



University Summary Report: Quantitative Reasoning Assessment of Student Learning September 29, 2020, version 2

INTRODUCTION

Special Note about COVID-19: It is important to note that a significant amount of the work referenced in this report was completed during the COVID-19 pandemic that began in the Spring of 2020 and continued in the Fall of 2020 when this report was written. This includes the collection, assessment, and analysis of student work in college discussions, and implementing college and University changes - all of which were impacted to some degree. While a moderate amount of assessment work was delayed one term, assessment efforts moved forward. The Educational Effectiveness Committee, along with other academic committees such as CAPR and the ILO Subcommittee, supported ongoing reflection about student learning for mindful, flexible, and nimble decision making during this dynamic period. Additionally, teaching, learning, and assessment discussions and decision-making related to diversity, inclusion, and social justice issues were a critical part of academic assessment during this time.

Purpose

[Institutional Learning Outcomes \(ILOs\)](#) are those learning outcomes that are expected of every graduate of the institution, both undergraduate and graduate, and are closely aligned with [General Education \(GE\)](#) requirements. ILO Assessment follows the [ILO Long Term Assessment Plan](#) which aligns the assessment schedule for undergraduate, graduate, and the [GE Long-term Assessment Plan](#).

Following the schedule for the [ILO Long Term Assessment Plan](#), Cal State East Bay has gathered recent student learning data to support the assessment of the University's Quantitative Reasoning Institutional Learning Outcomes. These data are intended to provide additional context for existing academic review discussions, analysis, and decision making to improve student learning.

Overview of Quantitative Reasoning

At Cal State East Bay, foundational-level proficiency in [quantitative reasoning](#) is demonstrated by the use of interpretation, representation, calculation, and communication of quantitative information at the college level. For most students, this is achieved through successful completion of the GE Area B4 requirement, typically completed by the end of the first year. B4 courses, currently offered by the Departments of Mathematics and Statistics, form the foundation for mathematical and quantitative skills that are built upon and reinforced in subsequent quantitative-intensive courses, the extent of which depend on the student's major, but also applied in GE Area B6, upper-division Science/Math. Entry-level B4 courses are supported through co-requisite support, embedded peer support, and access to the Math Lab Community Learning Space. Courses use an active learning pedagogy that encourages growth mindset and success strategies that serve students across

their college curriculum. Students are also required to fulfill upper-division GE B6 Science/Math, which has an explicit expectation of advanced quantitative reasoning skills. Transfer students are presumed to be ready to step into upper-division Area B6 and upper-division major-level courses which may emphasize mathematics and quantitative skills.

METHODS

The University gathered the most current available data from several relevant sources (Table 1). Additionally, colleges integrated relevant program data into college discussions as appropriate (e.g. program reviews, college surveys).

Table 1. Sources of key data and dates of collection for ILO Quantitative Reasoning assessment

Key Data Sources	Date
Pilot Assessment of GE B4 (Quantitative Reasoning)	2019-2020
Assessment of Undergraduate Upper Division Student Work for ILO Quantitative Reasoning	2019-20
Assessment of Graduate Level ILO Critical Thinking	2019-20
Student Center For Academic Achievement (SCAA)	2019-20
Student Life at CSUEB during a pandemic: Findings from a Spring 2020 Survey	Spring 2020
National Survey of Student Engagement (NSSE)	2017
Beginning College Survey of Student Engagement (BCSSE) First Year Institutional Report, Transfer Student Institutional Report	2019
AAC&U Report: On Solid Ground	2017

Pilot Assessment of GE B4 (Quantitative Reasoning)

Refer to the *General Education Assessment of Student Learning Area B4 Quantitative Reasoning* report which will be posted on the [GE Assessment](#) website.

Funded Professional Development Workshops Offered to Faculty with A Course Being Assessed

12 Faculty with an undergraduate upper division course being assessed for the ILO of Quantitative Reasoning participating in a year-long funded project. In the term their course assignment was to be assessed (Fall 2019 or Spring 2020), they met for a workshop in small groups with the ILO Subcommittee chair and the Associate Dean in the College of Science. The first part of the workshop was a review of general design strategies for any assignment instructed by the Office of Faculty Development based on their Engaging Assignments [video tutorial](#) and [companion handout](#). The second part of the workshop was faculty peer coaching to help faculty craft assignments to allow students to demonstrate their achievement of the ILO of Quantitative Reasoning

using both the [ILO Quantitative Reasoning Assignment Guide](#) developed by and for faculty as well as an adapted peer coaching model based on the [NLOA Assignment Charrette](#).

Assessment of Undergraduate Senior Level Student Work for ILO Quantitative Reasoning 2019- 2020

Undergraduate courses aligned to ILO Quantitative Reasoning: Twelve (12) senior level course sections were aligned to the ILO of Quantitative Reasoning (Table 2). These courses represented nine disciplines from three of the four colleges: College of Science (CSCI), College of Education and Allied Studies (CEAS), and the College of Business (CBE). None were assessed from the College of Letters, Arts, and Social Sciences (CLASS).

ILO Quantitative Reasoning Courses Assessed 2019-20 by College			
CEAS	CBE	CSCI	CLASS
1 course	1 course	10 courses	0 courses

Table 2. Numbers of courses assessed by college for ILO Quantitative Reasoning 2019-20.

College	Departments Represented	# Courses Assessed
CEAS	Hospitality	1
CBE	Management	1
CSCI	Biology Chemistry Computer Engineering Computer Science Geology Math Statistics	10
CLASS		0

Faculty Assessed Student Work: For each participating course section, 10 student samples were randomly selected using Blackboard Outcomes, an electronic assessment platform within Blackboard. Each student work sample was assessed using the [ILO Quantitative Reasoning rubric](#) by the faculty member whose course section was selected for assessment. Each faculty assessed at least five of seven ILO rubric categories. [ILO QR Faculty Calibration Training](#) was provided to participating faculty by the ILO Subcommittee chair, a faculty peer with a high degree of expertise in assessment.

Assessment of Graduate Level ILO Quantitative Reasoning Student Work 2019- 2020

Academic Senate policy requires that graduate programs align to at least two ILOs as specified in the ILO Long-Term Assessment Plan. 12 of the 35 graduate programs at CSUEB chose to align one or more of their Program Learning Outcomes with the Quantitative Reasoning ILO and hence participated in assessment of that ILO in 2019-2020. Due to the wide variation in the goals of the various graduate programs with respect to

the Quantitative Reasoning ILO (e.g., analysis methods appropriate to types of data in each discipline), each graduate program was asked to develop program-specific rubrics for assessing the Quantitative Reasoning ILO. Each participating program identified one or more graduate courses in which the ILO was to be assessed, and the instructor of the course was asked to develop an assignment that could be effectively used for assessment purposes. Individual programs decided how many samples they would gather in each assessed course and also identified faculty members responsible for applying the program-specific rubrics to generate the assessment data. Preliminary results were solicited during Summer 2020. The final results of the assessment efforts are to be provided in each program's annual report to CAPR, due in October 2020.

Student Center for Academic Achievement (SCAA)

The Student Center for Academic Achievement (SCAA) supports student learning through peer-to-peer interaction with trained peer tutors and supplemental instruction leaders. Tutors work with students one-to-one via appointments, in groups on a drop-in basis, and Supplemental Instruction Leaders are embedded in courses that have a quantitative element including not only mathematics and statistics, but also economics, the sciences, etc. Tutors and SI leaders work with students to guide them through how to solve different types of problems and ask questions to facilitate their ability to learn and develop their quantitative reasoning skills on their own.

Student Life at CSUEB during a pandemic: Spring 2020 Survey: Carl Stempel, Sociology

A CSUEB Student Covid Survey was conducted after the Spring 2020 semester from May 18, 2020 through June 1, 2020. With IRB approval, multiple invitations to participate were sent to all CSUEB undergraduates, and 1806 completed the survey, a 15% response rate. [Fixed-choice questions](#) focused on student experiences and well-being during the spring semester covering a range of topics including study conditions, academic performance, financial stress, difficulty concentrating on schoolwork, family conditions, psychological distress, resilience, social resilience, perceived support from faculty and advising staff, and attitudes towards online learning. Data was weighed to match population figures for college, gender, first generation in college, and class rank. Indexes were created for many variables with the criteria that a Principal Components Analysis found only one component with an Eigenvalue over 1.0 and that all items correlated with that component at .6 or higher. In addition, two open ended questions were asked, one about students' biggest problem with online classes in Spring 2020 and one on what they would tell professors as professors prepare their online classes for Fall 2020.

National Survey of Student Engagement (NSSE) Report 2017

The [National Survey of Student Engagement](#) (NSSE) collects information from four-year colleges and universities about first-year and senior students' participation in programs and activities that institutions provide for their learning and personal development. Among other areas, the survey captures questions related to student engagement experiences with quantitative reasoning. The survey data is presented in comparison with peer institutions regionally and nationwide.

Beginning College Survey of Student Engagement (BCSSE) Institutional Reports, 2019

[The Beginning College Survey of Student Engagement](#) (BCSSE) collects data related to students' academic expectations and perceptions for the coming year. It is generally administered to first-year students and new transfer students towards the start of the first term they enter the University. Information collected about

student engagement and experiences include content related to quantitative reasoning. The survey data presents student responses by first generation status and self-reported previous grade levels.

RESULTS

Pilot Assessment of GE A2 (First-year Composition)

Refer to the *General Education Assessment of Student Learning Area B4 Quantitative Reasoning* report which will be posted on the [GE Assessment](#) website.

Assessment of ILO Quantitative Reasoning at Graduation for Undergraduates 2019- 2020

Special note about academic assessment data: Comprehensive excel workbooks with results from undergraduate senior level work academic assessments completed in 2019-2020 for the ILOs of Quantitative Reasoning and Critical Thinking have been provided by Institutional Effectiveness and Research to college Associate Deans with the understanding that any data shared would be based on prior agreements about sharing academic assessment information. Only data that cannot identify a single course section or faculty member can be distributed. Additionally faculty who had their course assessed can receive the data that shows their course compared to others without identifier data and may use their own data as they see appropriate (e.g. program review, course improvement).

Student Performance Quantitative Reasoning

The results of assessment for the seven categories of student quantitative reasoning in the ILO Quantitative Reasoning rubric (Overall Communication, Limitations, Implications, Interpretation, Quantitative Analysis, Representation/Visualization, and Problem Formulation) ranged between 24% and 74% competent (Level 3) and fully competent (Level 4). Overall Quantitative Reasoning was strongest in the category of Representation/Visualization (74% competent and fully competent), and the weakest in the category of Overall Communication (24% competent and fully competent) (Fig. 1).

Quantitative Reasoning ILO: Distribution of Scores

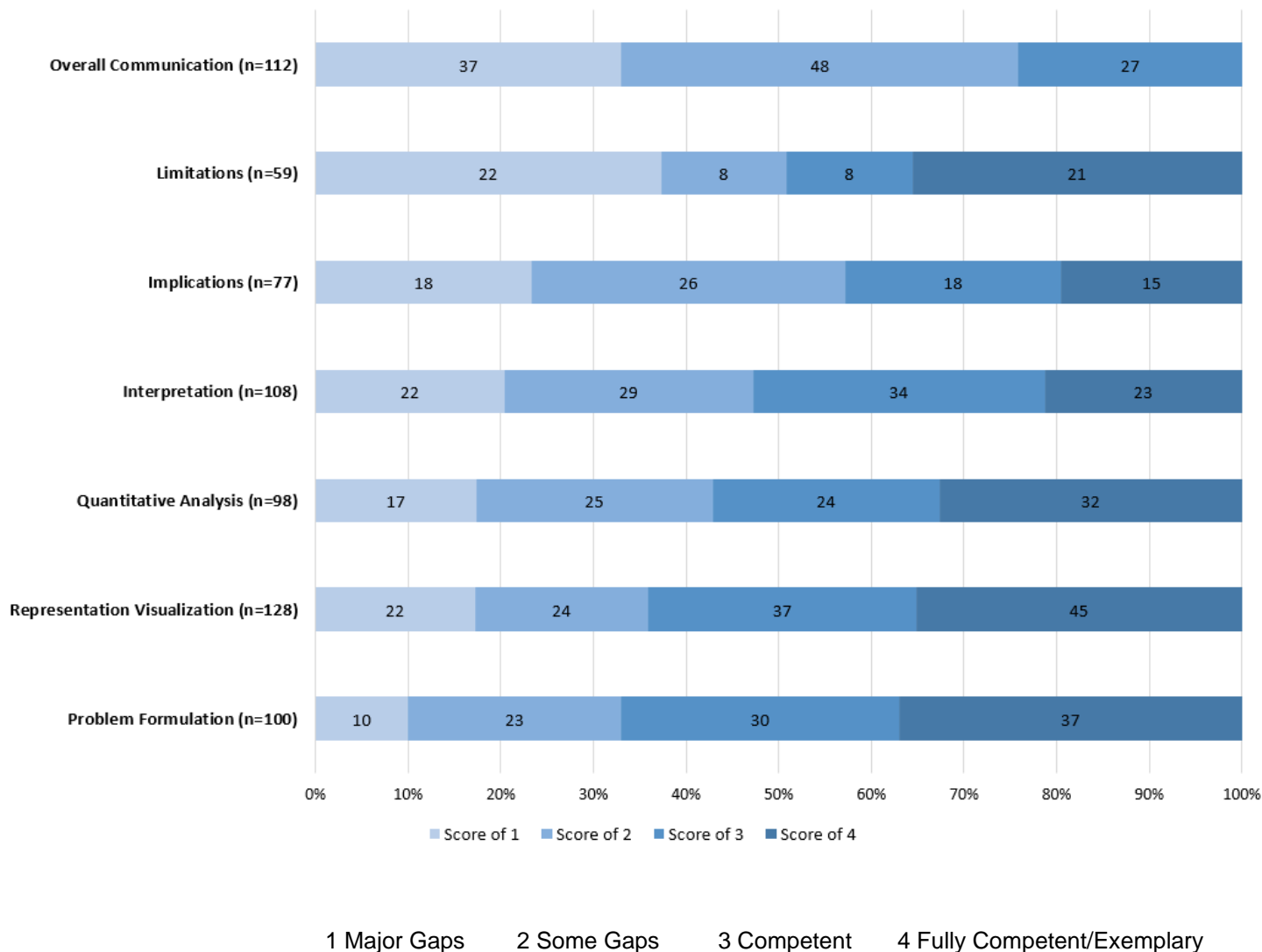


Figure 1. Student performance for quantitative reasoning indicated by percent of students in each performance level (1 major gaps to 4 fully competent/exemplary) in each of the seven categories (Overall Communication, Limitations, Implications, Interpretation, Quantitative Analysis, Representation/Visualization, and Problem Formulation). N = 120 students.

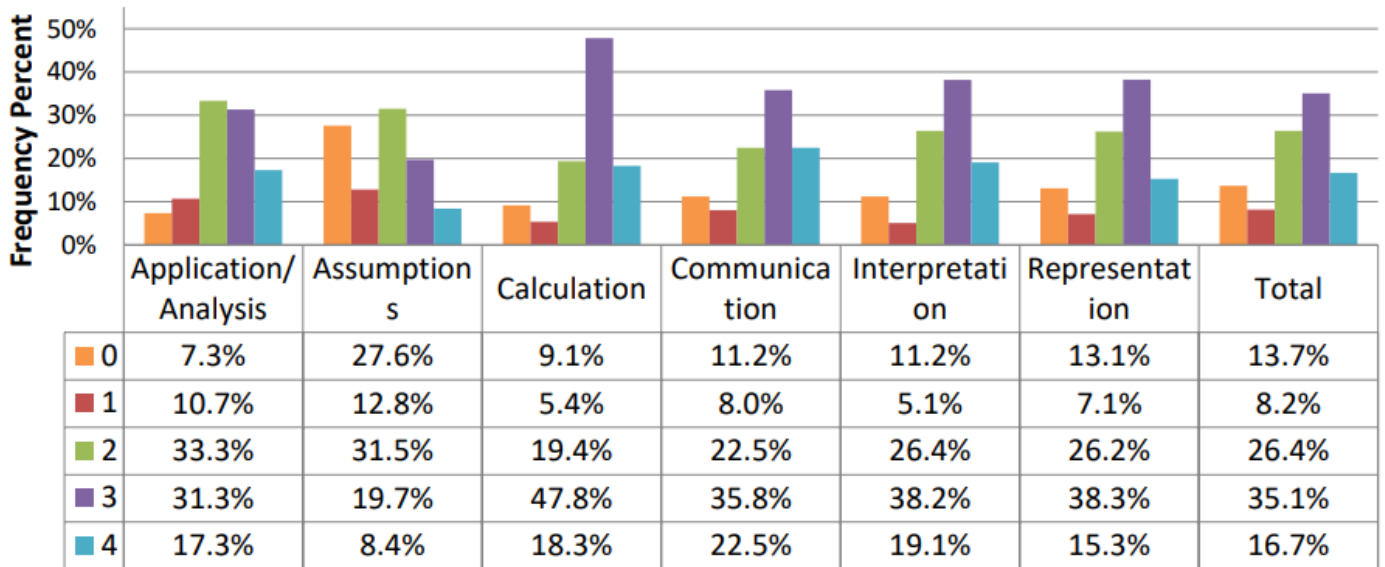
In 2009, the [Association of American Colleges and Universities](#) (AAC&U) led [VALUE](#) (Valid Assessment of Learning in Undergraduate Education) a campus-based assessment approach developed and led by AAC&U. VALUE rubrics provide tools to assess students' own authentic work, produced across students' diverse learning pathways, fields of study and institutions, to determine whether and how well students are meeting graduation level achievement in learning outcomes that both employers and faculty consider essential. The VALUE rubrics include Critical Thinking and Quantitative Literacy

Cal State East Bay adapted best practices for rubric development and assessment using the [VALUE Rubrics for Improvement of Learning and Authentic Assessment](#) and [Assessing Outcomes and Improving Achievement: Tips and Tools for Using Rubrics](#) AAC&U publications.

As of December 2015, the rubrics had been accessed by more than 70,000 individuals from more than 5,895 unique institutions, including more than 2,188 colleges and universities. The VALUE rubrics have also been approved for use in meeting national standards for accountability established by the Voluntary System of Accountability (VSA) and are used in all regional and some professional self-study reports and reviews for accreditation. In [On Solid Ground AAC&U](#) shares the results from the first two years of data collection for the VALUE (Valid Assessment of Learning in Undergraduate Education) initiative, a nationwide project that examines direct evidence of student learning. It represents the first attempt to reveal the landscape of student performance on key learning outcomes including Critical Thinking and Quantitative Literacy—that educators, employers, and policy makers agree are essential for student success in the workplace and in life.

Adapted from <https://www.aacu.org/OnSolidGroundVALUE>

MSC Pilot Study Results—Quantitative Literacy Dimension 4-Year Institutional Score Distribution
 % of student work products scored 4-0 by faculty scorers on each dimension of quantitative literacy



Note: Each work product was scored on 6 dimensions of quantitative literacy using a common AAC&U VALUE Rubric. See Slide 12 below for rubric dimension criteria. VALUE rubrics are available at www.aacu.org/value.

These results are not generalizable across participating states or the nation in any way. Please use appropriately.

Figure 2. Slide #10 from the report [On Common Ground](#), shows score distributions for several categories similar to the ILO Quantitative Reasoning rubric for general comparison of results. See slide 12 for description of Quantitative Reasoning rubric dimensions.

Faculty Feedback Highlights for Quantitative Reasoning

Complete comments from twelve (12) faculty who aligned an undergraduate senior level assignment to the ILO of Quantitative Reasoning and also completed the end-of-term faculty survey on patterns, the process, and the rubric are [here](#). While there were a variety of points raised, similar to faculty feedback for critical thinking, one theme related to faculty and student transition to remote learning as a result of COVID-19. In addition, a few themes included:

Student Strengths

- Persisting, despite challenges posed to transitioning to remote learning and COVID-19. “Overall I am impressed that they appeared to understand as much as they did, despite the lack of lab practice...” “I think most of the students made a good attempt at this project which was a little demanding.”
- Representation/Visualization: “The use of Excel was helpful to the students for visualization.”

Student Areas For Improvement

- Implications “...many of them took the question at face value and answered it without consideration for the context.” “...students performed consistently lower on implications....”
- Interpretation: “Students seem to be proficient at interpreting experimental results from a single experiment, but have a hard time putting the experiment into the context of a larger study, and even more trouble connecting it to the larger body of scientific literature out there.”

Assessment of Graduate Level ILO Quantitative Reasoning Student Work 2019-2020

Graduate programs have been asked to submit the assessment data that they collected in 2019-2020 as part of their annual reports to CAPR, due October 1, 2020. That data will be compiled and summarized to provide college-level and university level views. These views will be made available by late October to prompt discussions by the departments, colleges, and the university at large. In particular, discussions will be initiated within the Graduate Advisory Council.

In addition, preliminary results and comments were solicited from the program Graduate Coordinators during Summer 2020. Coordinators were asked how their program planned to close the loop on Quantitative Reasoning skills given current assessment data, how the university could help with these efforts, and how the assessment process could be made more effective. Nine programs shared their comments on these questions and two additional programs shared their full assessment report.

Themes regarding closing the loop centered on creating new courses or revising existing ones to provide more opportunities for students to practice quantitative reasoning skills. Consideration of assessment results by department committees, industry advisory boards, or accreditation organizations and implementation of their recommendations was also suggested. One program suggested that students be encouraged to submit multiple attempts at problem solutions, each using a different approach to help students improve their analytical skills. In regards to improved assessment processes, coordinators requested designated staff to help with the assessment process, more training for new faculty, mechanisms to improve consistency in

assessment as faculty change roles, clearly written and accessible instructions, and access to past results. In particular, one program asked for advice as to how to turn assessment results into actionable items.

Student Center For Academic Achievement (SCAA)

SCAA hires between 15-20 tutors per year to support a minimum of 21 mathematics and statistics courses and five software systems used in these courses such as SPSS and minitab. Supplemental Instruction (SI) supports between 30-45 courses per year depending on the availability of student assistants. All of the 30-45 courses have an aspect that requires quantitative reasoning and range from accounting to kinesiology. In SI, one SI Leader is embedded in a course with a faculty member, and meets with the faculty member once per week, and holds sessions two to three times per week to ensure students understand the material covered in the course.

Student Life at CSUEB During a Pandemic Survey Findings: Carl Stempel, Sociology

While data analysis is ongoing, our [most important findings](#) thus far highlight students' high levels of both difficulty concentrating on school work and psychological distress, unequal access to basic study conditions for online classes by race and social class, and the importance for student success of perceived support from professors, peer and academic advisors, and psychological counselors.

Over 4/5 of students (82%) reported that after Covid-19 hit they found it harder to focus on schoolwork, with over 2/3 of these reporting that it was "a lot harder." Difficulty concentrating on schoolwork strongly influenced school performance ($R^2 = .29$), and psychological distress (measured by PHQ-9, a nine item depression screener) strongly influenced difficulty concentrating ($R^2 = .31$). We also found that significant numbers of students did not have access to basic study conditions such as reliable internet, a computer, and/or a quiet place to study, and that lacking these resources was strongly associated with difficulty concentrating on schoolwork. Lower income, first generation college students, and racialized minorities (African Americans, Latinx, and Middle Eastern/Central and South Asian) were less likely to possess these basic study conditions. Finally, perceived support from professors, advisors, and counselors were highly intercorrelated and strongly associated with higher academic performance and greater ability to concentrate on schoolwork. We believe this indicates that many students perceived professors, advisors, and counselors as a united web of support that helped them through this difficult semester. Encouragingly, nearly 2/3 of students (65%) agreed that they could reach out for help from their professors if they were struggling academically, and perceived professor support was strongly associated with academic performance. However, non-white students were significantly more likely than white students to disagree that they could seek help from their professors, with Latinx students more than twice as likely to disagree.

Interesting Findings from the *Student Life at CSUEB During a Pandemic Survey*

- There were significant racial and social class disparities in access to basic student conditions Spring 2020 semester. For example:
 - African American students were three times more likely than white students to disagree that they had a working computer whenever they needed it (19% to 6%)
 - Latinx students were substantially more likely than white students to disagree that they usually had a quiet place to study (55% to 36%). Comparable figures for African Americans and Middle Eastern students were 43% and 44% respectively.

- Fifty-four percent of students from low income families (34% of our sample) disagreed that they had a quiet place to study.
- Over 4/5 of students (82%) reported that after Covid-19 hit they found it harder to focus on schoolwork, with over 2/3 of these reporting that it was “a lot harder.”
- Difficulty concentrating on schoolwork (5-item index) was strongly associated with school performance (3-item index) ($R^2 = .29$).
- Psychological distress (PHQ-9, 9-item depression screener) was strongly associated with difficulty concentrating on schoolwork ($R^2 = .31$).
- Using the PHQ-9's established cut points, 49% of CSUEB students scored in the moderate depression range or higher. This compares to 9% for U.S. adults, 30% among undergraduate students pre-Covid, and 41% among seven universities the American College Health Association surveyed between March and May, 2020.
- Sixty-five percent of students agreed that they could reach out for help from their professors if they were struggling academically
- Perceived professor support was strongly associated with students' academic performance (beta = .30 in bivariate regression with both variables scaled 0 to 1.0).
- Latinx students were 2.2 times more likely than white students (22% to 10%) to disagree that they could reach out for help from their professors. Middle Eastern (17%), African American (15%), and Asian American (15%) students were also more likely than white students to disagree that they seek help from professors.

[Here](#) is a related pre-print of an article under review for publication: *Examining the Impact of COVID-19 related disruptions, dislocations, and stressors on the academic performance of undergraduates at a diverse public university.*

National Survey of Student Engagement (NSSE) 2017

[Institutional Effectiveness and Research](#) administered the NSSE to first-year and senior-level undergraduate students in the spring of [2017](#). CSUEB student responses to quantitative reasoning-related NSSE questions demonstrate that our student population engages with quantitative reasoning concepts and skills at levels generally in line with comparison institutions (see [NSSE Summary](#)). The results from the NSSE show growth in all areas of quantitative reasoning understanding and skills from first-year to senior-level students (see [NSSE detailed results by student level](#)).

Beginning College Survey of Student Engagement (BCSSE) Institutional Reports 2019

[Institutional Effectiveness and Research](#) administered the BCSSE to incoming first-year and incoming transfer students in 2019. CSUEB student responses to BCSSE questions show lower levels of self-reported preparedness in quantitative reasoning from both first-year and transfer-level first generation students (see [BCSSE summary](#)). In addition, first-year students who identify as first generation and who self-reported grades of B+ or lower disclose less frequent previous experiences with quantitative reasoning concepts (see [BCSSE detailed results by student level](#)).

COLLEGE DISCUSSIONS

Role of ILO Subcommittee

The [ILO Subcommittee](#) will review calibration results and faculty feedback in order to recommend potential changes to the [ILO Quantitative Reasoning Rubric](#) and the ILO Assessment process.

College/Unit Discussions

Led by associate deans, each college/unit will decide their own approach to reviewing results and conducting discussions generally following the schedules outlined in ILO Long Term Assessment Plan and EEC Communication Plan focused on discussions in fall of 2020 and implementation in Spring 2021. This includes reviewing those results that add meaning to their discussions about student performance in critical thinking.

Support for College Discussions

Planning and meeting facilitation support is available from Academic Programs and Services and the Office of Faculty Development:

Academic Programs and Services
Maureen Scharberg,
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Office of Faculty Development
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Department of Sociology
Carl Stempel, carl.stempel@csueastbay.edu

College reports have been provided to Associate Deans. As individual faculty and students are not identified in this institutional assessment, disaggregated results will not be provided in the event that individual faculty can be identified.

Possible Meeting Format

- Brief overview and purpose of wide-scale assessment
- Presentation of key critical thinking results for the college/unit
- Discussion in large or smaller groups: consider questions that fit your college/unit and record discussion results:
 - First discuss results:*
 - How does this information fit with our experience of students' development of quantitative reasoning skills at Cal State East Bay?
 - How do the results compare with program/college for programmatic assessment of quantitative reasoning skills?
 - What are the most noticeable gaps?
 - Next, discuss possible/tentative course of action*
 - What seems to be working well that we can further support for building student competency for quantitative reasoning?
 - What can we do to improve?
 - How can we better meet students' needs for building quantitative reasoning skills at critical junctures for their learning?
- Summarize key topics and possible action steps and review next steps.