

The Quantitative Literacy (QL) Fellows charge was to identify the current conditions at UWT, analyze, and provide recommendations. In effect, to determine why the level of quantitative skill amongst students at UWT was low and what could be done to improve it. Our starting point was that a high level of quantitative literacy across all students was important and that this level was not being attained at UWT. We also wanted to start the process of improving QL and implement some ideas. As such, we invited local community college instructors to campus to discuss QL and lay the ground work for future discussions and workshops. As discussed below we implemented some diagnostic quizzes to assess QL and submitted a proposal to the National Science Foundation to support assessment.

In this document we outline why the level of QL at UWT is unsatisfactory and provide a series of specific proposals. Some of these proposals can be implemented quickly and inexpensively, where other proposals are longer term and require additional resources.

The agreed upon vision of the QL Fellows is that upon graduating, UWT students should have the confidence and independence in learning that they can tackle a challenging problem. In addition, each student

- is a critical consumer of the media vis a vis reports of statistical studies and graphs
- can use quantitative information in their own lives, and
- has the skills they need to succeed in their field.

However, to the extent that this vision is shared by faculty and administration, it is not evident in the policies and practices of the university. The current graduation requirements, the level of support across the curriculum (both in terms of widespread exposure to quantitative skills and remedial courses), and outside the classroom are woefully inadequate to achieve the aforementioned vision. To put it bluntly, a quantitatively illiterate student can enter UWT and, quite easily, graduate from UWT still quantitatively illiterate. We find this unacceptable.

Current state at UWT

Under the current set of UW requirements related to quantitative skills, in order to graduate a student has to obtain credit in only one class so designated as a QSR class. This requirement can be fulfilled at any point, including their last term prior to graduation. While this, in and of itself, is an inadequate requirement there is no mechanism currently in place to requiring such classes to have some minimum level of quantitative instruction. Furthermore, once designated, a course is always designated as QSR no matter how the content may evolve over time or with whomever teaches the course.

We found evidence, anecdotal to be sure, that students were being admitted to university without the minimum requirements necessary to do college level quantitative work. Both student advisors and students told us they were admitted without having the mathematical

requirements just as long as they met those requirements prior to graduation. If true, this is completely unacceptable as it has serious implications for the level of quantitative rigor possible in classes these students take.

There are relatively few lower level classes, remedial or otherwise, that are quantitative-based that provide students with challenges in this area opportunities to develop their skills. In addition, there are few courses outside the sciences incorporating quantitative analysis.

No matter what faculty and administrators may say, the fact is that the signal the university sends to students is that quantitative literacy is not very important.

Proposals

The following proposals offer a coherent, mutually reinforcing set of initiatives designed to fundamentally change the level of QL amongst the students at UWT. The first set of proposals is designed largely to improve the standards and send a signal to students of the importance of QL. These are followed by proposals designed to provide support to accomplish these goals, both in the short term and long term.

- 1) Change the graduation requirement such that all students must take at least two five credit classes that are designated as QSR. Furthermore, at least one of the classes must be taken within the first two years (or, within the first specific number of credit hours). The latter change is important. QL is, among other things, a tool a student should learn to apply. Allowing students to avoid taking QSR classes until the end of their time at university completely undermines the purpose of the QSR classes.
- 2) Strengthen the criteria to qualify for a QSR designation and set up a system where designated classes, must after a certain period of time, reconfirm that the class is meeting the criteria. One possible proposal to accomplish this is to create a committee that oversees Writing, Diversity, and Quantitative Literacy designations. We would recommend that such a committee develop very specific and demonstrable criteria for what qualifies a QSR class. Furthermore, given that a focus of these classes is, in addition to the content, to develop quantitative literacy skills, recognition should be given to the time consuming nature of such activity. As such, we would recommend these classes have lower enrolment caps, just as some writing classes currently do.
- 3) The UWT Core program's curriculum offers a coordinated series of courses representing the various disciplines in the university. The courses are designed to challenge first-year students to develop critical thinking, writing, research and analytical skills while focusing on socially relevant topics. We recommend that Quantitative Literacy take a co-equal

status in the learning objectives of CORE program. In other words, every group that passes through the CORE program would spend some time on applying quantitative skills. Part of the rationale for the CORE program is to introduce students to college level material. What is stressed implicitly conveys what the university community considers to be important. We think QL deserves to be part of that and it is very important for students to recognize this as early as possible. This recommendation has already started to be implemented; the Office of Undergraduate Education faculty reached out to the QL Fellows for discussions on how to implement QL and, one member, Linda Dawson not only has been working with OUE faculty but is currently teaching in the program. In Fall 2013, three QL objectives were incorporated into the core curriculum. We recommend that this relationship continue and be strengthened.

- 4) QL, as with so many skills, needs to be continually reinforced. This is one reason we recommend that QSR classes be taken over the course of a student's time at university and across as many different subjects as possible. Another way to reinforce this is to strengthen our prerequisite system. We recommend that in any class that has a quantitative prerequisite, say calculus or statistics, the faculty require students to take a diagnostic pre-test with a clearly specified grade indicating whether a student comes into a course knowing the required material sufficiently well. And if they do not, then they must take remedial classes to bring them up to the requirement level. In other words, having just passed a designated class is not sufficient. This significantly increases the transparency of the process, across both faculty and students, and, once again, conveys to students the importance of learning the material, not just passing a class. Also, we hope the implementation of such diagnostic quizzes will help facilitate consistent standards across departments. In Spring 2013, we implemented this requirement across a number of classes across the campus. The results were not encouraging to support the idea that simply requiring a course is an adequate proxy for certain level of competency in a subject.
- 5) Increased QL requirements will mean a growing role for the TLC to support students struggling with meeting these requirements. If additional resources are available to support QL then we would recommend the first resources be spent helping the TLC provide more comprehensive quantitative help, especially in coordinating and providing both remedial help with incoming students and those students requiring help in passing the pre-text exams (mentioned in point 4 above).
- 6) It is critical that all students obtain a level of quantitative proficiency as early in their time at the university thus enabling them to do college level work. As such, not only should additional remedial-type classes be offered but for those students, who are

otherwise qualified for college work but particularly weak in quantitative skills, then we propose the creation of a “summer bridge” program (somewhat based on the current program for writing). A detailed description of the Summer Bridge program is provided in Appendix A.

- 7) UWT students need to be quantitatively literate by the time they graduate. We use the term quantitative literacy broadly to include both statistical literacy and basic numeracy. During Dr. Anne Beaufort's tenure at UWT, she ran the Writing Fellows Institute (WFI), in which she brought her scholarship on teaching writing and models for student learning to a small group of faculty who aimed to improve their instruction of writing within their respective disciplines. WFI was relevant to all faculty, not just those who taught in disciplines traditionally associated with writing or courses with a "W" designation. We propose a complementary program in quantitative literacy, the Quantitative Fellows Institute, in which small groups of faculty from both quantitative and non-quantitative disciplines work together to increase the frequency of and improve student experience with quantitative concepts across the curriculum. Specifically, we propose the creation of working groups that include two faculty members and two students. One faculty member in each group will be from a STEM discipline or quantitative background, and the other will be from a non-STEM discipline. We propose 3 to 5 such working groups. The faculty will work together to create activities aimed for non-STEM courses, the students (along with the other working groups) will test-drive the activities and provide feedback on them. There is interest among non-STEM faculty to bring more quantitatively oriented activities into their curriculum; the Quantitative Fellows Institute will provide the structure and support to help faculty develop and implement these activities.
- 8) Open communication among the South Puget Sound area campuses, especially campuses from which many of our students transfer from, would allow for a community of scholars interested in increasing the quantitative literacy of the students across campuses. This is important for our transfer students as well as for researchers to discover the best practices for quantitative retention. Last year was the first Multi-campus Quantitative Literacy Meeting, which drew around 25 participants from four campuses in the South Puget Sound area. Support for an ongoing meeting is highly recommended by the QL fellows. The first meeting was possible with very little funds, and could be done with even less funds in the future. We believe that passing the meeting around to different campuses would allow for each campus to feel part of a larger group of concerned faculty and staff.
- 9) We need to evaluate both our students' baseline level of quantitative literacy and the opportunities we give our students to engage with quantitative topics. Without some

sort of assessment – beyond counting the number of students enrolled in QSR courses – it will be difficult to judge the impact of any of these initiatives. Several colleges and universities have begun examining samples or portfolios of students’ written work, collected prior to graduation or at the end of a particular required course, to gauge the amount and depth of QL-related writing. A similar plan could be easily implemented in programs that already collect student portfolios (e.g. IAS). To be effective, such an assessment program would need a small group of faculty to carry out the evaluation on an annual basis. Ideally, the evaluation group would be guided by faculty from other institutions who have already implemented such an assessment program at their home institutions. (See attached NSF proposal.)

Quantitative Literacy Fellows

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Appendix A

The Summer Bridge Program

Students who arrive at college underprepared or lacking in specific skills face significant challenges to success that can determine curriculum choices, career paths, and retention at that institution or whether a student stays in college at all.

A summer bridge program is offered in many colleges and universities to incoming freshmen as a way for a student to transition from high school to college. The curriculum offered, length of program, number of credits, timing, etc. are different for every school. The program provides supplemental education to build the skills required for student success in the first year. They can also provide focused or accelerated programs that can reduce the need for developmental courses to get a student up to speed. Finally, they help students learn how to navigate and utilize college resources and gain confidence and familiarity with the college faculty, staff, and students.

There has been little quantitative research on the effectiveness of these programs. A recent study conducted by Barnett et al. (2012) evaluated the effectiveness of summer bridge programs at eight institutions held in the summer of 2009. These programs were focused specifically in helping developmental students succeed to complete their remedial courses and become more prepared for college work. The programs had little effect on the number of credits attempted or earned. They did, however, have an impact on the acceptable completion of the students' first college level course in math and writing. At the end of the two year follow-up period, however, the differences between the two groups were no longer significant.

A recent pilot program is being implemented specifically for low-income students in two high schools in Tacoma. The Getting Ready for Success (GRS) Program is being funded by the Bill and Melinda Gates foundation. The plan for this study was presented at a conference sponsored by the National Center for Postsecondary Research (NCPR) (Sepanik, 2012). The program will address strengthening students' college preparation through a network of supports, both socially and academically with monetary incentives to increase a students' motivation to succeed finishing high school and entering college. This program is unique in that it will start in high school and continue through the summer prior to the students entering college. Some preliminary results are expected to be published this year.

Deidre Raynor (IAS faculty) has been heading up the current UWT Summer Bridge program since its inception. The UWT current Summer Bridge is offered every summer at the end of August until mid-September (approximately 4 weeks), ending just prior to the fall quarter. The program provides selected incoming freshmen with tools for success as they navigate a new academic environment and face the personal and academic challenges of being a first-year student. In the past, approximately forty students were selected for participation based on SAT scores, grades, and their written entrance narrative. The program was expanded and was offered to approximately double that amount in August 2013. Students who successfully complete the Summer Bridge earn five college credits for a course taught by one or more University of Washington Tacoma professors. In addition, other faculty and staff provide workshops on accessing and utilizing university resources and improving writing skills.

Up until now, the focus on the curriculum has been research and writing. No quantitative skills were taught in the program up until this year. Due to the initiative of the Quantitative Fellows group, it was proposed that a quantitative skills workshop be incorporated into Summer Bridge curriculum. UWT Summer Bridge offered an additional quantitative skills workshop for a smaller group of students (approximately twenty) for the summer session of 2013. The workshop included five separate sessions, lasting two hours each. The workshop description was developed and taught by Linda Dawson and is shown below:

Quantitative Workshop Description:

Quantitative skills and problems solving are essential to succeeding in college courses. The purpose of these workshops is to review quantitative concepts and skills that are used in other courses and help you to be more confident in your ability to solve problems.

The material covered is a review of concepts that were required for your entry in college. You may have forgotten these skills or never really mastered them. A simple review of these concepts can be enough for you to remember these skills so you can move forward.

The format of the workshops will be to first review a skill or concept and then have you apply it through practice. Problem solving will be a part of how the skills are applied in real world applications – such as environmental issues, space science.

The skills covered will include:

- percentages and percent error
- applications of algebra, solving for an unknown value
- interpretation of a graph, creating a graph from data
- basic trig functions
- exponential values
- map scaling and unit conversion
- scientific notation

A calculator with some scientific functions (trig functions – sine, cosine, etc. and numbers with exponents) will be required to solve the problems.

As a student taking these workshops, you will be evaluated on your ability to solve problems using these skills. Evaluation will be in the form of study worksheets and short quizzes. Online resources will be provided to help you practice the concepts. Peer tutors will also be available to help you study and solve the worksheet problems.

To the extent possible, the skills were taught in the context of a focused curriculum using a theme, such as rockets and space travel (Linda Dawson's expertise). Further offerings of these workshops could focus on the particular skills of the instructor teaching it.

A valued component of this workshop was a UW student tutor. There were no UW Teaching and Learning Center Tutors available in this timeframe so a UW Seattle student was hired. He was an engineering student and was exceptional in this role – very personable and able to lead students through problems step by step. This was a valued part of the workshop and demonstrated the importance of collaborative and peer instruction and learning. The tutor was also a great role model, telling the new students about his humble beginnings and experiences in school. Many of the students could relate to him. This became an unintended positive result.

Recommendations going forward included the following:

1. The workshops are offered with 1-2 credits, with homework and participation required for a grade. It could be C/NC.
2. The curriculum offered for these workshops be reviewed and enhanced by other math and science faculty to make sure that the most important basic skills are covered.
3. Continue with a tutor as good as the one hired for the first quantitative bridge workshops.
4. Continue to include practical applications of the math skills. The water rocket activity worked very well and was a good demonstration of a science activity, including taking data and doing analysis.

It was also recommended a Refresher Summer Bridge Program to be offered for a shortened period of time, one to two weeks long, prior to the start of the students' second year. The reason for this recommendation is that the research cited mentions that the first-year bridge programs help a student perform academically in the first year but the effect does not last into the second year. To assist students address specifically what is expected in the second year, a refresher course in both quantitative skills and writing would reinforce and review skills and resources necessary for success.

References:

Barnett, E. A., Bork, R. H., Mayer, A. K., Pretlow, J., Wathington, H. D., Weiss, M. J., ... & Zeidenberg, M. (2012). *Bridging the gap: An impact study of eight developmental summer bridge programs in Texas*. National Center for Postsecondary Research.

Sepanik, S. (2012). *Getting ready for success: bridging the gap between high school and college in Tacoma, Washington*.