Teaching Quantitative Literacy/ Quantitative Reasoning (QL/QR) Skills: A Numeracy Infusion Course for Higher Education (NICHE)

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Abstract
Scholars in the Quantitative Reasoning (QR) movement have repeatedly stressed the importance of multidisciplinary QR efforts. This paper describes how a QR faculty development workshop provided the foundation for a predominantly online Numeracy Infusion Course for Higher Education (NICHE) designed to train faculty in a wide range of disciplines. The workshop has led to the crystallization of several key components of NICHE. In particular, effective QR training must teach faculty how to (a) apply QR within a disciplinary context; (b) articulate QR learning goals/objectives; (c) identify and implement best practices for teaching QR: active learning, collaborative student learning, and writing with numerical information; (d) adapt and implement strategies for incorporating QR into course instruction; and (e) assess the effectiveness of QR initiatives, using the assessment results to further improve instruction. Successful QR initiatives must not only address students' learning but reduce the QR anxieties and improve the QR competencies of participating faculty.

Key Words: active learning, assessment, multidisciplinary instruction, numeracy, quantitative literacy, quantitative reasoning

1. Numeracy and Quantitative Literacy

Quantitative Literacy/Quantitative Reasoning (QL/QR) is increasingly recognized as an essential skill for college graduates. As the Association of American Colleges and Universities (2010: 1) reports, "Virtually all of today's students . . . will need basic QL skills like the ability to draw information from charts, graphs, and geometric figures, and the ability to accurately complete straightforward estimations and calculations."

Quantitative literacy (QL), also called "numeracy" and "quantitative reasoning" (QR), may be defined as "the ability to understand and use numbers and data in everyday life" (Madison and Steen 2003: 3).[1] QL/QR is not synonymous with mathematics or statistics, however. It may be viewed more generally as "a practical, robust habit of mind anchored

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[1] Some authors argue for a distinction among terms such as Quantitative Literacy, Quantitative Reasoning, and numeracy. For example, Powell and Leveson (2002) define quantitative literacy as "basic familiarity with numbers, arithmetic and graphs . . . and an ability of manipulate numbers." In contrast, they define quantitative reasoning as "the application of logic to problems and the ability to understand the real world meaning of numbers and mathematical statements."

in data, nourished by computers, and employed in every aspect of an alert, informed life" (Steen 2004b: 4). Some of the key skills that make up QL/QR include reading graphical displays, modeling real-world phenomena, solving practical problems through the use of data, justifying conclusions, and critiquing research designs (Johnson and Kaplan N.d.).

Unfortunately, there is a widespread quantitative literacy gap throughout the United States. "Most U.S. students leave high school with quantitative skills far below what they need to live well in today's society; businesses lament the lack of technical and quantitative skills of prospective employees; and virtually every college finds that many students need remedial mathematics" (Steen 2001: 1–2). The problem is especially acute among minority students. As Rivera-Batiz (1992: 313) reports, "low quantitative literacy appears to be critical in explaining the lower probability of employment of young Black Americans relative to Whites." For example, 2009 national data on proficiency in mathematics among 8th grade students reveal that 54% of Asian/Pacific students scored at or above the *proficient* level, compared to 44% of white students, 18% of American Indian/Alaska Native students, 17% of Hispanic students and 12% of black students (Aud, Fox, and KewalRamani 2010).

Just as poor quantitative skills inhibit success, good QR skills have an empowering effect. A number of QR skills, including computer literacy, are critical for success in today's technologically-oriented and data-driven world. Murnane, Willett, and Levy (1995) report that basic cognitive skills, including the ability to follow directions, manipulate fractions and decimals, and interpret line graphs, have become increasingly important predictors of wages due to rising demands in the labor market. Indeed, much of the knowledge acquired in computer-oriented courses (such as the ability to analyze and present data using Excel) can be transferred directly into the marketplace (Raymondo 1996). "Work roles in fields as diverse as personnel, city planning, marketing, and welfare administration require the ability to use research by others intelligently, to conduct simple research, and to collaborate with . . . researchers" (Markham 1991: 464).

Likewise, Wiest and associates (2007: 47, 53) note that QL is linked to social justice: "Without quantitative understanding . . . laypersons may be relatively powerless compared with a small number of individuals with specialized knowledge. . . . Informed political decision-making, retirement planning, active parenting, and the vast majority of choices we make in our personal, occupational, and civic lives can be better served by improved quantitative [reasoning]." Indeed, "the scientifically and mathematically illiterate are outsiders in a society in which effective participation in public dialogue presumes a grasp of basic science and mathematics" (Carnevale and Desrochers 2002: 29). Paulos (2001) notes that innumeracy has social and economic consequences and argues that "innumerate people characteristically have a strong tendency to personalize—to be misled by their own experiences, or by the media's focus on individuals and drama" (6). He also points to a belief in pseudoscience as one consequence of innumeracy.

2. Approaches to QR Instruction

Several organizations have put forth recommendations for QR instruction. For example, the Mathematical Association of America (1998) recommends that all colleges and universities (1) treat QL as a necessary goal for graduates; (2) expect every graduate to apply simple mathematical methods to the solution of real-world problems; (3) devise and establish QL programs that consist of a foundation experience as well as a continuation experience, and (4) accept responsibility for overseeing their QL programs through regular assessments. Dozens of colleges have responded to the QR challenge (Gillman 2006; Steen 2005). Some have instituted foundational QR classes, others have infused QR throughout the curriculum, and still others have adopted both approaches.

Perhaps not surprisingly, Writing Across the Curriculum (WAC) has now found its counterpart in Mathematics Across the Curriculum (MAC). Many scholars have called for a multidisciplinary, active learning approach to QR instruction. (See, for example, Diefenderfer, Doan and Salowey 2006; Fink and Nordmoe 2006; Gordon and Winn 2006; Haines and Jordan 2006; Hartzler and Leoni 204; Hillyard et al. 2010; Johnson 2006; Taylor 2006.) As Steen (2008: 19) states, "The success of writing across the curriculum is an inspiration to those who hope QL will follow in these footsteps."

Briggs (2006) stresses the need for collaborative, multidisciplinary QR efforts. Although QR rests on a solid mathematical foundation (Madison 2004: 4–5), it requires more than mathematical or statistical fluency (Madison and Dingman 2010; Wiest, Higgins, and Frost 2007: 48–49). As Ganter (2006: 13) notes, "QL must be everywhere in the curriculum, in all disciplines and all courses. . . . QL is a shared responsibility." Indeed, a multidisciplinary approach is central to many QR initiatives. "Like learning to write well or speaking a foreign language, numeracy is not something mastered in a single course. . . . Thus quantitative material needs to permeate the curriculum, not only in the sciences but also in the social sciences and, in appropriate cases, in the humanities. . . ." (Bok 2006: 134). Steen (2004a) notes that QL programs should involve faculty from multiple disciplines and that the social sciences may be especially well-positioned to take the lead in QR initiatives (Steen 2002). The recognition that QR is the responsibility of *all* faculty provides the impetus for our current initiative.

3. The Setting: The City University of New York

The City University of New York (CUNY) comprises more than 20 colleges and schools that together enroll 260,000 degree-seeking students. Altogether, 59% of CUNY students are female, and 57% self-identify as black, Hispanic or American Indian/Native American. Nearly 30% of CUNY students are 25 or older, 54% have household incomes of less than $30,000, and 44% are first-generation students (City University of New York 2010). Ten CUNY colleges are among the nearly 500 postsecondary minority-serving institutions identified by the US Department of Education (2007), and five CUNY colleges are members of the Hispanic Association of Colleges and Universities (2012.

Table 1 shows the sociodemographic characteristics of CUNY students. Although there is considerable variation by campus, the majority of full-time students are providing care for others and working for pay even at the most selective CUNY colleges. In many cases, the demands placed on these students outside the classroom are extraordinary. Moreover, CUNY students represent a significant and growing segment of the undergraduate population—students who are older, chiefly female, ethnically diverse, and likely to be working or raising a family. The CUNY colleges are typical of a particular kind of institution—public, urban, and nonresidential—that can be readily identified in community college and university systems throughout the United States (American Association of Community Colleges 2012).

Table 1: Sociodemographic Characteristics of CUNY Students, 2009–10

	Minority[1]	Female	Low inc.[2]	First gen.[3]	Prov. care[4]	Work 21+[5]	SAT rdng.[6]	SAT math[7]
Senior colls.	46	60	46	39	61	23	—	—
Baruch	28	51	43	40	57	26	545	605
Brooklyn	41	60	50	38	59	17	500	535
City	60	52	57	33	59	21	480	495
Hunter	33	67	44	34	62	27	530	550
Lehman	83	70	51	49	63	35	445	450
Queens	28	59	38	38	59	18	500	530
York	74	66	48	52	70	24	415	430
Comp. colls.	57	57	49	46	62	26	—	—
John Jay	67	57	49	41	68	29	460	465
M. Evers	97	74	66	59	76	25	—	—
NYC Tech.	67	48	56	49	59	23	—	—
Staten Isl.	26	57	32	41	52	27	500	510
Comm. colls.	66	58	63	48	58	24	—	—
Bronx	94	60	75	48	55	26	—	—
Hostos	90	69	72	58	64	20	—	—
Kingsbor.	49	55	66	45	69	27	—	—
LaGuardia	59	59	65	44	57	24	—	—
Manhattan	71	59	63	49	49	23	—	—
Queensbor.	53	55	46	50	60	21	—	—
Total, CUNY	57	59	54	44	60	24	—	—

Sources: City University of New York (2010), Grove (2010).
[1] Includes American Indian, Alaska Native, Black (not of Hispanic origin), and Hispanic.
[2] Percentage with household incomes of less than $30,000.
[3] Percentage in the first generation of their family to attend college.
[4] Percentage providing care to another person; refers only to full-time students.
[5] Percentage working for pay 21 or more hours per week; refers only to full-time students.
[6] Estimated median SAT Critical Reading score, 2008. The SAT is required only of incoming first-year students. At some CUNY senior colleges, the majority of students are transfer students.
[7] Estimated median SAT Math score, 2008.

Many students enter CUNY with weak quantitative skills and high levels of math phobia (Peskoff 2000; Wilder 2009, 2010). Many lack the fundamental mathematical skills that are part and parcel of quantitative literacy (Wilder 2009). As shown in Table 1, many incoming students at the CUNY senior colleges have SAT scores well below the median for all college-bound seniors. At some, such as Lehman College and York College, more than 75% of students score below the national median. Ensuring students' quantitative literacy remains a challenge at even the most selective CUNY schools (Collison et al. 2008). For this reason, all the CUNY schools must work hard to ensure that students have achieved a satisfactory level of QR competency.

4. The CUNY QR Alliance

Although several CUNY schools have implemented programs to help promote QL, no system-wide initiative has attempted to infuse QR throughout the curriculum. Likewise, no previous project has involved the large-scale training of QR instructors.

David Bressoud, director of the QR initiative at Macalester College, wrote that such a project "is only do-able and worthwhile if it is something you care deeply about and enjoy" (2009: 11–12). The faculty at CUNY are wholly committed to this initiative, and recent evidence shows that faculty, students and alumni all recognize the importance of QR skills (Wilder 2010). While many of the CUNY campuses have begun QR initiatives, no previous program has brought together faculty from a wide range of disciplines to design a program that teaches faculty best practices for responding to the QL needs of CUNY students. The NICHE project gained the support of the National Science Foundation in the fall of 2011.[2]

5. Lessons from the Quantitative Reasoning Program at Lehman College

The NICHE initiative draws upon an earlier project. From 2010–2012, we offered a series of workshops to infuse QR throughout the curriculum at Lehman College. The workshops were directed by Dene Hurley (Economics) and Esther Wilder (Sociology) with the assistance of two facilitators, Elin Waring (Sociology) and Judith Duncker (Political Science). About a dozen faculty/staff regularly attended the monthly QR workshops during the 2010–11 and 2011–12 academic years. We obtained IRB approval to use our findings for research purposes.

5.1 Motives for Faculty Participation in the Program

Table 2 shows the results of a questionnaire that was administered during the final sessions of the 2010–11 and 2011–12 workshops. Overall, an interest in QR and a concern for students were the most important reasons for faculty participation in the

Table 2: Faculty's Reasons for Participating in the QR Workshop, 2011 and 2012
Please indicate the importance of the following factors in your reason(s) for attending the QR workshop. (Percentage selecting each response.)

	Very imp.	Some-what imp.	Not very imp.	Un-imp.	NR
Interest in workshop topic, 2011	100	0	0	0	0
Interest in workshop topic, 2012	100	0	0	0	0
Concern for students, 2011	90	10	0	0	0
Concern for students, 2012	100	0	0	0	0
Faculty networking, 2011	30	50	20	0	0
Faculty networking, 2012	57	43	0	0	0
Convenient time, 2011	30	30	0	0	0
Convenient time, 2012	14	43	57	0	0
Financial incentive, 2011[1]	30	20	30	0	20
Financial incentive, 2012[1]	0	57	29	14	0

Source: QR workshop questionnaire administered during the final sessions of the 2010–11 and 2011–12 QR workshops.

[1] Of the ten 2011–12 respondents, seven were paid. Among the seven paid respondents, the majority (72%) indicated that the financial incentive was either *very important* (43%) or *somewhat important* (29%).

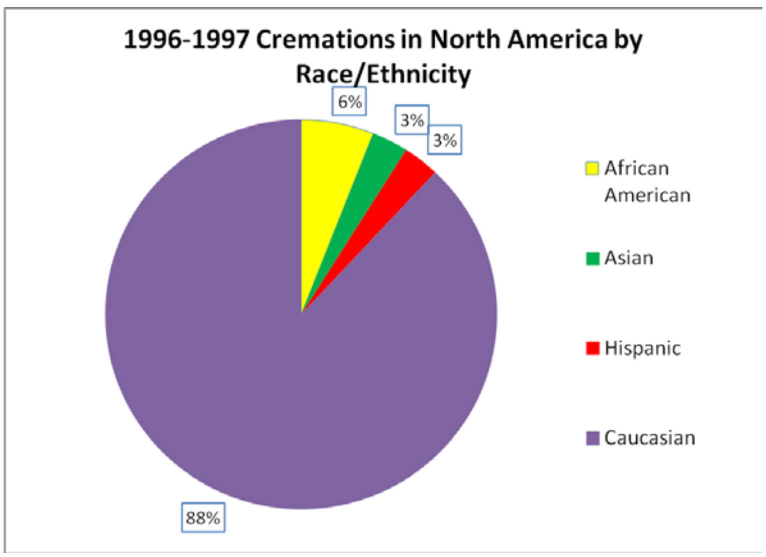
[2] The NICHE Team includes PI Esther Wilder (Sociology, Lehman College), co-PI Dene Hurley (Economics, Lehman College), co-PI Frank Wang (Mathematics, LaGuardia Community College) and approximately a dozen liaisons working throughout the CUNY system.

program. In both 2011 and 2012, 100% of workshop participants indicated that an "interest in [the] workshop topic" was a *very important* reason for their participation. Likewise, 100% of participants pointed to a "concern for students." Faculty networking, a "convenient time," and financial incentives were also identified as important.[3]

5.2 QR Skills of Faculty Participants

During the Lehman QR workshops, it became apparent that some faculty required instruction to build their own QR skills. This key finding has guided our approach to the development of the CUNY-wide NICHE course. During the 2010–11 QR workshops we noticed that some faculty were having problems fully understanding the material; their own QR deficits interfered with their ability to develop assignments and assessment instruments. In 2011–12 we began collecting data on the QR skills of faculty participants.

Figure 1 shows faculty performance on a QR assessment instrument that was administered midway through the 2011–12 workshop series. (The assessment instrument is one that I use in my *Sociology of Death, Dying and Bereavement* course.) The pretest



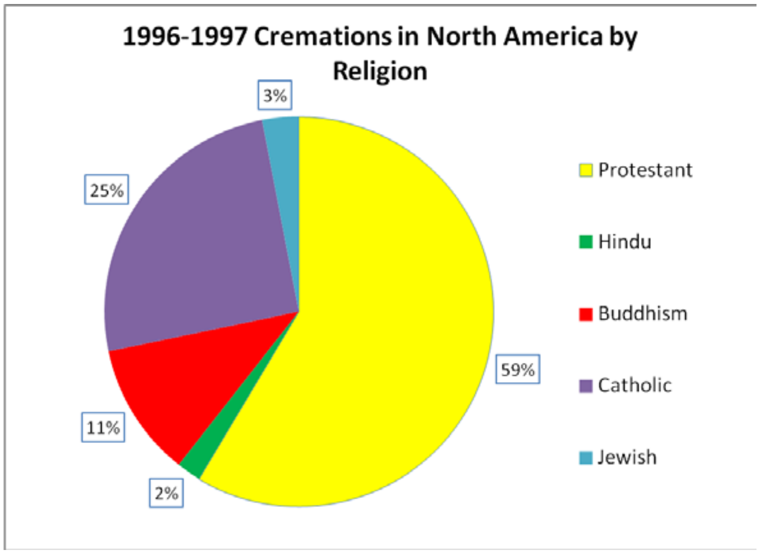
Source: Cremation Association of North America, 1999.

Based on the chart, which of the following is true?
(Faculty responses are in parentheses. Correct answer is in bold.)

(a) African Americans were twice as likely to be cremated than Asians (n=0; 0%)
(b) Asians and Hispanics were equally likely to be cremated? (n=0; 0%)
(c) **On average, 3 out of every 100 cremations were among Hispanics. (n=5; 50%)**
(d) Both (a) and (b) (n=0; 0%)
(e) All of the above (n=5; 50%)

Figure 1: Assessment of Faculty Performance on the QR Pretest Question; n=10 (7 in the sciences, 3 in the humanities).

[3] Faculty were paid $1,500 for their participation in the year-long workshop program. Participants met monthly for approximately 3 hours each session.



Source: Cremation Association of North America, 1999.

Based on the chart, which of the following is true?
(Faculty responses are in parentheses. Correct answer is in bold.)

(a) Jews are slightly more likely to get cremated than Hindus. (n=0; 0%)
(b) Protestants are the religious group most likely to get cremated. (n=2; 20%)
(c) 3% of Jews chose to get cremated. (n=1; 10%)
(d) All of the above (n=0; 0%)
(e) None of the above (n=7; 70%)

Figure 2: Assessment of Faculty Performance on the QR Posttest Question; n=10 (7 in the sciences, 3 in the humanities).

results revealed that 50% of faculty participants in the QR workshop interpreted the pie chart incorrectly. (Faculty indicated their responses to the question using clickers.) After the assessment results were tallied (the clickers yield immediate feedback), we reviewed them and discussed why option (c) was the correct answer. After the discussion, I administered a posttest that I use to assess whether students have learned how to correctly interpret pie charts. On the posttest, 70% of faculty participants chose the correct answer. (See Figure 2.) The faculty did not undertake the QR assignments that my students complete, so the improvement in scores from pretest to posttest (50% correct to 70% correct) is likely to have resulted from our discussion during the workshop.

5.3 The QR Program and the Changing Attitudes of Faculty Participants

To assess the potential impact of the program on the attitudes of faculty participants, we administered questionnaires during the first and last sessions of the 2011–12 QR workshop series (Sept. 2, 2011, and May 18, 2012).[4] As Table 3 shows, the program appears to have influenced participants' opinions in at least three respects:

[4] 2011: n=10; 7 sciences, 3 humanities. 2012: n=10; 6 sciences, 4 humanities. Individuals' responses cannot be compared over time, since two workshop participants were present at the first workshop but not at the final one, and vice versa.

Table 3: Faculty's Attitudes Toward Quantitative Reasoning, 2011 and 2012
(Percentage selecting each response.)

	Agree strongly	Agree some-what	Neither agree nor disagree	Dis-agree some-what	Dis-agree strongly
I have a good understanding of what Quantitative Reasoning is.					
STEM, 2011	29	57	14	0	0
STEM, 2012	83	17	0	0	0
Arts and humanities, 2011	0	0	0	100	0
Arts and humanities, 2012	100	0	0	0	0
Total, 2011	20	40	10	30	0
Total, 2012	90	10	0	0	0
I feel confident in my Quantitative Reasoning skills.					
STEM, 2011	43	43	14	0	0
STEM, 2012	100	0	0	0	0
Arts and humanities, 2011	0	67	0	33	0
Arts and humanities, 2012	25	75	0	0	0
Total, 2011	30	50	10	10	0
Total, 2012	70	30	0	0	0
I place a heavy emphasis on QR in my course instruction.					
STEM, 2011	14	43	14	14	14
STEM, 2012	67	33	0	0	0
Arts and humanities, 2011	0	0	33	33	33
Arts and humanities, 2012	25	25	25	25	0
Total, 2011	10	30	20	20	20
Total, 2012	50	30	10	10	0
QR has strong relevance to my discipline.					
STEM, 2011	100	0	0	0	0
STEM, 2012	100	0	0	0	0
Arts and humanities, 2011	33	33	0	33	0
Arts and humanities, 2012	50	0	25	25	0
Total, 2011	80	10	0	10	0
Total, 2012	80	0	10	10	0
QR is an important component of general education.					
STEM, 2011	100	0	0	0	0
STEM, 2012	83	17	0	0	0
Arts and humanities, 2011	100	0	0	0	0
Arts and humanities, 2012	100	0	0	0	0
Total, 2011	100	0	0	0	0
Total, 2012	90	10	0	0	0
Quantitative Reasoning is a fun skill to teach.[1]					
STEM, 2011	43	43	0	14	0
STEM, 2012	50	33	0	17	0
Arts and humanities, 2011	50	0	50	0	0
Arts and humanities, 2012	25	50	0	25	0
Total, 2011	44	33	11	11	0
Total, 2012	40	40	0	20	0

Source: QR workshop questionnaire administered during the first and last sessions of 2011–12.

[1] At the first 2011–2011 QR workshop, one faculty member in the humanities indicated "don't know" in response to this statement. That response is not included in these tabulations.

- During the first session, 60% of faculty agreed (either *strongly* or *somewhat*) that they had "a good understanding of what Quantitative Reasoning is." By the end of the workshop, 100% of respondents agreed with the statement.
- In September 2011, 80% of participants felt "confident in [their] Quantitative Reasoning skills." By the end of the academic year, 100% felt confident in their skills. The change is likely to have resulted from the several hands-on QR exercises that faculty completed during the workshop.
- From the first session to the last, the percentage of faculty who "place a heavy emphasis on QR in [their] course instruction" rose from 40% to 80%. Throughout the workshop series, faculty participants developed QR exercises and assessments that they integrated into their courses. That is, respondents' answers to this question are consistent with their behavior.

Although the math and science faculty universally agreed that "QR has strong relevance to my discipline," a greater percentage of humanities faculty agreed with the statement in September 2011 (67%) than in May 2012 (50%). This shift may reflect the presence of an additional humanities faculty member who disagreed with the statement in May 2012 rather than any systematic change in attitudes.

Table 3 also reveals two areas in which the QR workshops did not have a substantial impact. First, the percentage of respondents who felt *strongly* or *somewhat* that "QR is important component of general education" did not change from Fall 2011 to Spring 2012. The absence of a change is not surprising, however, since all the participants agreed with the statement even at the first session. Their favorable attitudes toward QR may simply reflect self-selection among program participants.

Secondly, the percentage who agreed that "Quantitative Reasoning is a fun skill to teach" did not change appreciably over the course of the workshop series. At the start of the program, 78% of participants agreed with the statement either *strongly* or *somewhat*; at the end of the program, 80% did. The two faculty who disagreed with the statement in May 2012 both elaborated on their responses. A biology faculty member stated that QR instruction is a challenge because students struggle so much with the material. Likewise, a faculty member in English wrote that students' resistance to QR is especially strong in humanities courses: "I have frequently used data for writing assignments but I realized during this workshop that I was not providing any support for students. (I didn't realize that they needed support for both the math and the reasoning.). . . . To get students to think quantitatively in a humanities course I have to make sure that the QR is relevant."

6. Teaching QR: Voices of the Faculty

Table 4 presents the results of a questionnaire administered to all faculty participants during the final sessions of the 2010–11 and 2011–12 workshops (May 2011 and May 2012). The 2011 sample (n=10) includes eight faculty in the sciences (including math and the social sciences), one in the humanities, and one staff member (the director of the Lehman College Tutoring Center). The 2012 sample (n=10) includes six faculty in the sciences and four in the humanities.

Specifically, Table 4 shows the pedagogical strategies that faculty regard as most (and least) important for teaching QR. Several strategies were regarded as especially important

Table 4: Faculty's Views on the Importance and Likelihood of Using Various Strategies for QR Instruction, 2011 and 2012

Please rate what you perceive to be the importance of each of the following for teaching QR to Lehman to students and indicate your likelihood of using each approach.

(Percentage selecting each response.)

Importance for Lehman College students	Very imp.	Some-what imp.	Un-certain or neutral	Some-what un-imp.	Very un-imp.
Active engagement in data analysis, 2011	80	20	0	0	0
Active engagement in data analysis, 2012	100	0	0	0	0
Pairing QR w/ writing/crit. reading, 2011	80	20	0	0	0
Pairing QR w/ writing/crit. reading, 2012	86	14	0	0	0
Revision of QR assignments, 2011	60	40	0	0	0
Revision of QR assignments, 2012	71	29	0	0	0
Assessment of QR learning, 2011	70	30	0	0	0
Assessment of QR learning, 2012	86	0	14	0	0
Computer software programs, 2011	40	50	10	0	0
Computer software programs, 2012	43	43	14	0	0
Collaborative student QR work, 2011	30	40	30	0	0
Collaborative student QR work, 2012	71	29	0	0	0
Using media sources to do QR, 2011	40	40	20	0	0
Using media sources to do QR, 2012	71	14	14	0	0
Web-based data analysis tools , 2011	30	20	50	0	0
Web-based data analysis tools, 2012	14	57	29	0	0
Audience response system (clickers), 2011	10	10	60	10	10
Audience response system (clickers), 2012	29	43	29	0	0
Likelihood of using in my own instruction	Very likely	Some-what likely	Un-certain or neutral	Some-what un-likely	Very un-likely
Active engagement in data analysis, 2011	78	22	0	0	0
Active engagement in data analysis, 2012	100	0	0	0	0
Assessment of QR learning, 2011	89	11	0	0	0
Assessment of QR learning, 2012	100	0	0	0	0
Pairing QR w/ writing/crit. reading, 2011	78	22	0	0	0
Pairing QR w/ writing/crit. reading, 2012	86	14	0	0	0
Collaborative student QR work, 2011	33	56	11	0	0
Collaborative student QR work, 2012	86	14	0	0	0
Revision of QR assignments, 2011	44	44	11	0	0
Revision of QR assignments, 2012	71	29	0	0	0
Using media sources to do QR, 2011	56	22	11	11	0
Using media sources to do QR, 2012	71	29	0	0	0
Computer software programs, 2011	56	22	22	0	0
Computer software programs, 2012	29	29	43	0	0
Web-based data analysis tools, 2011	33	33	11	22	0
Web-based data analysis tools, 2012	0	43	71	0	0
Audience response system (clickers), 2011	0	11	56	11	22
Audience response system (clickers), 2012	43	29	14	14	0

Source: QR workshop questionnaire administered during the final sessions of the 2010–11 and 2011–12 QR workshops.

in both 2011 and 2012: (a) active engagement in data analysis, (b) pairing QR with writing and/or critical reading, (c) the revision of QR assignments, (d) the assessment of QR learning, and (e) the use of computer software such as Excel. In 2012, faculty also emphasized the importance of collaborative student work and the use of media resources. By and large, these are the same strategies that faculty plan to use in their teaching.

Faculty were also asked whether their approach to QR teaching had changed as a result of the program. Many of their comments addressed this theme. For example, a faculty member in Economics and Business (2011) wrote, “This workshop allowed me to appreciate the importance of pairing QR with writing and/or critical thinking.”

Many of the faculty’s comments also spoke to the importance of QR assessment. When asked whether they were likely to assess QR learning in their own instruction, 100% of faculty in both 2011 and 2012 indicated that they were likely to do so. Indeed, many of their comments stressed the importance of assessment. For example, one Sociology faculty member (2011) wrote, “I benefited greatly from thinking about students and assessment.” Likewise, a faculty member in Health Sciences (2012) wrote, “I strongly believe that a foundational QR course and a screening test that assesses students’ QR skills and regular assessment of student learning would be a good start for a successful QR program at Lehman.” Another faculty member, from Philosophy (2012), wrote, “I am convinced of the advantages of assessment in general.”

Several faculty mentioned the importance of infusing QR throughout the curriculum rather than concentrating on QR in just a few courses. For instance, an adjunct faculty member in Mathematics (2012) wrote, “I see the necessity of using QR in all my classes and I will try to incorporate QR in every class. Instructors should be trained to see the importance of QR in all their classes.” Likewise, a faculty member in Economics and Business (2012) wrote, “I have always valued QR but had little confidence that I could transfer my values to my students. This workshop emboldened me to challenge my students by daring to teach the skills and [requiring] them to use them.”

Faculty participants were also asked to identify the components of QR instruction that are most important for the education of Lehman College students. As Table 5 reveals, most respondents indicated that nearly every component of QR instruction is important. (In both 2011 and 2012, at least 70% of respondents answered *very important* or *somewhat important* for every item.) There is some variation in the percentage who answered *very important*, however. By that standard, the most important elements of QR instruction are (a) wide and multidisciplinary QR participation, (b) the blending of QR instruction and writing instruction, (c) a screening test that assesses students’ QR skills, (d) a QR tutoring center, (e) regular assessment of student learning, (f) a standard set of QR learning objectives, and (g) a foundational QR course. According to these respondents, the less important elements of QR instruction include discipline-specific learning objectives, tiered QR instruction, and QR courses with lab components.

Faculty echoed many of these themes when asked how to develop a successful QR program at Lehman College. For example, an adjunct faculty member who teaches a variety of courses (2011) stated that “blending QR with critical writing is crucial.” A faculty member in African and African-American Studies (2012) wrote, “I think a faculty program modeled on this workshop & institutionalized like WAC [Writing Across the

Table 5: Faculty Views on the Importance of
Various Approaches to Teaching Quantitative Reasoning, 2011 and 2012
[These] QR initiatives . . . have been implemented at many different colleges and universities. Please indicate what you perceive to be the importance of each of the following here at Lehman College. (Percentage selecting each response.)

Importance for Lehman College students	Very imp.	Some-what imp.	Un-certain or neutral	Some-what un-imp.	Very un-imp.
Active engagement in data analysis, 2011	80	20	0	0	0
Active engagement in data analysis, 2012	100	0	0	0	0
Wide & multi-disciplinary participation, 2011	80	0	0	20	0
Wide & multi-disciplinary participation, 2012	86	14	0	0	0
QR and writing (blended) requirement, 2011	80	10	0	0	10
QR and writing (blended) requirement, 2012	71	29	0	0	0
Screening test that assesses QR skills, 2011	80	0	10	10	0
Screening test that assesses QR skills, 2012	71	29	0	0	0
QR tutoring center, 2011	70	10	20	0	0
QR tutoring center, 2012	71	14	14	0	0
Regular assessment of student learning, 2011	80	20	0	0	0
Regular assessment of student learning, 2012	57	43	0	0	0
Standard set of QR learning objectives, 2011	60	40	0	0	0
Standard set of QR learning objectives, 2012	71	29	0	0	0
Foundational QR course, 2011	70	20	0	10	0
Foundational QR course, 2012	57	29	14	0	0
Discipline-specific QR learng. objectives, 2011	40	30	30	0	0
Discipline-specific QR learng. objectives, 2012	57	43	0	0	0
Different tiers of QR across the curric., 2011	30	40	20	10	0
Different tiers of QR across the curric., 2012	43	57	0	0	0
QR courses with lab components, 2011	40	60	0	0	0
QR courses with lab components, 2012	29	57	14	0	0

Source: QR workshop questionnaire administered during the final sessions of the 2010–11 and 2011–12 QR workshops.

Curriculum] is ESSENTIAL to the success of Lehman's QR initiative." A few respondents also mentioned the need to allay instructors' fears about quantitative work. As a faculty member in the Department of Sociology (2011) wrote, "I think really dealing with faculty math anxiety will be a big goal."

Throughout the NICHE program, we will focus not only on teaching faculty how to provide instruction for QR, but on strengthening the faculty's own QR skills and making them more comfortable with quantitative tasks. Each unit of the course will focus on a different skill (interpreting graphs, using percentages and rates to reach conclusions, etc.).

7. The Future of the NICHE Project

The primary outcome of the NICHE project will be an online course that teaches faculty how to infuse QR into existing courses. Like the Lehman QR workshop and the Macalester College program, NICHE will "assist faculty from all disciplines to understand the relevance of quantitative methods to their own scholarship, and enable them to make connections to quantitative methods in their classes" (Bressoud 2006: 24).

The NICHE program will build on the knowledge we have gained from our experience directing the 2010–11 and 2011–12 QR workshops at Lehman College. It will focus not only on teaching faculty how to provide QR instruction, but also on strengthening the faculty's QR skills and overcoming their own QR anxiety. Five learning outcomes are designed to ensure that by the conclusion of the course, faculty learners will be able to

- apply Quantitative Literacy/Quantitative Reasoning within a disciplinary context
- articulate QR learning goals/objectives that reflect best practices for teaching quantitative literacy
- identify and implement best practices for teaching QR: active learning, collaborative student learning, writing with numerical information, etc.
- adapt and implement strategies for incorporating QR into course instruction
- assess the effectiveness of QR initiatives and use the results to improve instruction.

The course will make use of the same pedagogical approaches that have proven effective for teaching QR to undergraduates. Faculty learners will review and critically evaluate samples of student technologies that facilitate the online discussion of course materials. Finally, faculty who enroll in NICHE will be assigned to QR networks at their home institutions work, undertake QR assignments, and gain practical experience using QR assessment instruments. They will engage in collaborative learning through Blackboard, Voicethread, and other so they can further explore how their courses fit into the broader goal of ensuring that students graduate with the QR skills deemed essential by their colleges. Our aim is to build a sustainable, CUNY-wide community of faculty with QR teaching experience—faculty who can lead further campus-specific initiatives while drawing on the expertise of their QR-focused colleagues at the other CUNY colleges.

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