Report on ILO-C: Quantitative Reasoning

"Students will use numerical information to identify, analyze, and solve problems."

OBJECTIVES

- Measure the extent to which Cal Maritime students "use numerical information to identify, analyze, and solve problems."
- Give recommendations for improving assessment efforts.
- Give recommendations (where applicable) for improving program effectiveness.

METHODOLOGY

In the Academic Year 2021-2022, the IWAC conducted assessment of the institution-wide student learning outcome C (ILO-C), Quantitative Reasoning. Data was gathered from assessments done by faculty in their courses using the same common 6-point rubric (Appendix A) that contained a single dimension that was applied in each course to one or more assignments identified by the instructor as requiring an appropriate level of quantitative literacy. In total, 387 artifacts were gathered from 10 courses representing introductory and mastery levels. The introductory courses were CHE 105, CHE 110, MTH 100, MTH 210, and PHY 200. Mastery level courses were ET 460, GMA 310, NAU 410, ME 394, and MGT 410. The distribution of artifacts spans all majors and academic classes providing an accurate representation of the demographic profile of the University (Appendix B). The academic majors are: International Business and Logistics (IBL), Global Studies and Maritime Affairs (GSMA), Facilities Engineering Technology (FET), Marine Engineering Technology (MET), Marine Transportation (MT), Mechanical Engineering (ME), and Oceanography (OCN). Oceanography is a new degree program, and this is the first year that assessment data was collected for this major therefore only introductory level artifacts were collected for this major. Assessment scores were aggregated by major, graduation year, ethnicity, Pell grant recipients, first generation college students, and gender* (*gender data only includes male and female gender designations as reported in the Integrated Postsecondary Education Data System (IPEDS) and does not include the approximately 4.5% of students who identify as transgender, non-binary, or gender non-conforming).

RESULTS AND DISCUSSION

Compared to the prior assessment of Quantitative Reasoning in 2018, the number of artifacts collected was far fewer (387 vs. 741 artifacts in 2018), largely due to fewer lower division courses being

represented. The current data includes a substantial increase in the artifacts captured from mastery-level courses for all majors, as was recommended by the 2014 and 2018 assessments, and is accurately representative of the demographic profile of the University (Appendix B). It is therefore likely that these results are representative of student learning and are statistically significant. It is notable that the number of introductory-level artifacts collected for IBL, GSMA, and OCN majors was not statistically significant.

The rubric (Appendix A) used by all instructors was standardized using a six-point scale with a single dimension that could easily be applied to a variety of assignments in any discipline having a quantitative component. This is the same rubric that was used in previous assessment cycles. As in prior assessment cycles, the benchmark was set for 70% of students to score 4 or above on a 6-point scale.

Figure 1: Assessment of ILO-C: 64% of All Students achieved benchmark at Introductory and 75% at Mastery Level
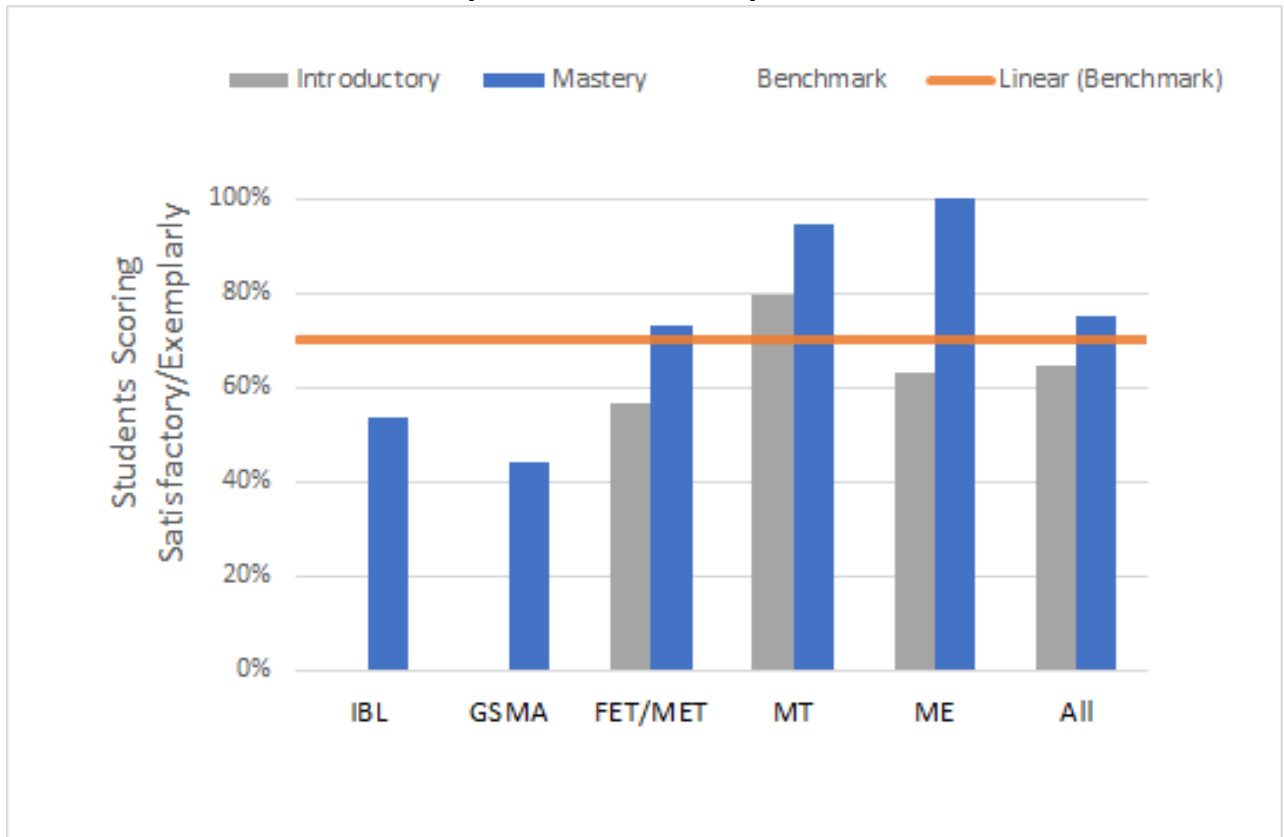
The benchmark was not quite attained for the institute-wide assessment of all student data (69.3%) which is comparable to the 70% meeting the benchmark during the 2018 assessment cycle (Figure 1 & Appendix B). At the mastery level the benchmark was met with 75% of all students scoring 4 or above while only 64% of all introductory level students scored 4 or above on the rubric (Figure 1 & Appendix C).

Broken down by major (Figure 1 & Appendix C), FET/MET (73.0%), MT (94.4%), and ME (100%) majors reached the benchmark at the mastery level while IBL (53.8%) and GSMA (44.1%) did not. It is not clear from the data whether the low assessment scores for IBL and GSMA are due to students being below expected learning competency or if the artifacts selected are inappropriate for this assessment. It is also suspicious that the ME assessment score is 100% and it is not clear from the data whether this is due to all students meeting or exceeding the expected learning competencies or if the

artifact and application of the rubric were appropriate. At the introductory level, only Marine Transportation (79.4%) met the benchmark. It is expected that introductory-level students would not reach the benchmark as students are making progress toward mastery through instruction in freshman-level courses.

Broken down by gender (Figure 1 & Appendices B & C), there was a significant gender gap, with only 65% of all female students reaching the benchmark compared to 74% for all male students representing a very slight improvement compared to 2018 (60% female & 72% male achieving benchmark). This gender gap is most prominent at the mastery level, with 78.3% of male students but only 61.8% of female students achieving the benchmark. Interestingly, at the introductory level, the gender gap is slight (65.4% for males and 63.0% for females achieving the benchmark). This gender gap appears significant and not due to the small sample size as the number of artifacts is substantial (N=80) and representative of the campus population.

Broken down by ethnicity (Figure 2 & Appendix C), students identified by IPEDS as white, Asian American & Pacific Islander (AAPI), two or more ethnicities (TWO+), and students of unknown ethnicity (UNK) exceeded the benchmark, while students identified as Hispanic (HISP) students did not reach the benchmark, with only 48.6% Hispanic students scoring greater than 4, respectively. While the number of Black students was very small and likely not significant enough to interpret meaningfully, the sample size is representative of campus population. Direct comparison of these results to the 2018 assessment cycle is not possible since that cycle did not contain significant enough data and all non-white students were aggregated as underrepresented minorities.

Pell grant recipients achieved the benchmark with 72.7% of all students reaching the benchmark (82.8% at the master level and 61.5% at the introductory level). First-time college students trailed well behind all other categories except for Hispanic students with only 54.5% of all first-time student scoring 4 or above on the rubric (64.3% at mastery level and 47.4% at introductory level).

Figure 2: Assessment of ILO-C by Demographic Categories
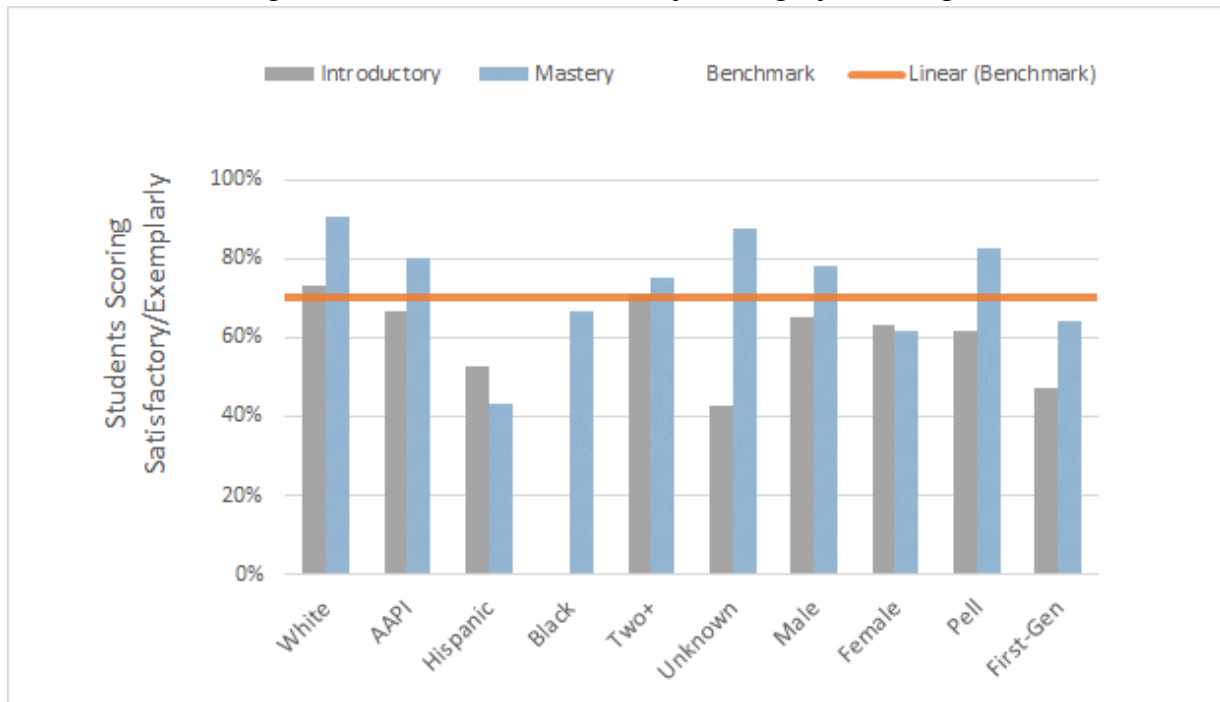
RECOMMENDATIONS

IWAC recommends:

Assessment Efforts:

The following recommendations are meant to address the assessment process and should be implemented by IWAC.

- IWAC should collect additional introductory- and reinforce-level data in future assessment cycles.

- Departments of all majors and IBL, GSMA, and ME in particular should investigate whether the artifacts identified for this assessment are appropriate for assessing mastery-level Quantitative Reasoning expectations. It is also recommended that each department considers whether additional courses and/or artifacts can be identified to increase the coverage of assessment data to better reflect student learning across each major at the mastery level.

Program Effectiveness:

The following recommendations are meant to address the Quantitative Reasoning program effectiveness and should be implemented by programs.

- Supply assessment data to university advisors, registrar, and admissions for insights and recommendations regarding the gender, under-represented minorities, and first-generation college student gaps.

- IBL and GSMA should investigate performance gaps and propose strategies to address deficiencies relative to the benchmark in this subject area.

- Departments of all majors and the Department of Sciences & Mathematics should investigate indirect measures to further examine gender, under-represented minorities, and first-generation college student gaps relative to the benchmark.

APPENDIX A: QUANITATIVE REASONING RUBRIC

ILO-C: "Use numerical information to identify, analyze and solve problems."

A person who is competent in quantitative reasoning possesses the skills and knowledge necessary to apply the use of logic, numbers, and mathematics to deal effectively with common problems and issues. A person who is quantitatively literate can use numerical, geometric, and measurement data and concepts, mathematical skills, and principles of mathematical reasoning to draw logical conclusions and to make well-reasoned decisions.

The benchmark for meeting this Student Learning Outcome will be a 4 or greater on this 6-point rubric.

	Initial (1-2)	Emerging (3)	Satisfactory (4)	Good (5)	Exemplary (6)
Demonstrate the ability to use numerical and/or symbolic information to identify, analyze and solve quantitative problems.	Demonstrates little or no understanding of what information and assumptions are needed to perform the analysis. Did not organize or calculate a mathematical strategy for a given situation, or did so in a completely invalid manner.	Demonstrates basic understanding of what information and assumptions are relevant to the analysis. Translation into mathematical symbols, graphs, and/or tables is flawed or incomplete. Approach and information gathering appears essentially effective, but includes major mistakes in organization or calculation	Demonstrates satisfactory understanding of what information and assumptions are relevant to the analysis, and translates into mathematical symbols, graphs, and/or tables with minor errors. Approach and information gathering appears essentially effective, but includes minor mistakes in organization or calculation	Demonstrates high level of understanding of what information and assumptions are relevant to the analysis, and correctly translate into mathematical symbols, graphs, and/or tables. Correctly organizes information in an appropriate form and calculates desired result with one minor error.	Demonstrates high level of understanding of what information and assumptions are relevant to the analysis, and correctly translate into mathematical symbols, graphs, and/or tables. Correctly organizes information in an appropriate form and calculates desired result with no errors.

Appendix B: Institution-Wide Data

ILO-C: Quantitative Reasoning (ALL)							
Major	**IBL**	**GSMA**	**FET/MET**	**MT**	**ME**	**OCN**	**ALL**
% Met/Exceeded	56.7%	41.7%	62.6%	86.1%	74.1%	45.5%	69.3%
Number Met/Exceeded	17	15	62	105	63	5	268
Total Artifacts Collected	30	36	99	122	85	11	387
Gender	**M**	**F**					
% Met/Exceeded	74.3%	65.0%					
Number Met/Exceeded	223	52					
Total Artifacts Collected	300	80					
Sample Distribution	79%	21%					
Campus Population*	81%	19%					
*2020 Census Data https://csusuccess.dashboards.calstate.edu/public/dashboard-index							
Ethnicity	**WHITE**	**AAPI**	**HISP**	**BLACK**	**TWO+**	**UNK**	
% Met/Exceeded	80.6%	73.2%	48.6%	75.0%	72.9%	71.1%	
Number Met/Exceeded	145	30	34	6	35	27	
Total Artifacts Collected	180	41	70	8	48	38	
Sample Distribution	47%	11%	18%	2%	12%	10%	
Campus Population*	46%	12%	22%	3%	11%	4%	
*2020 Census Data https://csusuccess.dashboards.calstate.edu/public/dashboard-index							
Institution Wide	**PELL**	**FIRST GEN**					
% Met/Exceeded	64.5%	54.5%					
Number Met/Exceeded	136	18					
Total Artifacts Collected	211	33					
ILO-C: Number of Artifacts by Class/Major							
Rubric Score	**IBL**	**GSMA**	**FET/MET**	**MT**	**ME**	**OCN**	**ALL**
Freshman	3	0	30	40	43	0	122
Sophomore	1	5	14	12	9	2	43
Junior	6	17	18	13	9	3	66
Senior	20	13	37	57	24	0	151
N	30	35	99	122	85	5	382

Appendix C: Rubric Scores by Major & Gender

ILO-C: Quantitative Reasoning (Introductory)								
Rubric Score	**IBL**	**GSMA**	**FET/MET**	**MT**	**ME**	**OCN**	**MALE**	**FEMALE**	**ALL**
% Met/Exceeded	75.0%	0.0%	56.5%	79.4%	63.3%	45.5%	65.4%	63.0%	64.5%
1	0	1	6	3	4	1	12	3	18
2	1	1	9	3	10	2	19	7	26
3	0	0	12	8	8	3	25	6	31
4	0	0	19	13	9	0	29	12	41
5	1	0	10	15	15	3	36	8	44
6	2	0	6	26	14	2	41	9	51
Number Met/Exceeded	3	0	35	54	38	5	106	29	136
Total Artifacts Collected	4	2	62	68	60	11	162	46	211

ILO-C: Quantitative Reasoning (Mastery)								
Rubric Score	**IBL**	**GSMA**	**FET/MET**	**MT**	**ME**	**OCN**	**MALE**	**FEMALE**	**ALL**
% Met/Exceeded	53.8%	44.1%	73.0%	94.4%	100.0%	ND	78.3%	61.8%	75.0%
1	2	0	1	1	0	0	2	1	4
2	7	1	0	1	0	0	6	3	9
3	3	18	9	1	0	0	22	9	31
4	4	13	19	10	7	0	43	10	53
5	5	2	4	9	7	0	22	3	27
6	5	0	4	32	11	0	43	8	52
Number Met/Exceeded	14	15	27	51	25	0	108	21	132
Total Artifacts Collected	26	34	37	54	25	0	138	34	176