Playing with Numbers: An Examination of Quantitative Reasoning Activities in College

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Abstract

Findings from national studies along with more frequent calls from those who employ college graduates suggest an urgent need to increase opportunities to develop quantitative reasoning skills. To address this issue, the current study examines the relationship between the frequency of quantitative reasoning activities during college and student characteristics, as well as whether students at institutions with organized quantitative reasoning programs report more quantitative reasoning activity. Results show that gender, major, full-time status, first-generation status, age, and pre-college ability relate to frequency of quantitative reasoning activities. Findings also suggest that such activities are indeed more common among institutions with formal quantitative reasoning programs.

Keywords: quantitative reasoning, quantitative literacy, student development

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In an increasingly data-driven world we must routinely use and make sense of quantitative information. Today's job market demands quantitative skills from college graduates, regardless of career (Rivera-Batiz, 1992; Steen, 2001; Dingman & Madison, 2011). Others have argued that quantitative literacy is increasingly important for effective democratic participation (Steen, 2001). However, the 2003 National Assessment of Adult Literacy (NAAL) found that only about one-third of college graduates demonstrated proficiency in quantitative literacy (Kutner et al., 2007). Findings from the NAAL and the importance of quantitative literacy to both citizenship and the workplace suggest an urgent need for institutions to assess opportunities for college students to develop their reasoning (QR) abilities.

Literature Review

The concept of QR was developed in the late in 20th century out of a call for workers to be more informed and better users of quantitative information (Wilkins, 2000). A person's functional literacy in the 21st century, as championed by Steen (1997), must extend beyond reading and writing to include the ability to understand and use quantitative information. Well informed and productive citizens must be able to use and understand the wealth of quantitative information available today in the workplace, on TV, the Internet, newspapers, and in everyday life: "As the printing press gave power of letters to the masses, so the computer gives the power of numbers to ordinary citizen" (Steen, 1997, p. xv).

The terms numeracy, quantitative literacy, and quantitative reasoning have been used interchangeably throughout the literature. The term numeracy was first used in the United Kingdom to included secondary school students' ability to reason and solve quantitative problems, to understand the scientific method, and to communicate about quantitative matters in

everyday life (National Numeracy Network, 2009). Others (Madison & Steen, 2003; Steen, 2001; Wilkins, 2000, 2009) use the term quantitative literacy and describe it as the comfort, competency, and habits of mind in working with numerical information. The National Numeracy Network (2009) website defines QR as "emphasizing the higher-order reasoning and critical thinking skills needed to understand and to create sophisticated arguments supported by quantitative data" (p. 1).

The AAC&U's VALUE (Valid Assessment of Learning in Undergraduate Education) rubric (2009) rubric describes individuals with QR skills as those who possess the ability to reason and solve quantitative problems in everyday situations and in a wide variety of contexts. In addition, these individuals can understand, create, and communicate sophisticated arguments supported by quantitative information. Wilkins (2000) describes a quantitatively literate person as one who possesses "a functional knowledge of mathematical content, the ability to reason mathematically, a recognition of the societal impact and utility of mathematics, and a positive disposition towards mathematics" (p. 406).

Quantitative literacy transcends the mere ability to perform mathematical computations to include a deeper understanding of quantitative data. Quantitative literacy includes an *everyday* understanding of mathematics; in other words, the ability to use numerical, statistical, and graphical information in everyday life (Steen, 1997, 2001; Wilkins, 2000, 2009). Steen (1997) described quantitative literacy as a "walking around" knowledge of mathematics or the ability to handle quantitative information that one might encounter in everyday life (Steen, 2001; Wilkins, 2000). Some examples of this might include the requisite knowledge to interpret a graph in a newspaper, to manage personal finances, to make informed medical decisions, or to identify the best priced item at the grocery store.

The Mathematical Association of America (Madison & Steen, 2008), the National Research Council (1989), National Council of Teachers of Mathematics (1989, 2000), the Association of American Colleges and Universities (AAC&U) (2009), and the National Committee on Excellence in Education (1983) have all emphasized the need for students to learn to apply mathematics to everyday situations and to function in a quantitative society. The AAC&U's VALUE rubric (2009) list QR as one of six learning outcomes in the category of intellectual and practical skills.

Despite these calls for students to develop competence in QR, a report sponsored by the US Department of Education's National Center for Education Statistics (Kutner et al., 2007) found no significant gains between 1992 and 2003 in quantitative literacy at any education level. More worrisome, the study found that only one-third of college graduates demonstrated proficiency in quantitative literacy. It also found significant gaps in quantitative literacy exists between men and women and between racial-ethnic groups. Men had higher average quantitative literacy than women, but the gap had narrowed since 1992; White and Asian/Pacific Islander adults had higher quantitative literacy than Blacks and Hispanic adults.

Employees at all levels and in all fields must be able to identify problems, analyze and interpret information, and make decisions based on that information (Wilkins, 2000). Chefs must use quantitative information to monitor the nutritional value of meals or and assess the cost of preparing those meals. Managers in a wide range of fields must deal with scheduling, budgeting, planning, and decision making based on quantitative information. Journalists need a sophisticated understanding of quantitative information to develop an informed understanding of news events, to critically assess the information used to advocate for various positions, and to ask thought-provoking questions.

The QR demands imposed by today's society and in the modern workforce are great and are growing (Dingham & Madison, 2010; Steen, 2001; Madison & Steen, 2008; Madison, 2009). The American public faces a multitude of quantitative information both in the workplace and in everyday life. As such, there is a growing consensus that to be able to function in today's society, people need to be quantitatively literate, that is, they need to be able to process and understand quantitative information (Shavelson, 2008). This increased need to understand, reason, and make decisions based on quantitative information has prompted a need for colleges and universities to enhance students' ability to make sense of, effectively use, and be knowledgeable consumers of quantitative information (Dingham & Madison, 2009, 2011; Taylor, 2008). Indeed, a number of colleges and universities have instituted formal programs designed to ensure that graduates develop QR skills regardless of major (Gillman, 2006). Given the growing importance of QR in both the workplace and everyday life, higher education institutions need to assess the opportunities they provide for students to develop their QR abilities. This study addresses this need by examining the prevalence of key QR activities in colleges and universities.

Research Questions

The purpose of this study is to explore the relationship between the frequency of QR activities and student and institutional characteristics, as well as whether students at institutions with formal QR programs report more QR activity. The following research questions guide this study:

(1) What is the relationship between student and institutional characteristics and the frequency of students' use of QR activities?

(2) Are the influences on students' reported use of QR activities the same for males and females and for STEM and non-STEM majors?

(3) Do students at institutions with formal QR programs report more frequent use of QR activities?

Methodology

Sample

Data for this study were from an experimental set of questions appended to the 2011 National Survey of Student Engagement (NSSE). Items asked students to gauge the frequency of various uses of numerical, statistical, and graphical information (see Appendix). The sample consisted of more than 13,000 first-year and senior students enrolled at 33 four-year institutions who had complete data on the variables described below. Nine of these institutions had a special QR skills development program. Institutions with special QR skills development programs were identified by Steen (2007) on his *Quantitative Literary* website. Approximately 61% of students in the sample were female, 97% were enrolled full-time, 33% were first-generation students, and 1% were taking all their courses entirely online. About 8% classified themselves as African-American, 6% as Asian, 73% as Caucasian, 6% as Hispanic, and the rest classified themselves as another racial/ethnic group or as multiracial.

Variables

The dependent variable, students' reported frequency of QR activities, was a scale derived from four items that asked how often during the current school year students have used number, graphs, or statistics to reach conclusions or to analyze an issue, how often they explained such numerical information in their writing, and how often they analyzed others' conclusions based on such information (see Appendix). The alpha reliability coefficient for this scale was 0.90 for both first-year and senior students. We examined the relationship between a

number of student and institutional characteristics and students' reported frequency of QR activities. Descriptive statistics for these items are given in Table 1.

Student characteristics examined included gender, race-ethnicity (with White as the reference group), age, first-generation status (defined as neither parent having completed a bachelor's degree or higher), transfer status, and distance education status. A variable that indicated whether a student was majoring in science, technology, engineering, or mathematics (STEM) was also included to examine disciplinary effects. Approximately 40% of first-year and senior students were STEM majors. Students' prior academic ability, measured by their entering combined verbal and quantitative SAT score, was also included. ACT scores were converted to the SAT scale using an ACT-SAT concordance table (ACT, 2008). The average combined SAT score for first-year and senior students was 1151 and 1144, respectively.

The institutional characteristics included enrollment size and control. Initially, we intended to also control for Carnegie classification, however, several classification categories included only one or two institutions. We attempted to collapse the classification into three categories (doctoral, master, and baccalaureate) and use two dummy variables to control for Carnegie classification; however, these two dummy variables were highly correlated with size ($r > .80$) and control ($r > .60$) and contributed to high multicollinearity in the regression models (VIFs > 10). Therefore, Carnegie classification was not included as a control in this study.

Data Analysis

Ordinary least squares (OLS) regression procedures were used to examine the relationship between student and institutional characteristics and students' reported frequency of QR activities. In addition, analysis of covariance (ANCOVA) was conducted to determine whether students at institutions with formal QR programs reported higher levels of QR activity.

Prior to estimation of the models, exploratory analyses were conducted testing the assumptions underlying the application of multiple linear regression and ANCOVA. Normal probability plots and residual analyses indicated no severe departures from the assumptions of independence, normality, homoscedasticity, and linearity. Variance inflation factors were checked for multicollinearity, which was not present in these analyses (all VIFs were less than 2).For the ANCOVA analyses, the homogeneity of regression effects was evident for all covariates. Intra-class correlations were also computed to estimate the proportion of variance in students' reported QR activities that is between institutions. Intra-class correlations for first-year and senior students were .015 and .013, respectively, demonstrating that nearly all variance in students' QR activities was between students rather than institutions.

We also tested for the possibility of interaction effects with gender and major group. Two sets of interaction terms were created, first by taking the product of each independent variable (other than female) and the indicator variable for female, and second by taking the product of each independent variable (other than STEM) and the indicator variable for STEM major. Separate regression models were estimated for first-year and senior students. For first-year students, a regression equation was estimated that included all the independent variables. Then the set of interaction terms for gender was added to the equation and the amount of incremental variance explained was calculated. The increase in variance explained by the addition of the gender interaction terms was not significant ($\Delta R^2 = .003$, $F(12, 6452) = 1.864$, $p > .01$) indicating that the influences of the variables in the model on the frequency of QR activities was not different for first-year males and females. Next, we estimated a regression equation that included the interaction terms for having a STEM major. The increase in variance explained by the addition of the interaction terms for major was not significant ($\Delta R^2 = .004$, $F(12, 6452) = 2.099$,

$p > .01$) indicating that the influences of the variables in the model on frequency of QR activities was not different for first-year students majoring (or intending to major) in STEM fields relative to other first-year students.

The same process was followed for seniors. The increase in variance explained by the addition of interaction terms for gender was not significant ($\Delta R^2 = .002$, $F(12, 5988) = 1.158$, $p > .05$) indicating that the influences of the variables in the model on frequency of QR activities was not different for senior males and females. Next, a separate regression equation was estimated that included the interaction terms for STEM major. Unlike the model for first-year students, the increase in variance explained by the addition of the interaction terms for STEM major was significant ($\Delta R^2 = .006$, $F(12, 5988) = 3.348$, $p < .001$) indicating that the influences of the variables in the model on the frequency of QR activities were different for seniors majoring in STEM fields and non-STEM fields. As a result of these findings, the regression analyses were then conducted separately for seniors majoring in STEM fields and those majoring in non-STEM fields.

Results

Student and Institutional Characteristics

Results for the three OLS regression analyses (one for first-year students and two for seniors) are given in Table 2. The nine variables defining the model for first-year students explained 5.2% of the variability in frequency of QR activities ($F(13, 6464) = 27.54$, $p < .001$). In the presence of the other variables in the model, five variables were significantly related to students' reported use of QR activities. These five significant effects are, in order of magnitude, STEM major ($\beta = .171$), female ($\beta = -.129$), private institution ($\beta = .072$), enrollment size ($\beta = .048$), and Asian ($\beta = .040$). Thus, after controlling for the other variables in the model, STEM

majors tend to report more frequent QR activities than non-STEM majors; male students tend to report more frequent QR activities than female students; students attending private institutions tend to report more frequent QR activities than their peers attending public institutions; students attending larger institutions tend to report greater frequency of QR activities, and Asians tend to report more frequent QR activities than Whites.

The model for senior STEM majors explained 4.1% of the variation in students' use of QR activities ($F (12, 2253) = 7.944$, $p < .001$). In the presence of the other variables in the model, three variables were significantly related to students' reported frequency of QR activities. These three significant effects are, in order of magnitude, female ($\beta = -.167$), full-time status ($\beta = .055$), and attending a private institution ($\beta = .054$). Thus, after controlling for the other variables in the model, male students tend to report more frequent QR activities than female students; full-time students tend to report more frequent QR activities than part-time students; and students attending private institutions tend to report more frequent QR activities than senior STEM majors at public institutions of comparable size.

The set of nine variables defining the model for senior non-STEM majors explained 2.9% of the variability in QR scores ($F (12, 3735) = 9.445$, $p < .001$). Net of the other variables in the model, six variables had a significant influence on non-STEM seniors' reported frequency of QR activities. These six significant effects are, in order of magnitude, female ($\beta = -.134$), first-generation status ($\beta = .054$), private institutional control ($\beta = .047$), age ($\beta = -.045$), African-American ($\beta = .044$), and Asian ($\beta = .043$). Thus, after controlling for the other variables in the model, male students, tend to report more frequent QR activities than females; first-generation students tend to report more frequent QR activities than those with college-educated parents; younger students tend to report more frequent QR activities than older students; African-

American and Asian students tend to report more frequent QR activities than White students; and students attending private institutions tend to report more frequent QR activities than their peers at public institutions.

Formal QR Programs

Separate one-way ANCOVAs were conducted for first-year and senior students to assess the effect of the presence of a formal QR program at an institution. Because of our OLS results, we initially ran separate ANCOVAs for STEM and non-STEM seniors; however, these results demonstrated similar effects for QR program. As a result, we elected not to split the sample by major. Results for the ANCOVA procedures are given in Table 3. The ANCOVA for first-year students was significant ($F(1, 6463) = 18.36$, $p < .001$), indicating that first-year students at institutions with formal QR programs report more frequent QR activities than otherwise similar first-year students at institutions without formal QR programs. The strength of relationship between institutions with formal QR programs and the frequency of QR activities was small, as assessed by eta-square, with the presence of a QR program accounting for only 0.27% of the variance in reported QR activities holding the other variables constant. The mean reported QR score for institutions with formal QR programs, adjusted for differences on the covariates, was 46.69 on a 0-100 scale, compared with 43.16 for institutions without a formal QR program (unadjusted means were 46.37 and 43.30, respectively). The effect size (Cohen's *d*) for these adjusted means is .13. The ANCOVA for senior students was not significant $F(1, 5999) = 1.07$, $p > .05$, indicating that seniors at institutions with formal QR programs do not report more frequent QR activities than seniors at institutions without formal QR programs. The absence of an effect for seniors is not particularly surprising given that most QR programs are directed at first-year students.

Limitations

The purpose of this study was to gauge how student and institutional characteristics relate to students' reported frequency of QR activities. As such, we only examined those measures. But there may be other important variables not included that also impact students' frequency of QR activities and the relatively small proportion of variance explained by the regression models seems to suggest this is the case. Although the student and institutional characteristics employed in this study did not explain much variability in the resulting regression models, the relationship between these variables and QR is important especially given that national assessments have shown gender and race-ethnicity differences in quantitative literacy (Kutner et al., 2007).

Our study used a very coarse measure of interventions to promote QR—the simple presence or absence of a formal program to promote QR. Future studies should investigate the specific nature of these interventions. It is likely that, as with many other reforms, the fine details of implementation matter. This study also considered only two coarse measures of institutional differentiation—size and control. Although the small portion of total variance attributable to institutions suggests this is not a severe shortcoming, it would nonetheless be valuable to examine whether the small but consistent finding of differences related to institutional control—in which QR activities are more frequent at private institutions—reflects other characteristics correlated with control. Finally, ours is a convenience sample of 33 institutions, not a nationally representative sample. It may be that a different sample of institutions would yield different results. However, the small share of variance attributable to institutions in our sample suggests that this is probably not a severe limitation. With these limitations in mind, this study presents a valuable first step in exploring the relationships with students' reported QR activities.

Discussion

These analyses document some interesting findings regarding the reported frequency of QR activities at a diverse set of 33 colleges and universities. Not surprising, both first-year and senior students in STEM fields reported more frequent use of QR than students majoring in non-STEM related fields. As demonstrated in Figure 1, first-year and senior students majoring in engineering, physical sciences, and biological sciences report the most frequent use of QR activities while education and arts and humanities majors report the lowest frequency of QR activities. In fact, first-year STEM majors report almost two-fifths of a standard deviation (Cohen's *d*=.38) more frequent QR activities than first-year non-STEM majors, and senior STEM majors report almost half a standard deviation (Cohen's *d*=.48) more frequent QR activities than non-STEM majors. Not only does having a STEM major affect the amount of QR activities students report, the influences of the variables examined on reported QR activity were different for senior STEM and non-STEM majors. These findings provide persuasive evidence of the need for colleges and universities to focus their efforts on developing QR skills among students majoring in non-STEM disciplines—especially in education and arts and humanities fields.

An interesting finding in these analyses is the consistent *absence* of a relationship between frequency of QR activities and measured cognitive ability as captured by SAT/ACT scores, net of the other variables in our models. This suggests that prior preparation and achievement do not pose a major obstacle to efforts to broaden students' exposure to QR activities.

While preliminary analyses did not indicate a significant interaction between gender and QR, we found that female students showed a consistently lower exposure to quantitative reasoning than males even after controlling for other demographic characteristics, major,

measured cognitive ability, and institutional characteristics. Furthermore, the gender gap between males and females ranged from about 8 units on the QR scale, or between .13 and .17 standard deviations, net of the other variables in the model. In other words, males reported between .13 and .17 standard deviations more frequent QR activities than females, even after controlling for major and other variables. While the gender gap was apparent in all three models, the female disadvantage was *largest* for STEM majors. This is likely related to differences in the gender composition of the various majors aggregated together as STEM majors (for example, women make up a much larger share of biological sciences majors than engineering majors (NSSE, 2011)).

We also found QR activity to differ by race-ethnicity. While we found no differences between African-Americans and Whites or Hispanic and Whites for first-year students, Asians reported more frequent QR activities than Whites. Racial-ethnic differences were also found for senior, non-STEM majors, among whom Asians and African-Americans reported more frequent QR activities than Whites. Despite these differences, results for senior STEM majors revealed no differences between Whites and African-Americans, Asians, or Hispanics. Thus among seniors, QR activity in STEM disciplines does not appear to vary with respect to race-ethnicity.

Across all three regression models, we found that students attending private institutions tend to report more quantitative reasoning activities than their counterparts attending public institutions. This could be due to the fact that a larger proportion of private institutions in this sample had formal QR programs. It may also be masking differences related to institutional type, because primarily undergraduate colleges are almost exclusively private institutions. We also found enrollment size to have a consistent impact on first-year students' reported use of QR activities. The larger the institution, the more frequently first-year students reported using

numerical, graphical, and statistical information. These findings raise some interesting issues. What is it about private institutions that accounts for the greater use of QR activities? What is it about larger institutions that accounts for the greater use of QR activities for first-year students but not for seniors? These are some important questions that call for further investigation.

The establishment of formal QR programs may be one way that institutions can increase students' exposure to QR activities, especially for first-year students and students in non-STEM disciplines. Results from the ANCOVA procedure demonstrate that after controlling for pre-college ability, major, and other student and institutional characteristics, first-year students at institutions with formal QR programs report significantly greater frequency of QR activity. Although the magnitude of the effect of the presence of a formal QR program was modest, five of the eight institutions with the highest average first-year QR scores had formal QR programs. Additionally, four of the top five institutions with regard to average QR scores for first-year arts and humanities majors had special QR programs. This is of particular interest because arts and humanities majors may be most in need of such programs because their major curricula do not emphasize QR activities. These results suggest that incorporating QR programs maybe one way that institutions can increase the amount of QR activities for students in all majors, but particularly for those in non-STEM majors.

With the growing use of quantitative information in the workplace and in everyday life, as well as the importance of quantitative literacy for effective democratic participation, it is essential that *all* college students—not just STEM majors—develop QR skills. Results of this study suggest that certain students may be at risk for not developing these important skills, especially women and students majoring in non-STEM disciplines. These findings also provide evidence for a modest positive impact of QR programs. Institutions might use these results to

begin conversations about targeting interventions for those at risk of not developing the QR skills necessary to succeed in this increasingly quantitative world.

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Table 1: Descriptive Statistics

	First-year Students				Senior Students			
	Mean	St. Dev.	Min	Max	Mean	St. Dev.	Min	Max
Quantitative Reasoning (QR)	44.24	28.47	0	100	50.98	29.49	0	100
Female	0.63	0.48	0	1	0.60	0.49	0	1
African-American	0.09	0.29	0	1	0.07	0.25	0	1
Asian	0.07	0.26	0	1	0.05	0.22	0	1
Hispanic	0.07	0.25	0	1	0.05	0.22	0	1
Combined SAT score	1150	161	530	1600	1144	169	510	1600
First-generation status	0.33	0.47	0	1	0.34	0.47	0	1
Age	18.52	1.44	16	54	22.08	2.60	18	61
Transfer student	0.04	0.20	0	1	0.18	0.38	0	1
Full-time	0.99	0.10	0	1	0.95	0.21	0	1
Distance education student	0.01	0.07	0	1	0.01	0.11	0	1
STEM major	0.41	0.49	0	1	0.38	0.48	0	1
Institutional enrollment size (in thousands)	20.28	13.55	1.06	37.83	20.69	14.17	1.06	37.83
Private institution	0.22	0.42	0	1	0.24	0.43	0	1
QR program	0.30	0.46	0	1	0.24	0.43	0	1

Table 2: OLS Regression Results[a]

		Seniors	
Independent variables	First-Year	STEM	Non-STEM
Female	-7.62***	-9.24***	-8.16***
	(-0.13)	(-0.17)	(-0.13)
African-American	0.60	-1.69	5.15**
	(0.01)	(-0.02)	(0.04)
Asian	4.39**	1.30	6.29**
	(0.04)	(0.01)	(0.04)
Hispanic	-0.65	2.74	1.49
	(-0.01)	(0.02)	(0.01)
SAT score	-0.003	0.005	-0.01
	(-0.02)	(0.03)	(-0.04)
First-generation status	0.79	-1.68	3.35**
	(0.01)	(-0.03)	(0.05)
Age	-0.41	-0.24	-0.48*
	(-0.02)	(-0.02)	(-0.05)
Transfer student	2.76	-0.96	1.36
	(0.02)	(-0.01)	(0.02)
Full-time	2.50	7.25**	3.05
	(0.01)	(0.06)	(0.02)
Distance education student	-0.45	3.68	5.25
	(0.001)	(0.01)	(0.02)
STEM major	9.86***	--	--
	(0.17)	--	--
Institutional enrollment size (in thousands)	0.10**	0.04	0.07
	(0.05)	(0.02)	(0.03)
Private institution	4.92***	4.33*	3.01*
	(0.07)	(0.05)	(0.05)
R^2	.052***	.041***	.029***

[a]Standardized coefficients given in parentheses
*p<.05; **p<.01; ***p<.001

Table 3: ANCOVA Results

	First-Year				Seniors			
Source	SS	df	MS	F	SS	df	MS	F
Female	86846	1	86846	113.2***	105651	1	105651	132.0
African-American	17	1	17	0.0	1813	1	1813	2.3
Asian	4015	1	4015	5.2*	3515	1	3515	4.4
Hispanic	417	1	417	0.5	982	1	982	1.2
SAT score	1414	1	1414	1.8	469	1	469	0.6
First-generation status	983	1	983	1.3	2705	1	2705	3.4
Age	1610	1	1610	2.1	5346	1	5346	6.7
Transfer student	1796	1	1796	2.3	64	1	64	0.1
Full-time	273	1	273	0.4	5581	1	5581	7.0
Distance education student	17	1	17	0.0	1379	1	1379	1.7
STEM major	152114	1	152114	198.2***	235267	1	235267	294.0
Institutional enrollment size (in thousands)	8236	1	8236	10.7**	2328	1	2328	2.9
Private institution	8754	1	8754	11.4***	2790	1	2790	3.5
QR Program	**14091**	**1**	**14091**	**18.4*** **	**859**	**1**	**859**	**1.1**
Error	4959422	6463	767		4800372	6014	800	
Total	5248984	6477			5228656	6013		

*p<.05; **p<.01; ***p<.001

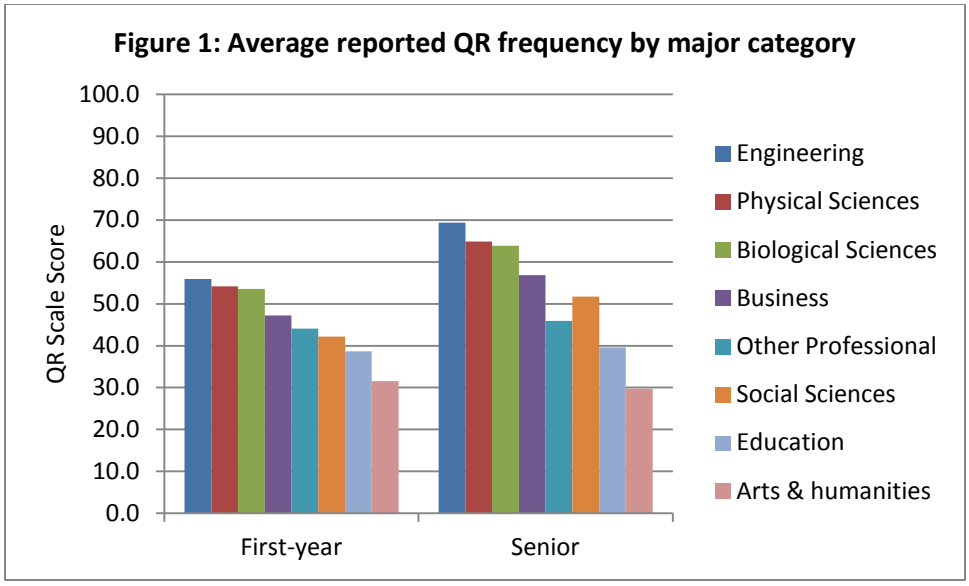
Figure 1: Average reported QR frequency by major category
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
QR Scale Score
First-year
Senior
Engineering
Physical Sciences
Biological Sciences
Business
Other Professional
Social Sciences
Education
Arts & humanities

Appendix

NSSE 2011 Experimental Items on Quantitative Reasoning

In your experience at your institution during the current school year, about how often have you done the following? [Response options: *Very often*, *Often*, *Sometimes*, *Never*]

1. Reached conclusions based on your own analysis of numbers, graphs, or statistics
2. Used numbers, graphs, or statistics to help analyze a contemporary or historical issue (poverty, climate change, etc.)
3. Explained in writing the meaning of numbers, graphs, or statistics
4. Analyzed others' conclusions by using numbers, graphs, or statistics