Georgia Institute of Technology
Office of Academic Effectiveness

General Education

Learning Outcome Assessment

Natural Sciences, Math & Technology

(Spring 2023)

Contents

Executive Summary

The General Education curriculum provides foundational knowledge in academic disciplines, exposing students to diverse learning perspectives and ways of knowing in Mathematics, Science, Social Sciences, and Arts and Humanities (University System of Georgia). Georgia Institute of Technology (Georgia Tech) General Education (Gen Ed) has six learning outcomes: (1) Communication, (2) Quantitative, (3) Computing, (4) Humanities, Fine Arts, and Ethics (5), Natural Sciences, Math, and Technology, and (6) Social Sciences. They are assessed in accordance with our established timeline. Nurtured by the Subcommittee on Gen Ed and Policy, the 3-Year Georgia Tech Gen Ed Assessment Plan (2021-2024) sets the framework for good practice in course delivery and assessment, capitalizing on the good judgment of faculty members regarding students' levels of attainment of Gen Ed learning outcomes. Faculty develop signature assignments in their Gen Ed courses, and the assignments, along with student performance, are collected for review and analysis at the end of each semester. To better understand our students' performance, the Office of Academic Effectiveness (OAE) then partnered with faculty to develop a scale for scoring. The general scale is structured to assess each Gen Ed learning outcome on a continuum: 1-Developing, 2-Meets Expectations, 3-Exceeds Expectations.

This report summarizes the evidence of student learning (n = 409) and provides descriptive statistics for the **Natural Sciences, Math & Technology** Outcome to support conversations regarding Gen Ed learning and opportunities for improvement.

Highlights

- **94.8%** (n= 388) of students met or exceeded the Natural Sciences, Math & Technology Outcome expectations, which means students demonstrated the ability to obtain, analyze, interpret, and criticize qualitative observations and quantitative measurements to explain natural phenomena and to test hypotheses. Students' performance in the Natural Sciences, Math & Technology outcome met or exceeded Georgia Tech's acceptable target (80%).

- Comparing student demographics for the Natural Sciences, Math & Technology Outcome, the results indicated that all demographic groups met or exceeded the target of 80%.

Background

An integral part of the delivery of General Education (Gen Ed) at the Georgia Institute of Technology (Georgia Tech) includes the assessment of the learning outcomes. The learning outcomes were approved by the Georgia Tech Undergraduate Curriculum Committee and Faculty Senate, and then by the University System of Georgia's (USG) Council on General Education in April 2011:

- **Communication (Core Area A1)**
  Outcome: Student will demonstrate proficiency in the process of articulating and organizing rhetorical arguments in written, oral, visual, and nonverbal modes, using concrete support and conventional language.

- **Quantitative (Core Area A2)**
  Outcome: Student will demonstrate the ability to apply basic elements of differential and integral calculus to solve relevant problems.

- **Computing (Institutional Options B)**
  Outcome: Student will be able to develop algorithms and implement them using an appropriate computer language and will understand algorithmic complexity and reasonable versus unreasonable algorithms.

- **Humanities, Fine Arts, and Ethics (Core Area C)**
  Outcome: Student will be able to describe relationships among languages, philosophies, cultures, literature, ethics, or the arts.

- **Natural Sciences, Math, and Technology (Core Area D)**
  Outcome: Student will be able to demonstrate the ability to obtain, analyze, interpret, and criticize qualitative observations and quantitative measurements to explain natural phenomena and to test hypotheses.

- **Social Sciences (Core Area E)**
  Outcome: Student will demonstrate the ability to describe the social, political, and economic forces that influence social behavior.

The purpose of this report is to provide assessment results to support conversations regarding General Education learning and opportunities for improvement.

Methods

Georgia Tech conducted an intensive review of the Gen Ed learning outcomes and how students demonstrate their learning in these areas by engaging faculty in Gen Ed assessment conversations in the following steps: (1) Study course enrollment and identify representative courses. We examined enrollment patterns for students taking courses in Gen Ed for the last five years. Patterns were determined, too, by class size (large class-100 or more students; medium class-50-99 students; small class-20-49 students). This exercise led to the value that all class sizes would be included in the 3-year Gen Ed Assessment Plan, as well as coverage of each discipline that contributes to Gen Ed. A total of 38 courses represented from different colleges were selected (See Appendix A and B). (2) Identify or develop signature assignments that align with the outcome. Faculty identified measures

that are tangible, visible, self-explanatory, and provide compelling evidence of exactly what students have learned. (3) Develop performance scale. Faculty met and developed a scale for scoring. The general scale is structured to assess each Gen Ed learning outcome: 1-Developing, 2-Meets Expectations, 3-Exceeds Expectations. The following image indicates our goal for this step.

Figure 1 Scoring Method from Course Level Assessment to Outcome Level Assessment

This three-step process has become the basic collaboration framework across courses and units for meaningful Gen Ed assessment.

Sample Size

The following table indicates the representative nature of the sample by comparing the student demographic information of the sample and the undergraduate student population of the Institute.

Table 1 Sample Size by Student Demographics

Student Demographic	Sample N (%)	Institutional Population N(%)
Gender	Total=409	Total=18,415
Male	236 (57.7%)	11,178 (60.7%)
Female	173 (42.3%)	7,237 (39.3%)
Race/Ethnicity		
White	925 (45.7%)	6,876 (41.5%)
Black or African or American	188 (9.3%)	1,492 (9.0%)
Asian	579 (28.6%)	5,766 (34.8%)
Hispanic or Latino	209 (10.3%)	1,696 (10.2%)
Two or More Races	107 (5.3%)	554 (3.3%)
Unknown	17 (0.8%)	232 (1.4%)
First Generation College Student		
Continuing Generation	1,857 (91.7%)	14,167 (85.6%)
First Generation	169 (8.3%)	2,384 (14.4%)
Citizenship		
Domestic Student	347 (84.8%)	16,561 (89.9%)
International Student	62 (15.2%)	1,864 (10.1%)
Transfer Student Status		
Non-Transfer Student	348 (85.1%)	17,695 (96.1%)

Transfer Student	61 (14.9%)	720 (3.9%)

The Natural Sciences, Math, and Technology Outcome Statement and Representative Courses

MATH 1554 and MATH 1711 are listed under General Education Core Area D Natural Sciences, Math, and Technology, which is associated with the following outcome:

Student will be able to demonstrate the ability to obtain, analyze, interpret, and criticize qualitative observations and quantitative measurements to explain natural phenomena and to test hypotheses.

Measures and Targets for the Natural Sciences, Math, and Technology Outcome

In MATH 1554, students will demonstrate the ability, given a transition diagram or stochastic process word problem, to obtain a stochastic matrix which represents the transition diagram, determine whether the Markov Chain corresponding to a given initial state tends to a long-term steady state vector by analyzing the values in stochastic matrix, and then compute the steady state vector if it exists. Students will then interpret the information to predict the long-term distributions of the given population. Faculty will score students' responses to a final exam/quiz question on a scale.

In MATH 1711, students will demonstrate the ability, given a word problem relating a real life situation involving a business scenario or natural phenomenon and containing a table of data, to obtain a linear regression model for the data by analyzing the data points. The student will then use the linear regression model to analyze and interpret the information in order to predict the future value of the dependent variable and make a recommendation on a desirable course of action. Faculty will score students' responses to a final exam/quiz question on a scale.

Scoring and Data Analysis

For the Natural Sciences, Math, and Technology outcome, students were asked to respond to exams, questions, or write a report. This Natural Sciences, Math, and Technology Outcome report presents the student performance data from 2 classes from Spring 2023. The following table indicates the sample size and the scoring methods.

Table 2 Natural Sciences, Math, and Technology Scoring

Course Scoring	Signature Assignment	Scoring Method	N
MATH 1554	Exam	1-3	278
MATH 1711	Exam	0-15	131
Total			409

The following table presents student performance by Course and Scale. Faculty determined a common evaluation scale for the Natural Sciences, Math, and Technology outcome

achievement. The following table presents the score interpretation proposed for understanding students' performance at outcome level assessment:

Table 3 Score Interpretation

Score Interpretation			
Course	Developing	Meets Expectations	Exceeds Expectations
MATH 1554	<2	2.0 & 2.5	3.0
MATH 1711	<9	9-11	12-15

Findings

Based on faculty agreement on the score interpretation, the frequency and percentage of achievement were calculated. Overall, **94.8%** (n = 388) of students met or exceeded the Natural Sciences, Math, and Technology Outcome expectations, which means students demonstrated their abilities to obtain, analyze, interpret, and criticize qualitative observations and quantitative measurements to explain natural phenomena and to test hypotheses.

Table 4 Natural Sciences, Math, and Technology Outcome Overall Performance

Score Interpretation	% (n)	Target Achieved?
Developing	5.1% (n = 21)	Yes (94.8%)
Meets Expectations	20.0% (n = 82)	
Exceeds Expectations	74.8% (n = 306)	

The following sections provide more details of students' performance data by different demographic populations. The results indicated that all demographic groups met or exceeded the target of 80%

Table 5
Natural Sciences, Math, and Technology Outcome Overall Performance

(From All Represented Courses)	Developing	Meets Expectations	Exceeds Expectations	Overall Score	
	n (%within subgroup)	n (%within subgroup)	n (% within subgroup)	Mean (SD)	Target (80%) Achieved?
Gender					
Male (n=236)	9 (3.8%)	49 (20.8%)	178 (75.4%)	2.72 (0.53)	Yes (96.2%)
Female (n=173)	12 (6.9%)	33 (19.1%)	128 (74.0%)	2.67 (0.60)	Yes (93.1%)
Race/Ethnicity					
White (n=123)	4 (3.3%)	23 (18.7%)	96 (78.0%)	2.75 (0.51)	Yes (96.7%)
Black or African American (n=22)	3 (13.6%)	2 (9.1%)	17 (77.3%)	2.64 (0.73)	Yes (86.4%)
Asian (n=150)	7 (4.7%)	36 (24.0%)	107 (71.3%)	2.67 (0.56)	Yes (95.3%)
Hispanic or Latino (n=32)	2 (6.3%)	4 (12.5%)	26 (81.3%)	2.75 (0.57)	Yes (93.8%)
Two or More Races (n=18)	2 (11.1%)	2 (11.1%)	14 (77.8%)	2.67 (0.69)	Yes (88.9%)

Unknown (n=2)	0 (0.0%)	0(0.0%)	2 (100.0%)	3 (0.00)	Yes (100%)
First-Generation College Student					
Continuing Generation (n=318)	15 (4.7%)	61 (19.2%)	242 (76.1%)	2.56 (0.66)	Yes (95.3%)
First Generation (n=29)	3 (10.3%)	6 (20.7%)	20 (69.0%)	2.54 (0.65)	Yes (89.7%)
Citizenship					
Domestic Student (n= 347)	18 (5.2%)	67 (19.3%)	262 (75.5%)	2.70 (0.56)	Yes (94.8%)
International student (n=62)	3 (4.8%)	15 (24.2%)	44 (71.0%)	2.66 (0.57)	Yes (95.2%)
Transfer Student Status					
Transfer Student (n=61)	8 (13.1%)	16 (26.2%)	37 (60.7%)	2.48 (0.72)	Yes (86.9%)
Non-Transfer Student (n=348)	13 (3.7%)	66 (19.0%)	269 (77.3%)	2.74 (0.52)	Yes (96.3%)
GA Residence					
GA Residence (n=196)	14 (7.1%)	28 (14.3%)	154 (78.6%)	2.71 (0.59)	Yes (92.9%)
Out of State Residence (n=213)	7 (3.3%)	54 (25.4%)	152 (71.4%)	2.68 (0.53)	Yes (96.8%)

Appendix A: Represented Courses List

Outcomes	Represented Courses	Total
Communication	ENGL 1101, ENGL 1102	2
Quantitative	MATH 1552, MATH 1712	2
Computing	CS 1301, CS 1315, CS 1371	3
Humanities, Fine Arts, and Ethics	Large Class: FREN 1002, SPAN 2001, ID 2202, ID 2241, PHIL 3109, ARCH 2111 Middle Class: LMC 3226, ML 2500 Small Class: LMC 2100, PHIL 4176	10
Natural Sciences, Math, and Technology	CHEM 1310, BIOS 1207DL, EAS 1600, PHYS 2212, MATH 1554, MATH 1711	6
Social Sciences	Large Class: ECON 2100, HIST 2111, HIST 2112, INTA 1200, 2030, POL 1101, PSYC 1101, PSYC 2210, PSYC 2230, SOC 1101 Small Class: ARCH 3135, CP 4020, POL 2101, PUBP 3000, PUBP 3315	15

Appendix B: Represented Courses Associated College

Represented course associated college	Number of courses from the represented course list	Associated outcome
Ivan Allen College of Liberal Arts	19	Communication, Humanities, Fine Arts, and Ethics, Social Sciences
College of Sciences	11	Quantitative, Natural Sciences, Math, and Technology, Social Sciences
College of Design	5	Humanities, Fine Arts, and Ethics, Social Sciences
College of Computing	3	Computing