	46%
Virginia	4	19%	14	38%	14	39%	32	36%
Wisconsin	5	1%	9	6%	6	10%	20	6%
Total	*22*	*24%*	*76*	*38%*	*53*	*38%*	*151*	*36%*
Cohort 2								
Michigan	n/a	n/a	1	5%	9	14%	10	13%
Oregon	n/a	n/a	4	15%	4	17%	8	16%
Washington	n/a	n/a	3	47%	5	51%	8	49%
Total	*n/a*	*n/a*	*8*	*26%*	*18*	*25%*	*26*	*25%*

Note: The Texas team did not submit data for year 2, and one of the Virginia colleges did not report changed courses for year 2. Data for the North Carolina team are excluded because Latinx data were reported in a manner inconsistent with the template.

Table C.7. *Average Percentage Non-traditional Age Enrollment in Changed Course Sections*

Teams (Cohort 1 & 2)	Year 2		Year 3		Year 4		Total	
	Number Changed Course Sections	Average Percent Non-Trad. Age of Changed Course Sections	Number Changed Course Sections	Average Percent Non-Trad. Age of Changed Course Sections	Number Changed Course Sections	Average Percent Non-Trad. Age of Changed Course Sections	Number Changed Course Sections	Average Percent Non-Trad. Age of All Changed Course Sections
Cohort 1								
Florida	3	20%	6	23%	2	14%	11	20%
Illinois	9	21%	19	15%	9	16%	37	18%
New York	2	25%	4	15%	4	12%	10	16%
North Carolina	4	29%	8	27%	7	26%	19	27%
Oregon	2	21%	9	25%	6	27%	17	25%
So. California	3	11%	15	19%	6	18%	24	18%
Texas	n/a	n/a	7	19%	7	15%	14	17%
Virginia	4	20%	14	24%	14	30%	32	26%
Wisconsin	5	9%	9	12%	7	15%	21	12%
Total	*32*	*19%*	*84*	*20%*	*55*	*22%*	*185*	*20%*
Cohort 2								
Michigan	n/a	n/a	1	5%	9	20%	10	19%
Oregon	n/a	n/a	4	21%	4	25%	8	23%
Washington	n/a	n/a	5	10%	4	11%	9	10%
Total	*n/a*	*n/a*	*10*	*14%*	*17*	*19%*	*27*	*17%*

Note: The Texas team did not submit data for year 2, and one of the Virginia colleges did not report changed courses for year 2.

Table C.8. *Average Percentage Pell Eligible in Changed Course Sections*

Teams (Cohort 1 & 2)	Year 2		Year 3		Year 4		Total	
	Number Changed Course Sections	Average Percent Pell Eligible of Changed Course Sections	Number Changed Course Sections	Average Percent Pell Eligible of Changed Course Sections	Number Changed Course Sections	Average Percent Pell Eligible of Changed Course Sections	Number Changed Course Sections	Average Percent Pell Eligible of All Changed Course Sections
Cohort 1								
Florida	2	43%	6	48%	2	59%	10	49%
Illinois	9	30%	19	25%	9	36%	27	29%
New York	2	18%	4	14%	4	25%	10	19%
North Carolina	4	38%	8	38%	8	29%	20	35%
Oregon	2	33%	9	44%	6	36%	17	40%
So. California	3	70%	15	72%	6	72%	24	72%
Texas	n/a	n/a	7	30%	7	20%	14	25%
Virginia	4	39%	14	33%	14	38%	32	36%
Wisconsin	5	47%	9	26%	4	48%	18	37%
Total	*31*	*39%*	*84*	*39%*	*53*	*41%*	*182*	*39%*
Cohort 2								
Michigan	n/a	n/a	1	33%	9	36%	10	36%
Washington	n/a	n/a	5	14%	5	24%	10	19%
Total	*n/a*	*n/a*	*6*	*17%*	*14*	*32%*	*20*	*27%*

Table C.9. *Course Enrollment and Successful Completion of Changed Course Sections*

Teams (Faculty CA Only)	Year 2		Year 3		Year 4		Total	
	Number Enrolled in Course Sections	Percent Completed Course Sections	Number Enrolled in Course Sections	Percent Completed Course Sections	Number Enrolled in Course Sections	Percent Completed Course Sections	Number Enrolled in Course Sections	Percent Completed Course Sections
Cohort 1								
Florida	95	96%	107	97%	29	86%	231	95%
Illinois	273	55%	473	53%	351	46%	1097	52%
New York	42	44%	83	69%	95	63%	220	62%
North Carolina	119	66%	274	65%	278	66%	671	66%
Oregon	47	94%	239	91%	127	92%	413	92%
So. California	83	70%	382	70%	193	63%	658	68%
Texas	n/a	n/a	203	78%	195	78%	398	78%
Virginia	91	69%	284	78%	275	85%	650	80%
Wisconsin	52	75%	98	63%	86	79%	236	71%
Total	*802*	*68% (.21)*	*2143*	*71% (.18)*	*1629*	*73% (.20)*	*4574*	*71% (.19)*
Cohort 2								
Michigan	n/a	n/a	21	90%	184	87%	205	87%
Oregon	n/a	n/a	99	88%	93	92%	192	90%
Washington	n/a	n/a	147	84%	183	83%	330	84%
Total	*n/a*	*n/a*	*267*	*86% (.07)*	*460*	*87% (.09)*	*727*	*87% (.08)*

Table C.10. *Average Percentage Females Successfully Completed Course Section*

Teams (Faculty-CAs Only)	Year 2		Year 3		Year 4		Total	
	Number Changed Course Sections	Avg Percent Female Completed Course Section (Standard Deviation)	Number Changed Course Sections	Avg Percent Female Completed Course Section (Standard Deviation	Number Changed Course Sections	Avg Percent Female Completed Course Section (Standard Deviation)	Number Changed Course Sections	Avg Percent Female of All Completed Course Sections
Cohort 1								
Florida	3	96%	5	99%	2	92%	10	97%
Illinois	9	49%	19	56%	9	49%	37	53%
New York	2	60%	4	77%	4	63%	10	68%
No. Carolina	4	62%	8	68%	8	66%	20	66%
Oregon	2	94%	9	88%	6	94%	17	91%
So. California	3	70%	15	67%	6	66%	24	67%
Texas	n/a	n/a	7	79%	7	82%	14	81%
Virginia	4	76%	14	69%	14	84%	32	76%
Wisconsin	5	71%	9	56%	6	76%	20	65%
Total	*32*	*67% (.23)*	*90*	*69% (.22)*	*62*	*74% (.23)*	*184*	*70% (.23)*
Cohort 2								
Michigan	n/a	n/a	1	85%	9	83%	10	84%
Oregon	n/a	n/a	4	86%	4	93%	8	89%
Washington	n/a	n/a	5	94%	5	87%	10	91%
Total	*n/a*	*n/a*	*10*	*90% (.11)*	*18*	*87% (.12)*	*28*	*88% (.12)*

Note: The Texas team did not submit data for year 2, and one of the Virginia colleges did not report changed courses for year 2. Due to the need for brevity in statistical tables, readers should contact the lead author to obtain standard deviations for cells reporting average results.

Table C.11. *Average Percentage Racially Minoritized Successfully Completed Course Section*

Teams (Faculty-CAs Only)	Year 2		Year 3		Year 4		Total	
	Number Changed Course Sections	Avg Percent Racially Minoritized Completed Course Section (Standard Deviation)	Number Changed Course Sections	Avg Percent Racially Minoritized Completed Course Section (Standard Deviation)	Number Changed Course Sections	Avg Percent Racially Minoritized Completed Course Section (Standard Deviation)	Number Changed Course Sections	Avg Percent Racially Minoritized of All Completed Course Sections
Cohort 1								
Florida	3	100%	6	96%	1	50%	10	93%
Illinois	5	30%	13	27%	9	38%	27	31%
New York	2	25%	4	48%	4	33%	10	38%
Oregon	n/a	n/a	8	89%	6	82%	14	86%
So. California	3	65%	15	68%	6	61%	24	66%
Texas	n/a	n/a	7	77%	6	71%	13	74%
Virginia	4	58%	14	70%	14	77%	32	72%
Wisconsin	1	0%	4	25%	5	80%	10	50%
Total	*18*	*52% (.37)*	*71*	*63% (.31)*	*51*	*64% (.29)*	*140*	*62% (.31)*
Cohort 2								
Michigan	n/a	n/a	1	100%	8	92%	9	93%
Oregon	n/a	n/a	4	75%	4	94%	8	84%
Washington	n/a	n/a	3	84%	5	90%	8	85%
Total	*n/a*	*n/a*	*8*	*82% (.35)*	*17*	*90% (.12)*	*25*	*88% (.22)*

Note: The Texas team did not submit data for year 2, and one of the Virginia colleges did not report changed courses for year 2. Data for the North Carolina team are excluded because Latinx data were reported in a manner inconsistent with the template. Due to the need for brevity in statistical tables, readers should contact the lead author to obtain standard deviations for cells reporting average results.

Table C.12. *Average Percentage Non-traditional Age Students Successfully Completed Course Section*

Teams (Faculty-CAs Only)	Year 2		Year 3		Year 4		Total	
	Number Changed Course Sections	Avg Percent Non-Trad Age Completed Course Section (Standard Deviation)	Number Changed Course Sections	Avg Percent Non-Trad Age Completed Course Section (Standard Deviation)	Number Changed Course Sections	Avg Percent Non-Trad Age Completed Course Section (Standard Deviation)	Number Changed Course Sections	Avg Percent Non-Trad Age of All Completed Course Sections
Cohort 1								
Florida	3	92%	6	100%	2	100%	11	98%
Illinois	9	69%	19	62%	9	60%	37	64%
New York	2	81%	4	72%	4	75%	10	75%
No. Carolina	4	66%	8	62%	7	73%	19	67%
Oregon	2	94%	9	93%	6	100%	17	95%
So. California	3	72%	15	66%	6	83%	24	71%
Texas	n/a	n/a	7	80%	7	81%	14	81%
Virginia	4	54%	14	86%	14	84%	32	81%
Wisconsin	5	67%	9	73%	7	92%	21	78%
Total	*32*	*72% (.27)*	*91*	*76% (.25)*	*62*	*81% (.26)*	*185*	*77% (.26)*
Cohort 2								
Michigan	n/a	n/a	1	100%	9	92%	10	93%
Oregon	n/a	n/a	4	90%	4	89%	8	89%
Washington	n/a	n/a	5	69%	4	100%	9	85%
Total	*n/a*	*n/a*	*10*	*82% (.21)*	*17*	*93% (.15)*	*27*	*89% (.18)*

Note: The Texas team did not submit data for year 2, and one of the Virginia colleges did not report changed courses for year 2.

Table C.13. *Percentage Pell Eligible Students Successfully Completed Course Section*

Teams (Faculty-CAs Only)	Year 2		Year 3		Year 4		Total	
	Number Changed Course Sections	Avg Percent Pell Eligible Completed Course Section	Number Changed Course Sections	Avg Percent Pell Eligible Completed Course Section	Number Changed Course Sections	Avg Percent Pell Eligible Completed Course Section	Number Changed Course Sections	Avg Percent Pell Eligible of All Completed Course Sections
Cohort 1								
Florida	2	91%	6	98%	2	83%	10	94%
Illinois	9	48%	19	48%	9	34%	37	44%
New York	2	8%	4	71%	4	68%	10	57%
No. Carolina	4	65%	8	59%	8	65%	20	62%
Oregon	2	88%	9	88%	6	91%	17	89%
So. California	3	65%	15	68%	6	60%	24	66%
Texas	n/a	n/a	7	86%	7	77%	14	81%
Virginia	4	71%	14	77%	14	84%	32	80%
Wisconsin	5	74%	9	74%	3	89%	17	77%
Total	*31*	*62% (.26)*	*91*	*70% (.27)*	*59*	*70% (.26)*	*181*	*69% (.27)*
Cohort 2								
Michigan	n/a	n/a	1	86%	9	89%	10	88%
Washington	n/a	n/a	5	90%	5	82%	10	86%
Total	*n/a*	*n/a*	*6*	*89% (.20)*	*14*	*86% (.12)*	*20*	*87% (.14)*

Note: The Texas team did not submit data for year 2, one of the Virginia colleges did not report changed courses for year 2, and the Oregon cohort 2 team did not submit Pell data. Due to the need for brevity in statistical tables, readers should contact the lead author to obtain standard deviations for all cells reporting average results.