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Going Public: What Institutional Moments Bring Everyone to the Table?

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Introduction

Quantitative literacy (QL), as distinguished from mathematical literacy, has been part of the educational landscape since at least 1968 (Steen, 2001; Scheaffer, 1990), and the public mandate for teaching skills that we now identify as QL is at least as old as the 1970s (Zacharias, 1972; Muller, 1974). But the growth of programs, curricula, and support for QL in higher education has been especially dramatic in the 21st century, accelerated by both a more ready access to information about existing programs and professional networks of support. Indeed, as consensus that QL itself is a "situated convergence of the practices of different communities" to engage with quantities has come into focus (Fisher, YEAR), so too has there been a convergence of practices in the diverse communities of educators engaged in the teaching and support of QL skills.

Despite the intellectual and professional leadership of organizations such as the Mathematical Association of America and National Numeracy Network in defining what QL is and how it *may* be taught, supported, and assessed, there have until recently been few mandates that specify what, if any, QL *must* be present at a given institution. With little national, state, or system-level coordination, programs for quantitative literacy in higher education have emerged mostly organically and have a wide diversity of scopes and sizes across institutions. Each institution has discovered and responded to its need for QL programming on its own timetable and in its own way (Gillman, 2006a). Yet, like many processes of wide-scale institutional change, this has not been a methodical, incremental process on many campuses; instead, QL programs tend to emerge from particular "moments" of crisis in an institution's life cycle. Because of the broad scope of quantitative literacy, the broad engagement of stakeholders from across disciplines and divisions required to initiate and sustain the work can be difficult to achieve in the absence of exigent circumstances.

The history of emergent programs in quantitative literacy seems to have been one of "going public," both on the long timescale in which programs which first emerged at small private institutions have been spread into larger sectors of higher education, and in the sense that at each institution campus change agents have been required to engage many "publics" in the work. In this chapter, we identify and explore some of the more common types of exigencies that have led to the growth of QL programs at institutions and trace their prevalence through the literature. We also explore the range of institutional responses to fit the need, and offer a study of the case of Hamilton College's program, which illustrates the complex dynamics at play when all parties are brought to the table. We conclude with four questions for proponents of QL to

consider when attempting to establish a QL program of their own that marries the "stable core" of quantitative literacy with the unique features of their institution's "shifting context."

Defining a "QL Program"

There are as many ways to design and implement a QL program as there are institutions who have or will do so. However, *Quantitative Reasoning for College Graduates: A Complement to the Standard* (Sons, 1996) defines a "QL Program" as having the following characteristics:
1) Explicit requirements of quantitative experience for college entry or for entry into courses or experiences which can be credited toward the baccalaureate degree;
2) Placement testing intended to help determine appropriate entry into the quantitative literacy program;
3) Foundation experience(s) to be accomplished ordinarily within the first year of the student's college work;
4) Further quantitative experiences in diverse contexts to be accomplished during a student's sophomore, junior, and senior college years so as to be interspersed throughout the work of these years.

In our examination of the literature, we did not find many explicit references to entrance exams or placement testing, though we assume these to be in place as they are standard at most institutions. Instead, we examined institutions who placed an emphasis on providing "quantitative experiences in diverse contexts" by expanding QL beyond the discipline of traditional mathematics.

Institutional Calls to Action Around QL

Professional organizations such as the Association of American Colleges and Universities (AAC&U), Mathematical Association of America (MAA), National Numeracy Network (NNN), and National Council of Teachers of Mathematics (NCTM) have each offered definitions of quantitative literacy that, because of the essential role played by contextual reasoning skills, emphasize its cross-disciplinary nature. Balancing the various needs and incentives of faculty (especially across disciplines), students, administrators, accreditors, and alumni is a difficult and often slow process that necessitates a "cultural approach" to institutional change that is responsive to the individual context in which each campus operates (Kezar & Eckel, 2002).

Overcoming institutional inertia to establish a QL program requires campus engagement from faculty and staff across various and somewhat disparate disciplines; a task that would theoretically prove more challenging at larger institutions with more requisite participants. Perhaps for this reason it is widely believed that the earliest QL programs appeared mostly in small, private colleges and that the movement grew to larger, public institutions later. Indeed, five private institutions are consistently cited as the inspirations for the development of QL programs at other schools (Gillman, 2006a): St. Olaf College, Mount Holyoke College,

Dartmouth College, Wellesley College, and Alverno College. Whether this is reflective of an actual trend of QL moving from private to public institutions, however, has not previously been investigated in the literature.

To test the hypothesis that QL programs were over-represented in private institutions, we recorded the Carnegie classification of every institution whose QL program was referenced in the literature up to the 2006 publication of *Current Practices in Quantitative Literacy* (Table 1), and compared this proportion of public and private institutions with the overall national proportion using a chi-square goodness of fit test. Private for-profit institutions were omitted as there were no descriptions of any QL programs in the literature from such institutions. Few community colleges were found in the literature prior to 2006 (see Hartzler & Leoni, 2006, for an exception), but Getz et al. (YEAR) offer further insights on more recent developments in two-year institutions.

Private institutions comprised the majority (26 of 41, 63.4%) of institutions with QL programs in the literature reviewed. Compared to the national proportion (1731 of 3377, 51.3%), the difference in the proportion of public versus private not-for-profit institutions in the literature from that in the country on the whole was not significant ($\chi^2 = 2.02$, $p = 0.1194$). Thus it seems that despite the widespread attribution of QL programs to work that originated in private institutions, the prevalence of implemented QL programs was representative of the national public/private distribution as of the 2006 publication of *Current Practices*. This finding shows that the end of the 21st century was a time of great growth which resulted in the propagation of QL programs in institutions of all types, but especially in those with public funding. In this period of growth, what conditions or moments in an institution's life cycle have most readily given rise to the formal development of QL?

While conversations around QL may begin at a smaller scale as in, for example, with the collaboration of faculty who teach statistics courses in order to improve student success (Hillyard, 2006), there are some institutional moments that by their nature trigger the kinds of broader conversations necessary for larger-scale change. Chief among these are proposals to revise requirements for graduation or general education. In nearly every case in the literature where a rationale for change was documented, the implementation of a QL program was preceded by a faculty review of the general education requirements. These reviews were precipitated by a variety of different events, from major changes in institutional identity, as in the cases of Farmingdale University (Gordon & Winn, 2006) and Dominican University (Coe & Ziesler, 2006), to the ripple effects of smaller faculty conversations around graduation requirements, such as the former college algebra requirement at Virginia Commonwealth University (Ellington & Haver, 2006). Indeed, rarely has an institution brought a new QL program into being without eventually confronting revisions to its general education requirements writ large, with the program at the University of Nevada - Reno being an apparent exception (Johnson, 2006).

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In recent years, institutional accreditation has had an increasing role in necessitating work around quantitative literacy in general education. The Association of American Colleges and Universities' LEAP project has been highly influential in identifying QL as an essential competency for liberal education (Vacher, 2011), and some multi-campus accrediting organizations have since identified quantitative literacy or quantitative reasoning as a core expectation for all undergraduate students (WASC, 2013). Since re-accreditation is an ongoing institution-level priority that relies on partnerships between faculty and administrators, the role of the emergence of QL in the accreditation context cannot be understated in its ability to bring wide groups of stakeholders to the table.

However, accreditation has rarely been singled out in the literature as a primary motivator of curricular change. More often, institutions credit their faculty having made a decision regarding the curriculum (Diefenderfer, Doan & Salowey, 2006; Fink & Nordmoe, 2006; Bukowski, 2006). Given the growing prominence of QL in accreditation standards, we suspect that this external pressure may become increasingly responsible for precipitating such faculty decision-making in the future.

Additional sources of exigencies in the literature that have lead to the development of QL programs include those that result in a change in the makeup of the student body of an institution. While this can occur gradually over time, as in with Hamilton College in the 1980s, these changes can come more suddenly as well. Whether due to an institutional reclassification as with Dominican University (Coe & Ziesler, 2006), or a merger between institutions as Hamilton and Kirkland Colleges underwent in the 1970's (Smith, personal correspondence 2016), these moments necessitate a review of the purpose and mission of a given institution. Consideration of curricular demands and needs follows from this, and can provide a ripe opportunity for the development of a QL program of some form.

How Institutions Fit their Response to their Need

Pressure for stronger quantitative reasoning skills among college graduates has mounted in recent years, exerted on higher education by the needs of the skilled workforce (Carnevale & Desrochers, 2003), accreditors (WASC, 2013), and economic development organizations (OECD, 2013). An institution's response to these needs, however, may originate in many corners of the campus: from administrators who want external accountability for students' QL skills, from academic support centers facing an unmet demand for tutors to work with students in QL-rich courses, and from faculty members themselves -- particularly outside of the mathematics department -- lamenting students' apparent QL skill deficits or inappropriate requirements in hallway conversations (eg. Ellington & Haver, 2006). Perhaps because of the variety in the sources of initiatives to develop new QL programs, the forms of institutional responses vary as well, though most will in some way address graduation requirements, new QL courses and course components, learning outcomes assessment, support for student learning, or support for faculty professional development.

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Graduation Requirements

While most schools have a standard for competency in mathematical skills as an entrance requirement, as in a minimum score on the SAT, many also include mathematical reasoning as a general education requirement. Such requirements are typically satisfied by a combination of exam scores or courses taken for credit at the institution. However, mathematical reasoning *per se* is an insufficient proxy for quantitative literacy (Steen, 1999).

The simplest course of action, then, seems to be to replace a previously existing “mathematics” requirement with a “quantitative reasoning” requirement. As with mathematical reasoning, these requirements may be met by passing an exam, as at Juniata College (Bukowski, 2006), University of Massachusetts Boston (Mast & Pawlak, 2006), or historically at Hamilton College (Kantrowitz & O’Neill, 2006). Increasingly, however, institutions have developed a course or courses specifically to meet that end. Examples abound, like the “Problem Solving” course at Point Loma Nazarene University (Jimenez & Zack, 2006) or the “Quantitative Reasoning and Informed Citizenship” at Moravian University (Sevilla & Somers, 2006). These courses have supplemented and, in some cases, supplanted courses such as college algebra which traditionally focus to a greater extent on mathematical reasoning.

Development of QL “overlay” courses

While many examples of courses addressing foundational QL skills exist, they are not on their own sufficient for what Gillman (2006a) describes as a full QL program, namely, various implementations of QL embedded in context throughout the curriculum. To this end, many successful QL programs have developed courses on a myriad of other topics that infuse, interlace, or embed QL skills into those courses. These can be existing courses that get re-tooled or entirely new courses altogether. A model originating at Wellesley College that has proven to persist is to offer a “little q” course oriented around basic mathematics and QL skills and “Big Q” or “overlay” courses (Taylor, 2006). The Big Q courses are about topics within majors and disciplines, but have an emphasis on application of quantitative reasoning to these other disciplines. This model has been the inspiration for other institutions like Hollins University (Diefenderfer et al., 2006) and the University of Washington Bothell (Hillyard, 2006), and persists to this day. In fact, similar models have been used by both Skidmore College (Steen, 1999) and Lawrence University (Haines & Jordan, 2006), with Big Q course following a traditional mathematics-type first course at Babson College (Steen, 1999).

Assessment

Wherever QL skills occur in a student’s experience, there is a need to evaluate the extent of their success in those skills. Evidence-driven assessment of student learning outcomes does not feature in the MAA’s earliest definitions of the components of a QL program. Indeed,

assessment culture in higher education is largely a 21st-century phenomenon (NCPPHE, 2000), and increasing expectations from accrediting organizations and state funding agencies have spurred assessment efforts from the course-level to the institution-level and even beyond. The recent literature on assessment of quantitative literacy is rich and continues to grow, and efforts have been developed to measure these outcomes through skills tests (Gaze et al. 2014), within QL courses and programs (The QR Program at Wellesley, 2005), within multidisciplinary portfolios of student writing (Grawe, Lutsky, & Tassava, 2009), and within a "state of nature" where no quantitative prompt is given (Boersma & Klyve, 2013). Assessment data can both inform campus conversations around QL skill attainment, as well as lead them, providing evidence of need for new supports, programming, and even new courses (Kantrowitz & O'Neill, 2006).

Support for Student Learning

Whether triggered by an external assessment, as found during re/accreditation or during a top-down review by a central state agency, or developed independently within an institution, acknowledgement of a need for developing student quantitative reasoning skills can arise. To address the need to support students' quantitative reasoning skills in a wide range of courses across the disciplines, many institutions have established campus-wide "quantitative support centers" (QSCs). These centers typically provide individual and/or small-group tutoring, with the operation of the center and the recruitment and training of its tutors typically overseen by a professional staff or faculty director.

The campus-wide nature of the support being offered usually situates QSCs outside of academic departments and in proximity to other campus-wide learning supports such as writing centers. This autonomous model typified the structure of the quantitative reasoning programs in a survey of twelve small, selective private colleges (Karaali et al., 2010). QSC staff may also partner with academic departments in the coordination of quantitative reasoning curricula and course offerings, especially in cases where a faculty liaison or faculty director oversees the center, and in these cases may engage in leading faculty development as well (Salomone & Bjorge, 2016).

Support for Faculty Development

Certainly any change in curriculum requires support from some or all of an institution's faculty, and that often requires support *for* the faculty. Faculty support is offered in a variety of ways, and often depends on the changes being implemented at the institution. For the development of new courses, and the overlaying of existing courses, stipends may be offered, often provided through National Science Foundation grants, such as at NYU, Sam Houston State University, and University of Nevada Reno (Johnson, 2006). The Washington Center at The Evergreen State College offers faculty-driven workshops, and has found bringing respected speakers from

other campuses can help faculty across disciplines to see the value of quantitative literacy (Hillyard, 2006).

At the University of Washington Bothell currently, the director of the Quantitative Skills Center meets with primarily Interdisciplinary Arts and Sciences faculty one-on-one to develop quantitative assignments that bolster and augment the instructor's qualitative goals. In one such assignment, students analyze the quantitative evidence from a scientific paper about gender, and are encouraged to try different ways to visually represent the data. In a different series of workshops, students play an academic version of "The Hunger Games" (Collins 2008) to get an intuitive feel for probability and risk. The students are assigned aliases from different "districts," in which in-class performance affects one's entries into a public quiz on course content. As another example, the director of the QSR Center at Hamilton College, with the support of a faculty advisory committee, has recently begun to assist faculty in the social sciences and humanities to develop and incorporate relevant QL content into pre-existing courses.

Bridgewater State University began its support for quantitative reasoning with a faculty development initiative called Quantity Across the Curriculum ("QuAC"). QuAC has given support to individual faculty teaching and developing courses with quantitative content in the disciplines, as well as to institutional research and assessment efforts around QL. An absence of learning outcomes behind the quantitative skills requirement, however, has necessitated much work to create an institutional conversation around the nature of quantitative literacy, raising awareness of its complementary relationship to mathematics in preparation for subsequent work to revise the general education requirements at the institution..

A Complex Interplay of Responses: The Case of Hamilton College

While what has been described above is indicative of the most common practices, things are rarely so straightforward. We offer a bit of insight into the long history of QL at Hamilton College to illustrate how incorporating a truly cross-curricular program required multiple campus-wide conversations initiated by the types of exigencies discussed above.

Hamilton's early explorations into QL began as a response to factors both at the grassroots and the institutional level. On one hand, faculty members, primarily in the economics department, who were concerned about students' poor performance with quantitative skills sought a grant in 1978 from the IBM Corporation to fund a multi-year skills assessment and remediation project (Kantrowitz & O'Neill, 2006). This assessment-first approach is notably different from later programs at Hollins and Wellesley which redesigned course content prior to institutional assessment efforts.

Meanwhile, in the same year, previously all-male Hamilton College merged with neighboring all-female Kirkland College to form a coeducational institution. This change in the makeup of the student body was one motivator for examining QL according to those involved with the initial

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project (Smith, personal communication, October 4, 2016). As Hamilton's more traditional focus on the liberal arts met Kirkland's more contemporary emphasis on humanities, the merger of colleges necessitated a new integration of educational philosophies that led to the development of formal educational goals in the mid-1980s. These goals were implemented alongside the introduction of a "QSkills" exam in 1984, one of the recommendations of the so-named Quantitative Literacy Project funded by the IBM Grant. As such, this change was intrinsically motivated and faculty-driven, even in the presence of external catalysts.

Another recommendation of the QL Project was the establishment of a Quantitative Literacy Center (Quantitative Literacy Committee of Hamilton College, Memorandum to Committee on Academic Policy, May 24, 1984), which was ultimately established in 1990. Its original mission was to support students preparing to meet the QSkills exam requirement, though it soon began to also provide tutoring for students taking courses with quantitative content. By 1996, students could satisfy the QL graduation requirement through successfully achieving a minimum score of 50% on the QSkills exam, successfully completing a series of QLC tutorial sessions, or completing one of the credit-bearing courses for which the QLC provided tutoring support (Kantrowitz and O'Neill, 2006). Later, the faculty voted to eschew distribution requirements in favor of an open curriculum. In 2004 the QSkills exam became fully optional, then was retired with the entering cohort of 2009. In the same year, the faculty voted to adopt a Quantitative and Symbolic Reasoning (QSR) course requirement, which is still in place as of this writing.

The QSR designation expanded on the notion of quantitative literacy in allowing adequate amounts of formal symbolic manipulation, graphical representation, as well as mathematical and statistical analysis to qualify a course as QSR. Students must now complete one such course before the end of their second year. These courses are found in a variety of disciplines which include philosophy, theatre, sociology, and dance and movement studies in addition to the traditional math, science, and economics. The rebirth of QL as QSR at Hamilton occurred very shortly before another revision of the campus Educational Goals in 2011, which now include: "Analytic Discernment — analyzing information, patterns, connections, arguments, ideas, and views *quantitatively and symbolically*" (Hamilton College, 2016, emphasis added). The QL Center was rebranded as the Quantitative and Symbolic Reasoning Center, a source for tutoring students in designated courses and independent statistical research projects, as well as for helping faculty design quantitative course content.

Hamilton's own transition from assessment, to skills testing as a requirement, to course requirements, reflects some of the more common exigent circumstances leading to the implementation of QL content, but with significant overlap in models of execution and a blurring of the lines between different models. The evolution of QL/QSR at Hamilton can serve as a reminder for those seeking to develop content at their own institutions that while useful to consider the most relevant factors, the path in developing such a program can be long and far from clearly defined. Ambiguity notwithstanding, there are certain considerations worth taking

when embarking on effecting change for the development and implementation of QL programming.

Considerations for QL Program Implementation

While descriptions of, and suggestions for, QL programs abound (Sons 1996, many other chapters in this and the previous volume), those aspiring to initiate a QL program may consider the following four questions:

1) What conversations are currently, or could be, occurring at our institution that would bring together stakeholders from multiple disciplines and campus roles?

The revision of graduation requirements and/or a general-education curriculum are overwhelmingly cited as the exigency giving rise to new or revised QL programs. Because graduation requirements affect the educational experience of all of its students, these requirements encode an institution's most deeply-held cultural values, such as what knowledge and skills it views as most "worth having," and therefore what social and practical value is assigned to the credentials it awards. These requirements also drive every aspect of the educational experience at an institution, from the courses offered by academic departments to the content taught by faculty members in those courses and the means by which the institution assesses that content (and, by extension, assesses the faculty and the departments who teach them). Revision of these requirements poses a unique opportunity to bring together stakeholders across all divisions of an institution.

Other conversations that bring people of multiple campus roles to the table may include those surrounding institutional image or branding, shifts in student demographics or demands, revised models of developmental mathematics education, and how to meet accreditation standards, among others.

2) What role could or should our Mathematics Department play in the development and implementation of our QL Program?

While QL requirements and programs are by nature defined, designed, and delivered as shared responsibilities across departments (Gillman, 2006a), mathematics faculty are crucial stakeholders in developing and maintaining such programs. The institutional momentum of a large mathematics department, and the expertise and engagement of its faculty, can provide a powerful push for QL program implementation. Finding champions within the department and clearly defining their role in the wider campus conversation are necessary steps to ensure this push occurs in a forward direction.

Mathematicians as a rule are keenly aware of the distinction between mathematical reasoning and quantitative reasoning, and an initiative to elevate one may be received as a threat to the

other. At least one faculty "champion" within the department is essential to speaking to his or her colleagues' apprehensions on the one hand, and ensuring on the other hand that the voice of the department is present in the design of QL courses and programs. These liaisons are sometimes found among mathematicians with disciplinary specialties in applied mathematics or statistics. They may also be faculty members in any subfield of mathematics who are most engaged with the institution's general education program.

Defining the role of this liaison with respect to the wider campus conversation is critical. Recent sentiment in the literature favors a model not of ownership, but partnership across disciplines. Neil Lutsky has suggested that mathematicians function more as "librarians" than leaders: as a nexus of information and resources that brings together a faculty conversation across many departments (Madison & Steen 2009). Even in the majority of institutions surveyed by the MAA's SIGMAA-QL group whose quantitative reasoning requirements necessarily included one or more courses taught by a mathematics department (Schield, 2010), the work of mathematics faculty across disciplines is critical to ensure these skills are appropriately supported and reinforced in a wider variety of contexts in other courses.

3) How can we liaison with existing support services for students?

Regardless of the form a QL program might take, considerations for providing student support are necessary. As most schools provide some form of academic support, whether peer or professional, there is no need to reinvent the wheel when developing support for QL.

For institutions which have pre-existing academic support for mathematics, there will likely be overlap in the goals between established support centers and any new initiatives. Rather than duplicating services or generating competition (real or perceived), consider expanding the function of the existing center to include intentional support for QL. Even established non-quantitative support centers can serve as allies through shared staff training, data management and usage tracking, as well is in marketing and referrals. Maintaining positive ties with all academic support programs can help build a cohesive student experience and a collaborative culture on campus, in addition to providing QL support.

4) How can we leverage existing faculty support structures?

Support both from and for faculty in the implementation of a QL program is essential to its long-term success. In particular, securing buy-in from faculty, particularly those who would be involved in the ultimate delivery of QL programming, is essential to successful implementation tactic. In another chapter, Dewar, Larson, & Zechariah (YEAR) describe factors that promote faculty buy-in for sustainable instructional innovation.

Where structures already exist to support faculty professional development, such as teaching and learning centers, these can be a nexus for invaluable partnerships that both increase buy-in

and provide faculty a vehicle for ongoing support. In a personal interview, Cinnamon Hillyard said that when she became Director of the QSC at the University of Washington Bothell, social sciences faculty were already accustomed to working with subject-specific librarians to support their curricular development. Dr. Hillyard came alongside faculty for specifically quantitative curricular development and believes her approach was one of the reasons for the successful adoption of QL at UW Bothell (2016, Parsons personal communication).

QuAC at Bridgewater State University had similar origins. It originated as partnership between BSU's Office of Teaching and Learning on the one hand, and its Math Services academic support center on the other, with the faculty director of the latter coordinating the initiative (Salomone & Bjorge, 2016). While the university's 2006 Core Curriculum provided for separate graduation requirements for mathematical reasoning and quantitative reasoning (Bridgewater State University, 2016), learning outcomes for the QL requirement had not been developed and students were permitted to use a second course in mathematics to meet the QL requirement. The QuAC initiative has, through these faculty support channels, helped better inform faculty of the distinction and complementary importance of mathematical and quantitative reasoning.

Conclusion

Existing literature demonstrates that a QL program can be successfully and sustainably implemented in academic institutions of any size or mission class. The flavor of implementation most likely to succeed at any given institution will be as varied as the factors motivating the shift from a narrower "private" focus strictly on mathematics to a broader "public" application of quantitative reasoning across the curriculum. Those wanting to implement a new quantitative literacy program may wish to introduce the idea in tandem with conversations around institutional identity and general graduation requirements, partnership with mathematics faculty, and to leverage existing support structures for both students and faculty for implementation.

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Table 1: Carnegie classifications of institutions with QL programs described or referred to by others in *Current Practices in Quantitative Literacy* (Gillman, 2006a), *Achieving Quantitative Literacy* (Steen, 2004)*, Mathematics and Democracy* (Steen, 2001), *Quantitative Literacy Requirements (Working Draft, 06/26/99)* (Steen, 1999), and the National Numeracy Network Newsletter (The QR Program at Wellesley, 2005).

	Public	**Private Not-for-Profit**
Small	Farmingdale State University	Alverno College Babson College Clark University DePauw University Dickinson College Dominican University Hamilton College Hollins University Juniata College Kalamazoo College Lawrence University Macalester College Moravian College Mount Holyoke College Mount Mary College Point Loma Nazarene University Skidmore College Trinity College Wellesley College
Medium	The Evergreen State College University of Washington - Bothell	Dartmouth College Rensselaer Polytechnic Institute

	U.S. Military Academy - West Point	St. Olaf College
Large	Appalachian State University Edmonds Community College Indiana University Northern Illinois University Oklahoma State University Sam Houston State University State University of New York - Stony Brook University of Massachusetts - Boston University of Nevada - Reno University of Tennessee - Knoxville Virginia Commonwealth University	DePaul University Massachusetts Institute of Technology New York University University of Pennsylvania