Program Review 2021-2022

Physics

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General Information (Program Review 2021-2022)

2021/22 Program Review

2021/22 PROGRAM REVIEW FORM

Form: 2021/2022 Program Review (See appendix)

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MESA2030 COMPREHENSIVE MASTER PLAN

ROADMAP TO MESA2030: STRATEGIC PLAN 2021-2026

MESA DATA DASHBOARDS

Requests Forms

REQUEST PORTAL

Appendix

A. **2021/2022 Program Review** (Form)

Form: "2021/2022 Program Review"

Created with : Taskstream
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2021/2022 Program Review

(REQUIRED) Name of Lead Writer and Manager/Service Area Supervisor

Jennifer Snyder and Paloma Vargas

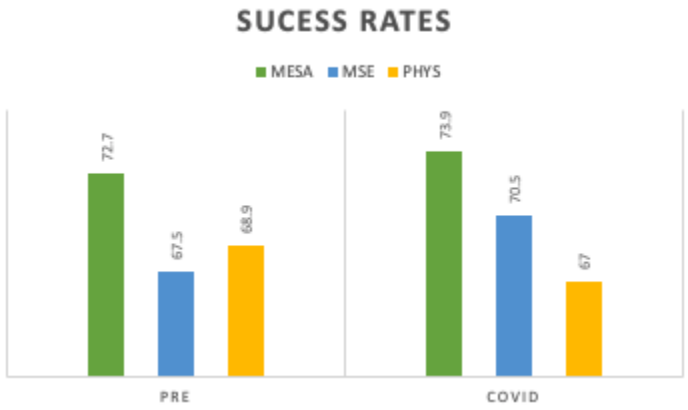
(REQUIRED) In what ways (if any) did changes to an online/remote modality due to COVID-19 impact student success and equity in your area/program? Please provide evidence.

Courses in the PHYS program include four different pathways. PHYS 100 primarily serves technical degree programs. PHYS 125-126 serves health science professional programs and some biology transfer programs. PHYS 180A/B is primarily taken by biology or pre-med students interested in transferring to schools in the UC System. Finally, PHYS 195-197 is taken by Physical Science and Engineering majors. Each course sequence has a full-time faculty member "captaining" the courses to provide curricular and lab support to adjunct instructors. Each of these pathways requires an equity-minded and student-centered approach to institutional practices and processes proven to increase student completion of certificates, degrees, and transfer requirements by providing students with the structure and personal support needed to achieve their educational, career, and life goals.

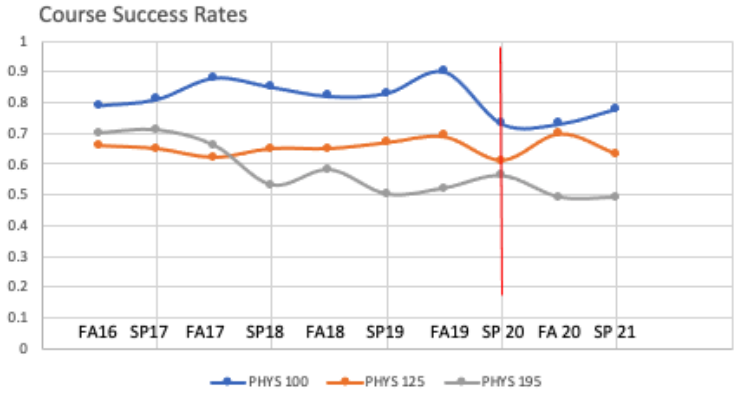
One impact of COVID has been the unexpected retirements of contract faculty. We lost one contract faculty member in Fall 2021 and expect to lose a second at the end of Spring 2022. This will leave current faculty stretched and with some course sequences without direction. For physics courses our FTEF = 9.404.Three contract faculty cannot properly support these four distinctly different pathways. With the retirement of Michael Goldstein, we expect a dire need for faculty practiced in teaching students in General Physics courses. These courses are typically difficult for faculty to teach since they don't require a high level of mathematics and are much more conceptual. These courses tend to be much more diverse and thus require more understanding of Culturally Responsive Practices. The loss of these faculty (40% reduction) is expected to have a strong impact on student success in the future. We hope that Mesa College will provide support to quickly replace the departing contract faculty members. Without new contract faculty, an over-adjunctification seems inevitable unless the program greatly reduces the numbers of courses and sections offered. This of course will negatively impact students' progress towards transfer, but at least will allow for some measure of quality control. We feel this is the lesser of the two evils. It is more desirable that we provide an excellent educational experience to a handful of students as opposed to serving a large number of them poorly. Providing the program with the faculty needed to run at full capacity will benefit everyone involved and allows for the work that has already begun to continue unabated.

To explore COVID-19 impact on Course success rates we used the Student Outcomes Data Dashboard. Success rates were calculated PRE-COVID using only Spring and Fall semesters from Spring 16 to Fall 19. It was decided that intersession and summer populations were too different to include in comparisons. COVID success rates were calculated using only Fall 2020 and Spring 2021. It was decided not to use Spring 2020 since it was a turbulent time for

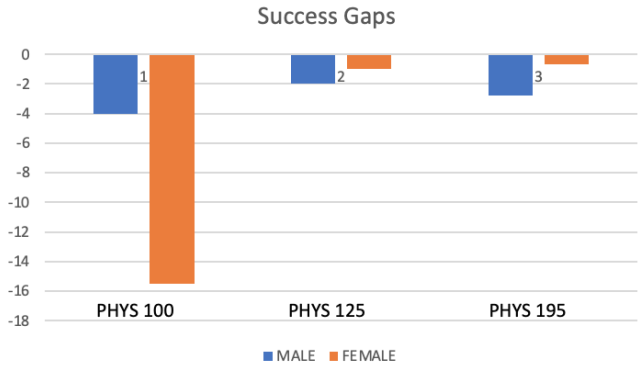
students. Success data is shown in the following graph along with the values for the entire Mesa Campus and the School of Math, Science and Engineering (MSE) for comparison.

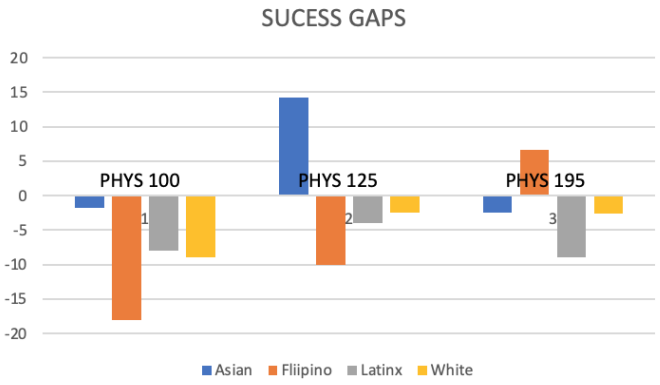


During the pandemic, student success rates across the Mesa Campus increased slightly while the School of MSE saw a much greater increase. Student success in the PHYS program decreased during the pandemic overall. Our interpretation of this decline is not that faculty weren't able to teach in a remote format, but that the courses themselves are not suitable for online learning. Course Success Rates for PHYS 100, PHYS 125, and PHYS 195 were compared because these courses are the first of their sequence and are most likely to be "gatekeepers" to further advancement. PHYS 180A/B were not included because Fall 2020 was the first offering for these courses. As can be seen in the chart, success rates for PHYS 100 and PHYS 125 had been mostly steady Pre-Pandemic with PHYS 125 on the rise. Both courses took a strong decline during Spring 2020. We suspect that it may be due to students not having independence, persistence, motivation and a good studying environment to succeed in physics in the online environment. In addition, many of the students in these courses are employed in Health care professions and saw an increase in work obligations. PHYS 195 success rates have been in a decline for the last few years. There was a slight increase during Spring 2020. Instructors attribute that to rampant cheating that began during that semester. Two instructors submitted over two dozen academic sanction cases each involving cheating on exams. In general, instructors were unprepared to deal with academic dishonesty at the time. Many students who were struggling while on campus found themselves turning to internet "tutoring" for answers for exam questions. During Fall 2020 and Spring 2021, faculty were prepared for both potential cheating and to provide students with more support to prevent the need for cheating. Success rates approached the (weak) pre-pandemic rates.

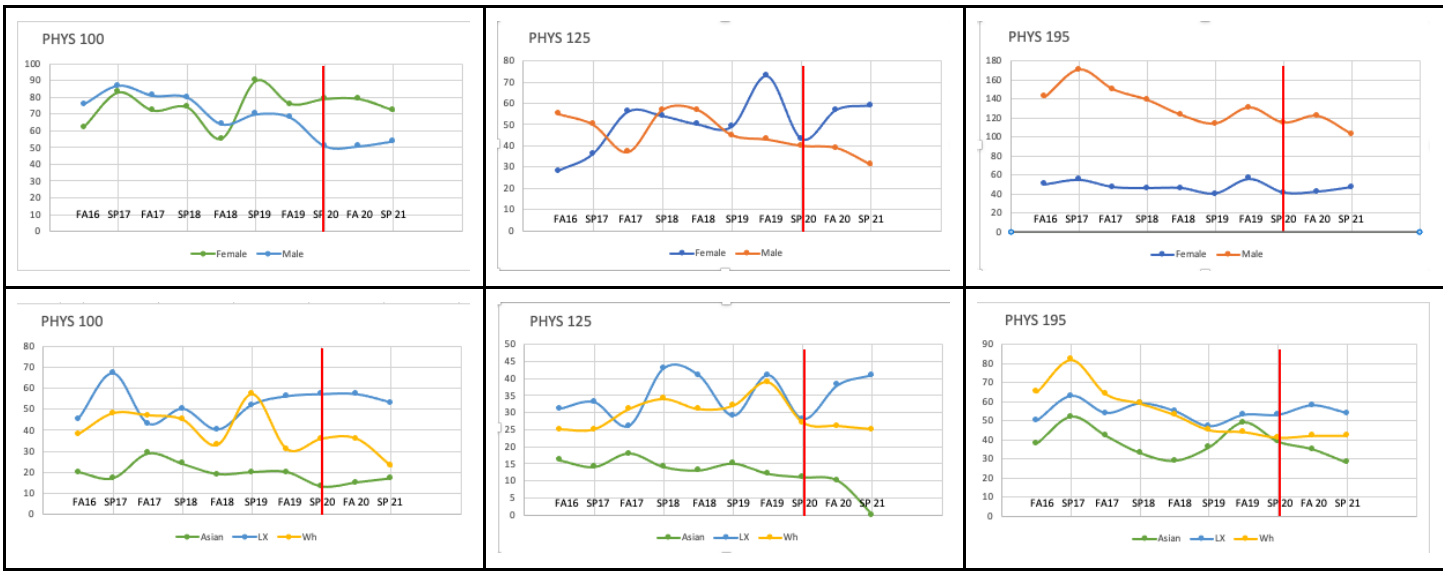


We also calculated Success Gaps for students in PHYS 100, PHYS 125, and PHYS 195 in order to find out more about how the pandemic affected different student groups. These gaps were determined by calculating the average Success Rates during the semesters before Spring 2020 and those after. Success gaps for female students were much more severe in PHYS 100 than for our male students indicating that the pandemic impacted them more strongly. We do not see these similar gaps in success for PHYS 125 or PHY 195. We suggest that this may be because the female students in PHYS 125 and PHYS 195 are in a different demographic. Students in PHYS 100 are more likely to be part time students and much more likely to be taking this course as a path to a new career. Students in PHYS 125 and PHY 195 are more likely to be traditional students in terms of age and preparation. We don't see any particular trends in our Success gaps among our ethnicities in the success gaps that we have calculated. Our Latinx students have large success gaps in most of the courses and according to the Data Dashboards, success gaps in PHYS courses that were not significant pre-pandemic became significant during the pandemic semesters.





The following data shows us changes in enrollment. We are seeing drops in our enrollment of male students in all of our courses, but this trend appears to have begun prior to the pandemic. We know that enrollments nationwide have decreased during the pandemic. National data also suggests that male student enrollment has been on the decline in recent years. It is unclear whether the pandemic has increased this decline. This data could be following a national trend, but since our PHYS 195-197 courses are primarily male (approximately 75%), it is definitely a trend that we will keep an eye on.



Finally, student enrollment by ethnicity showed an interesting trend. Our Asian population in PHYS 125 and PHYS 195 declined during the pandemic whereas our Latinx population increased. We have no particular theories as to why this is happening. We will have to monitor this trend once courses come back onto campus since it is possible that there is a preference among Latinx students for remote learning options.

Instructors also report a lack of engagement in the course material (asking questions, relating material to everyday life, interacting with other students). One instructor cited very minimal effort during the pandemic and low-level understanding exhibited in student questions. In addition, instructors report low levels of attainment of CLO's in second and third semester PHYS courses. Other instructors report that remote learning did seem to work for some students. In some classes, students participated in Zoom Breakout rooms and office hours. However, anecdotal evidence provided indicates that these students are students that would have been successful in any modality. Meaning that during the pandemic we lost the students most vulnerable with the possibility of not getting them back

(REQUIRED) What practices has your area/program implemented since the last program review cycle that you would like to improve/continue? Identify impacts on student success and equity.

The online modality was the impetus for most of the changes that we have made over the last 18 months.

Many faculty, as a part of adapting courses to remote instruction during the pandemic, have created videos. These videos serve to introduce concepts, demonstrate problem solving skills, or provide problem solutions. Post pandemic, faculty have been able to offer these to students to offer another resource for students. In some courses, they are available for students to consult for problems integrating (pun intended) course material and prerequisite mathematics. For other faculty, they are used as pre-lecture viewing for in-person classes. For on-campus courses, they have been edited down to short clips – generally 5-10 minutes long – that students watch before coming to lecture. Approximately, 20 – 30 minutes of video is assigned

for students to watch each week in preparation for class. This has opened up space during the lecture for significantly more student participation in problem-solving. For one PHYS 195 instructor, spending more class time on problem solving has led to an improvement in student performance. This is evidenced by a 6 percentage point increase in exam scores Spring 2021 to Fall 2021, even as the quizzes were more difficult and students were allowed less time than they were during remote instruction. While some of this improvement is likely related to the benefits of returning to in-person instruction, scores from the first half of the class are also up by 5 percentage points from fall of 2019, the last full semester of in-person instruction before the pandemic. This data indicates that this improvement reflects the benefits of more in-class problem solving.

During the pandemic, faculty had to convert labs for a remote environment. This took a few different forms. Some faculty prepared videos of them doing the lab and provided data for students to analyze. Others created lab kits that students picked up at the beginning of the semester in order to labs in their own home. In addition, many faculty used the video labs in Pivot Interactives. Pivot Interactives is a resource for video-based labs in which the students can take data. These labs were as close to the actual experiments completed the on-campus setting as could be in a remote modality. The video labs continue to be a resource during the return to on campus classes. Some faculty have used the labs as preparation for their on campus lab experiments. Other faculty have used these experiments to create short assignments to prepare and give context to students for work in lecture. Pre-pandemic, this sort of work would be assigned as Pre-Lab or Pre-Lecture reading. The students have been much more likely to complete these interactive video assignments before coming to the lab or lecture. In this way, more instructional time can be spent on interacting in the lab and with problems in the lecture than on reading instructions or getting context. Students are much more engaged with both the lecture and the lab.

During the pandemic, we have also had the opportunity to consider why we do labs. We have heard from many faculty that students can't do labs remotely, but why? We discard the notion that the students need to be in the lab in order to be "hands on" with the equipment. Instead, we suggest that the lab should be an opportunity for students to learn the process of science. To this end, we've developed several new lab exercises for PHYS 125, 180A, and 195. These labs are more inquiry-based than traditional physics labs. They focus on formulating hypotheses, designing experiments to test those hypotheses, and drawing conclusions from the data. All of the labs require students to think carefully about experimental uncertainty and how it affects the conclusions they can draw from an experiment. The PHYS 180A and 195 labs have the extra emphasis on calculating and propagating uncertainty. These labs introduce methods for finding the uncertainty in the mean of a set of data, propagating that uncertainty through to calculated quantities, and displaying that uncertainty on graphs using error bars. This is an essential skill that is broadly applicable in STEM fields that students are now acquiring in physics 195 and 181A.

In terms of evaluation, many instructors have altered their evaluation plan. As discussed previously, Academic Dishonesty during the pandemic was a pandemic in itself. Students used "tutoring" platforms to post exam questions that would be solved by experts in less than 20 mins. In addition, some students had other people take their exams for them. There was not one solution to this problem, but one remedy was to move away from offering high-stakes exams and toward offering a greater number of low stakes quizzes. Although this was designed to reduce cheating on remote exams, it has been carried forward to in-person instruction. In principle, this should reduce student stress over high-stakes exams. Further, instructors report

that having frequent quizzes that have significant weight in the grade helps motivate students to stay on track and keep up with the material. During the pandemic other instructors have used alternate forms of examination such as having students make up and solve their own problems and using experimental data for exam questions. This has had the result that students can introduce their own interests and apply their understanding to situations in their lives. Questions that students have used reflect diverse backgrounds and approaches to problem solving. In addition, using experimental data for exams has identified weaknesses in students' abilities to relate theoretical problems to those with real data. Post-pandemic, this has pushed faculty to pay more attention to making sure that students understand the context of the lecture problems and to emphasize evidence-based learning outside of the laboratory setting.

Finally, during remote learning, faculty and students have learned how to use computer resources for teaching. There are many computer simulations (and the video labs!) that can be used to help students understand physics concepts. During the pandemic it was very easy to create and assign activities using these to students because they were already online and on computers. Recently, the department has gotten 48 new laptop computers which has opened up these same possibilities in the classroom. Pre-pandemic it was very difficult for students to use these resources during class or lab time since most of them did not have access to a computer or tablet. Now, the students can borrow laptop computers during class to use for these interactive simulations. Students work together in groups to solve problems in a much more engaging way than they did with paper and pencil. In addition, we have found that the students are much more tech savvy than they were pre-pandemic. Many come with their own computers and tablets to work on during on campus instruction. Also, Zoom office hours are probably here to stay. Zoom office hours allow students more freedom to meet with instructors and with other students.

(REQUIRED) What practices has your area/program implemented since the last program review cycle that you would like to change/discontinue? Identify impacts on student success and equity.

As discussed in this document, the greatest change that we have implemented is online instruction. None of the Physics courses were offered in a remote modality pre-pandemic. We have seen success rates and engagement decrease and academic dishonesty increase. This is definitely something that we intend to discontinue. We do not feel that remote learning has been good for our students' learning or mental health. We feel strongly that remote learning has impacted our most vulnerable students who need to be on campus. We acknowledge that for some students, being on campus is a privilege. It is an opportunity for them to take time to focus on themselves as a student, not a parent, child, caregiver, or worker. Our goal is to make sure that every minute that they spend in class is valuable for them because we also consider it a privilege to be their instructors. We understand that remote learning may work for some courses, but feel that the evidence presented supports that physics is not one of them. In addition, we have no confidence that our transfer partners will transfer our lab courses. We are not willing to take chances on behalf of our students in that regard. However, we acknowledge that remote learning may have been successful for some students. We will continue to keep an open mind and will reassess our success and enrollment data as it comes.

(REQUIRED) What college-wide practices implemented since the last program review cycle have affected your area/program positively or negatively? Identify impacts on student success and equity.

The most impactful college-wide practice during the pandemic was the increased emphasis and offering of professional development in both online instruction and culturally responsive

teaching. Our faculty were active as participants and leaders in these programs. Jennifer Snyder worked with the LOFT to help faculty during the Spring 2020 pivot to transition to online instruction and served as a Mesa Buddy during Summer 2020 to help faculty complete the district Online Certification course. Several of our faculty completed online certification during the Spring and Summer semesters. In addition, our faculty participated in the Catalyst Teaching Conference in Spring 2021 as both presenters and participants. Starting in the Spring of 2021, the Mesa LOFT created a program called FIGs - Faculty Inquiry Groups - which is designed to support faculty in developing course modifications that promote student success and equity. Most of our full-time and adjunct faculty have participated in and facilitated FIGs over the last two semesters. These groups have been instrumental in developing new lab curricula for physics 125/126, 195/196/197, and 181A/B. The emphasis that the FIG program places on equity has helped us focus our course redesigns on approaches that have been shown to close achievement gaps - inquiry based instruction, group work that builds a sense of community, etc. These groups have also helped to strengthen a sense of community among the faculty. FIGs will be especially important for building a cohesive approach to teaching across our program if we hire new full-time faculty. Also, Irena Stojimirovic participated in the LOFT sponsored summer course Curriculum Equity & Excellence Review (CEER). This was a week-long summer course intended to provide faculty with the opportunity to revise their curriculum using an equity lens. The LOFT's emphasis on increased professional development in equity issues is one that we expect to impact our courses and student success in years to come. In the Fall 2021 Irena Stojimirovic, supported by Mesa College, participated in the Hispanic Association of Colleges and Universities (HACU) annual conference.

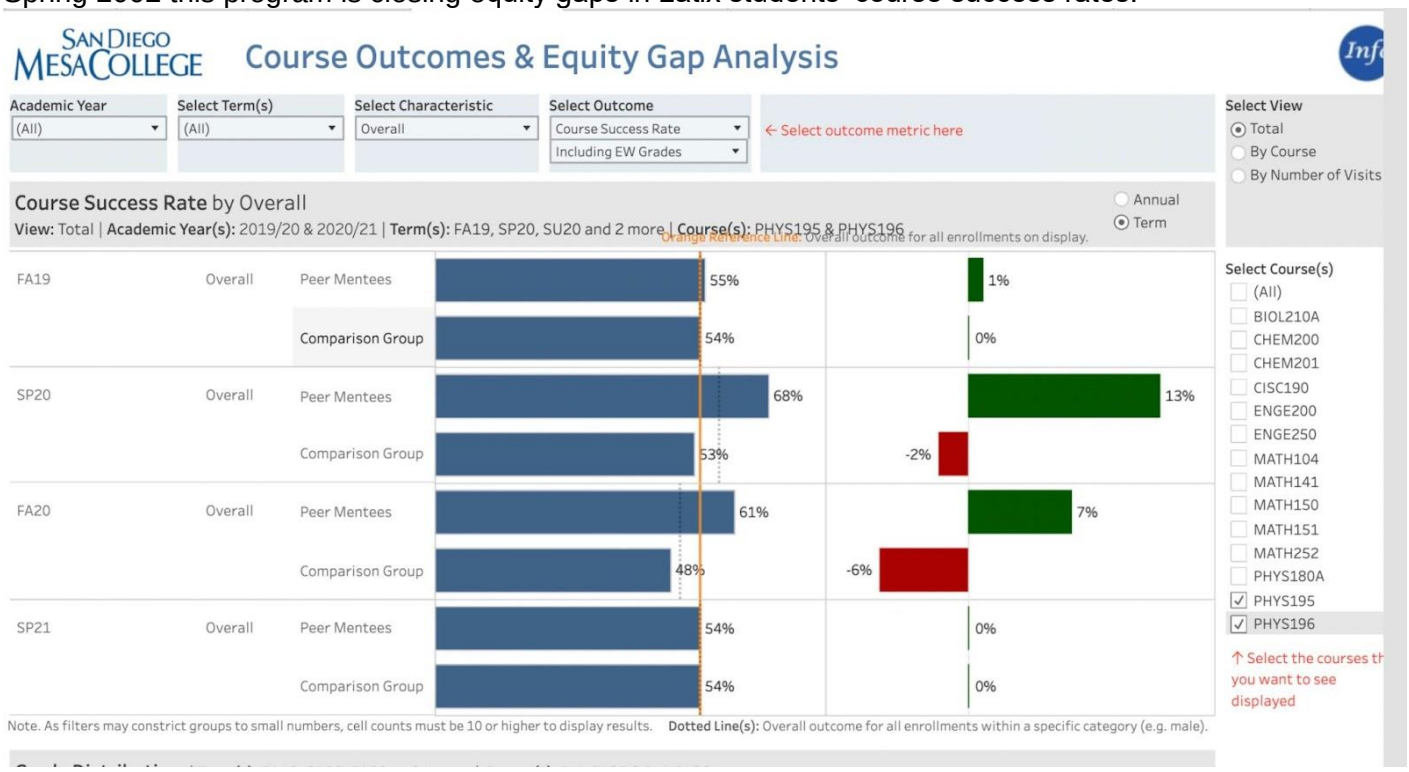
As part of HERF for returning to in-person and hybrid instruction, we were able to purchase new lab equipment, instructional demonstrations, and supplies. This includes a new set of microscopes and spectrometers to completely overhaul phys 181A/B labs in order to make the content more relevant to life-science majors. We also received new laptop computers that have been instrumental in increasing engagement in the classrooms by providing evidence-based interactive learning opportunities for students. Incorporating this equipment into our courses and developing activities that will utilize it fully will be a multi-semester project. This project would benefit greatly from bringing in new full-time faculty members who can implement and refine their lab courses over multiple semesters.

The college has also encouraged a renewed goal in grant writing to involve faculty in long term planning and larger projects. Our faculty first wrote an NSF Grant in Fall of 2019, but were unsuccessful due to administrative issues. During the Spring 2021 semester, our faculty were instrumental in working on the newly funded STEM E^3 Grant. Several of our faculty worked to develop the activities for the grant. Jennifer Snyder acted as one of the faculty writers for the grant and Irena Stojimirovic will have a major role as the Peer Mentoring program is expanded as part of the grant. Also, one of the activities of the grant will be to adapt some classroom space into studio space. Studio teaching was developed originally by physics teaching researchers and many of our faculty are adept in its use. We are looking forward to creating space and activities to better engage our students. Finally, several of our faculty worked on developing a grant to NSF to incorporate research experiences into our classroom. We look forward to hearing back on those efforts.

During the Fall 2021 semester, we found that many students are struggling to get counseling appointments, and those who do are not always getting reliable information about transfer requirements. An unusual number of students we spoke to had questions about which physics class they should be taking and what classes they needed in order to transfer. We've spent

much more time than in previous semesters helping students with their educational plans. The lack of access to counseling may be a result of services being primarily offered remotely.

STEM Peer Mentoring program funded by our HSI-STEM grant was piloted in the Fall of 2018 and it has become a primary way for physics students in PHYS 195/196 to get academic support. For example in the Fall 2020, peer mentoring program served 50 students in calculus-based physics courses in 416 sessions, while tutoring served 27 students in 163 sessions. The Peer mentoring program has students return for support more frequently than tutoring. We will continue to use this program as it provides a partnership between physics faculty and mentors in supporting physics students. Using the peer mentoring dashboard we captured data that shows Course Success rates increase for students attending physics peer mentoring, specifically students that attend peer mentoring 10 or more times have much higher success rates than average students or control group students. Data also demonstrates that since Spring 2002 this program is closing equity gaps in Latix students' course success rates.



SAN DIEGO MESA COLLEGE

Course Outcomes & Equity Gap Analysis

Academic Year: (All) | Select Term(s): (All) | Select Characteristic: Overall | Select Outcome: Course Success Rate, Including EW Grades ← Select outcome metric here

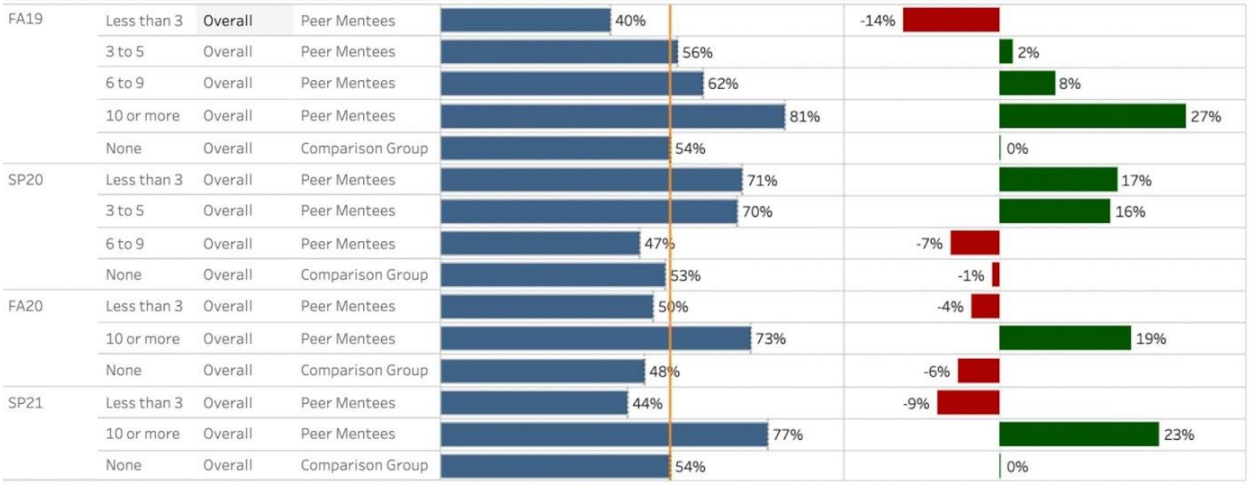
Select View: Total | By Course | By Number of Visits

Course Success Rate by Overall

View: By Number of Visits | **Academic Year(s):** 2019/20 & 2020/21 | **Term(s):** FA19, SP20, SU20 and 2 more | **Course(s):** PHYS195 & PHYS196

Orange Reference Line: Overall outcome for all enrollments on display.

Annual | Term



Select Course(s): (All), BIOL210A, CHEM200, CHEM201, CISC190, ENGE200, ENGE250, MATH104, MATH141, MATH150, MATH151, MATH252, PHYS180A, ☑ PHYS195, ☑ PHYS196

↑ Select the courses th you want to see displayed

Note. As filters may constrict groups to small numbers, cell counts must be 10 or higher to display results. **Dotted Line(s):** Overall outcome for all enrollments within a specific category (e.g. male).

SAN DIEGO MESA COLLEGE

Course Outcomes & Equity Gap Analysis

Academic Year: (All) | Select Term(s): (All) | Select Characteristic: Ethnicity | Select Outcome: Course Success Rate, Including EW Grades ← Select outcome metric here

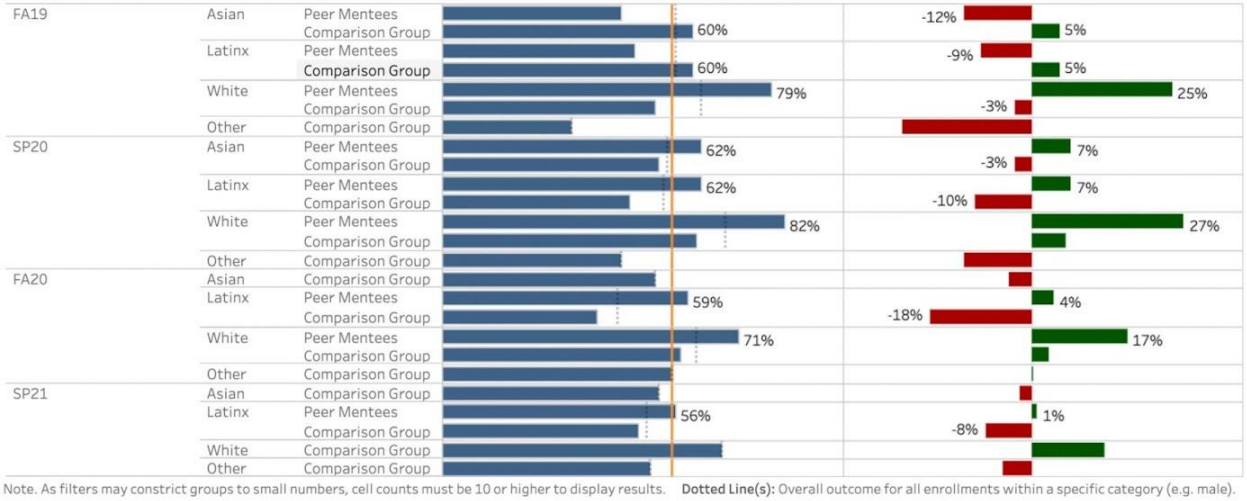
Select View: Total | By Course | By Number of Visits

Course Success Rate by Ethnicity

View: Total | **Academic Year(s):** 2019/20 & 2020/21 | **Term(s):** FA19, SP20, SU20 and 2 more | **Course(s):** PHYS195 & PHYS196

Orange Reference Line: Overall outcome for all enrollments on display.

Annual | Term



Select Course(s): (All), BIOL210A, CHEM200, CHEM201, CISC190, ENGE200, ENGE250, MATH104, MATH141, MATH150, MATH151, MATH252, PHYS180A, ☑ PHYS195, ☑ PHYS196

↑ Select the courses th you want to see displayed

Note. As filters may constrict groups to small numbers, cell counts must be 10 or higher to display results. **Dotted Line(s):** Overall outcome for all enrollments within a specific category (e.g. male).

SAN DIEGO MESA COLLEGE

Course Outcomes & Equity Gap Analysis

Academic Year: (All) | Select Term(s): (All) | Select Characteristic: Ethnicity | Select Outcome: Course Success Rate, Including EW Grades ← Select outcome metric here

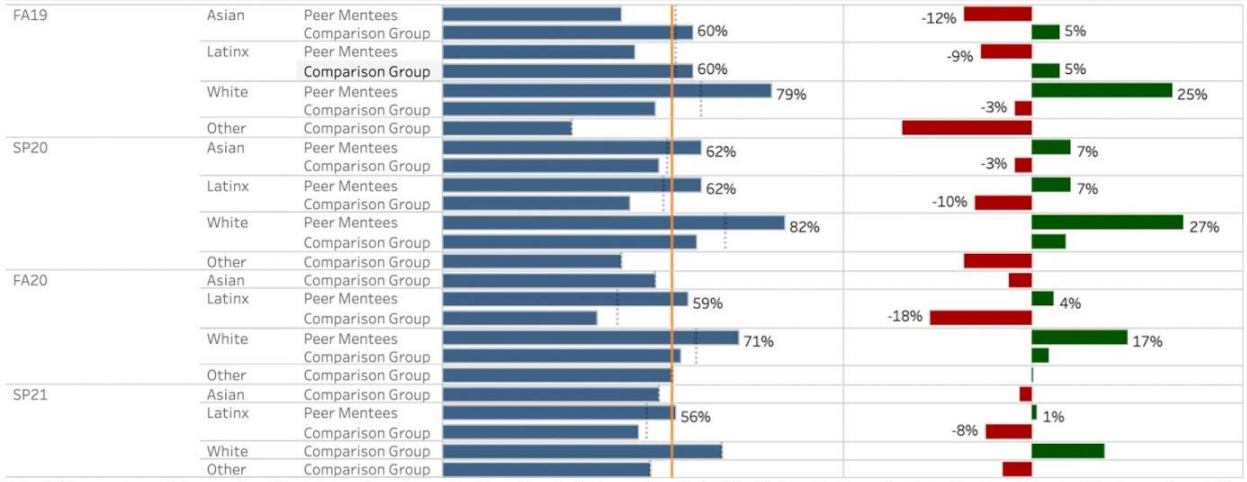
Select View: Total | By Course | By Number of Visits

Course Success Rate by Ethnicity

View: Total | **Academic Year(s):** 2019/20 & 2020/21 | **Term(s):** FA19, SP20, SU20 and 2 more | **Course(s):** PHYS195 & PHYS196

Annual | Term

Orange Reference Line: Overall outcome for all enrollments on display.



Select Course(s)

- [ ] (All)
- [ ] BIOL210A
- [ ] CHEM200
- [ ] CHEM201
- [ ] CISC190
- [ ] ENGE200
- [ ] ENGE250
- [ ] MATH104
- [ ] MATH141
- [ ] MATH150
- [ ] MATH151
- [ ] MATH252
- [ ] PHYS180A
- [x] PHYS195
- [x] PHYS196

↑ Select the courses th you want to see displayed

Note. As filters may constrict groups to small numbers, cell counts must be 10 or higher to display results. **Dotted Line(s):** Overall outcome for all enrollments within a specific category (e.g. male).