Mathematics Department
Unit-Level Assessment Liaison Report
Spring 2018

Liaison Project Start Date: Spring 2017
Liaison Report prepared by Camelia Salajean

I. Department Buy-In and Outcome Definition

A year ago, the Mathematics department decided to assess one of the Math 118 – General Education Mathematics common Student Learning Outcomes (SLOs): "*Interpret and draw inferences from mathematical models such as formulas, graphs, tables, and schematics*."

Math 118 is designed to fulfill general education requirements. It is not a prerequisite for any other mathematics course. At Harold Washington College (HWC) this course is offered in all three formats: face-to-face, hybrid and online, and it is mainly taught by part time faculty. Math 118 is the only college level course for which the instructor selects 4 out of 12 topics to be taught. For all these reasons, Math 118 presents a unique challenge when it comes to creating a unified and relevant assessment.

Since the Spring of 2017, a committee consisting of six full-time HWC Math faculty members has been working continuously on the Math 118 assessment process. First we revised the SLOs for this course, which had been presented specifically for each of the 12 possible topics of the course, but did not include general SLOs that would be met in every section, regardless of the topics selected by the individual faculty member. As a result, I organized and worked with a district wide committee (at least one faculty member from each of the City Colleges) to determine common SLOs for Math 118 that students can meet no matter what topics are taught in the course. The next step was to present these common SLOs to my colleagues, and we unanimously picked: "*Interpret and draw inferences from mathematical models such as formulas, graphs, tables, and schematics*" to investigate during this assessment cycle.

II. Assessment Research and Design

Subsequently, the math faculty researched and reviewed different assessment tools and processes for our specific student learning outcome. *Quantitative Reasoning Test* available through Madison Assessment LLC was one of the national assessment tools that caught our attention. This test is a computer-based assessment designed to be content-free, in other words correct responses to the questions do not require specific content knowledge of any domain of science but rather general quantitative reasoning that the course aims for. Borrowing questions from *Quantitative Reasoning Test*, we created a pilot assessment called *Spring 2017 HWC Math 118 Survey*.

The Math 118 pilot was designed using Google Forms, a free service that is convenient for collaboration and sharing processes and outcomes between members of the committee. It is browser independent and especially mobile friendly, which is a significant advantage for students as well. The responses are

organized automatically into pie charts and bar graphs that are viewable dynamically as the survey progresses. As the sample size grows, we see the results evolving in time. Another advantage of the tool is the fact that the responses can be exported into an excel spreadsheet easily and conveniently for further data analysis.

The Math 118 pilot consisted of three mathematical problems designed to assess how students get the information and draw inferences from a formula, a table and a graph. The questions were aligned to the student learning outcome that was chosen. Moreover, we strived to limit the number of words of the contextual problems to make sure students would focus on math, rather than on reading comprehension of the text.

III. Pilot Assessment Tools and Processes

In collaboration with instructors who were teaching Math 118 in various formats, this pilot assessment was administered to students before the Spring 2017 semester ended. Considering the advantages of Google and the incentives provided by faculty, we were pleasantly surprised to record about 170 responses.

Students did very well on using the temperature formula and getting straightforward information from a table. However, they struggled with interpreting information, particularly percentages, from a table and with drawing inferences from graphs. It seems that hybrid students performed the best, but there was a very small sample, only 7 students out of 122, so no statistically significant difference was detected (see Appendix A).

IV. Administer Specific Assessment

To create a proper assessment, during the Fall 2017 semester, we decided to expand the pilot tool into two parts: a pre-test and a post-test. These two tests were intended to examine how effectively students learn to interpret and draw inferences from various mathematical models while taking a general education mathematics course. First, we reviewed the pilot and the raw data results, and we decided to slightly modify one of the questions to ensure it was content free.

Using Google Forms, we created the pre-test assessment called *Fall 2017 HWC Math 118 Survey* (see Appendix B). We put some thought into finding the best time for this test to be administered and we decided to administer the pre-test assessment during weeks 3 and 4 of the semester. Making sure the students taking our mini sessions classes were included, we kept the survey open only for them during the 5th week (since that was their first week of school).

The pre-test and post-test had exactly the same questions. We changed the order of the problems only to give the surface impression of a “new” survey. We didn’t want students to immediately realize that they were solving the same problems twice in a semester, although students may have still recognized the underlying similarity. During this particular term, Fall 2017, we had a high participation rate from the students for these two tests. We collected over 170 responses.

Since students had some difficulty with addressing the question related to graph interpretation, in the Spring 2018 Math 118 assessment, we decided to create a replacement for this question to understand if it was the type of question or the specific example used that was the source of the students' errors (see Appendix C).

V. Data Analysis

During Fall 2017, right after the pre-test results were collected, we sent them for analysis to one of the Assessment Committee Research Analysts. We received two reports, one for the pilot administered at the end of the Spring 2017 semester and one for the pre-test assessment administered at the beginning of the Fall 2017 semester. Math faculty met a couple of times to discuss and compare these reports. Since we modified one of the questions, a direct comparison of the correct responses was not appropriate. Students performed similarly in most questions except for the one involving graphs. The pre-test of Fall 2017 had only 35.62% of students answering the question correctly compared to 44.16% in the pilot. As a consequence, we decided to revise this question for the Spring 2018 assessment.

At the end of the Fall 2017 semester, we administered the post-test assessment for which we got a data analysis report in the Spring 2018 term. The results for the post-test were not so different from the pre-test. Students still struggled with interpreting a percentage from a data table (instead of computing 50% of 66 people, which amounts to 33 people, students selected the percent itself, 50, as an answer for the number of people). For this particular question, students performed poorer in the post-test (only 5.06% answered correctly) than in the pre-test (when 9.59% answered correctly). It seems that in the post-test more students selected the total number of people, 66, as an answer than in the pre-test. This was somehow better as an incorrect answer, even though still erroneous, than answering with a percent since they were supposed to find out an actual number of people.

From the analysis of the Fall 2017 Math 118 assessment, we found out there were only 59 students who took both the pre-test and the post-test. Therefore all comparison analyses for these two tests were done on these students. No statistically significant difference was detected between the two tests results. The online students were the most consistent with their answers between pre- and post-tests. Since no statistical difference was detected while comparing the students' responses between the three instructional modes: face-to-face, hybrid and online, no conclusion can be made at this point (see Appendix D).

VI. Supporting Evidence-Based Change (Use of Findings)

We were hoping that students would do better in the post-test as compared to the pre-test, however that did not materialize. Performances were similar. It is still unclear why this was the outcome. Further examination of these data along with the upcoming report from the Spring 2018 assessment may reveal some underlying causes, and allow us to make adjustments to future versions of this assessment.

The Math faculty consensus is that we need to gather additional data, covering a sufficient sample size, to draw conclusions and make pertinent recommendations for refining the teaching of Math 118 and improving this specific SLO. Therefore, we will continue the cycle on Math 118 Assessment in the Fall 2018 semester.

Success Factors

It is encouraging that the amount of responses gathered for the Math 118 assessment was substantial in number, beyond what was expected. We were able to get most part-time instructors teaching this course as well as online instructors from other colleges involved in this process.

Another positive aspect is the fact that half of the full time faculty of HWC Mathematics Department have worked together and successfully collaborated towards the same goal.

More globally, a district wide committee was formed to discuss the students' learning outcomes which induced a more cohesive revision of the master syllabus of the Math 118 course across the CCC system. As a consequence, Math 118 is going through the PACC process for all seven City Colleges of Chicago at this time.

Recommendations

The committee worked closely to improve Math 118 assessment during the last three semesters by modifying the questions on the survey to ensure that they properly measure the targeted SLO. We will continue in this vein and amend the Fall 2018 survey accordingly.

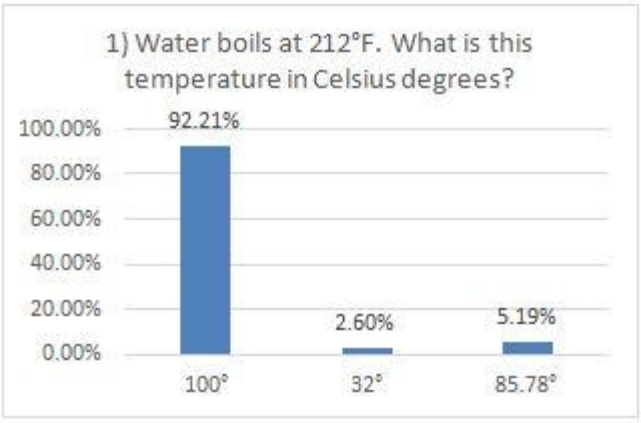
It is clear to us at this point that students struggle particularly with the concept of inferring percentages from quantities presented in a table, which is a fact that other stakeholders across the college should be aware of as well. We recommend that more focus should be paid to this topic across the curriculum in the Mathematics Department.

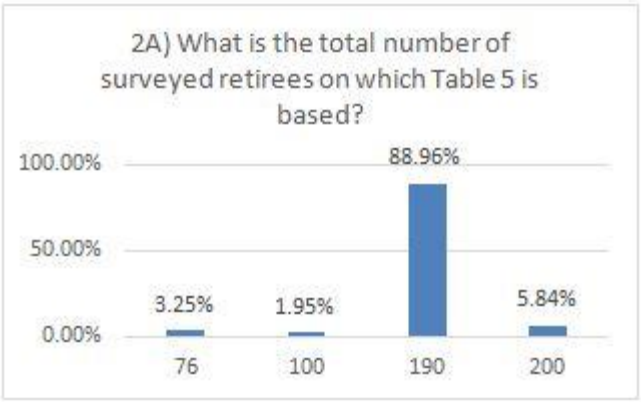
As for the other part of the assessment, namely how students performed in the topic of drawing information from reading graphs, we plan to analyze the results from the Spring 2018 assessment to identify which part of the graph-reading process is eluding students. This will eventually lead us to make further recommendations in order to improve the students' understanding and learning of this topic.

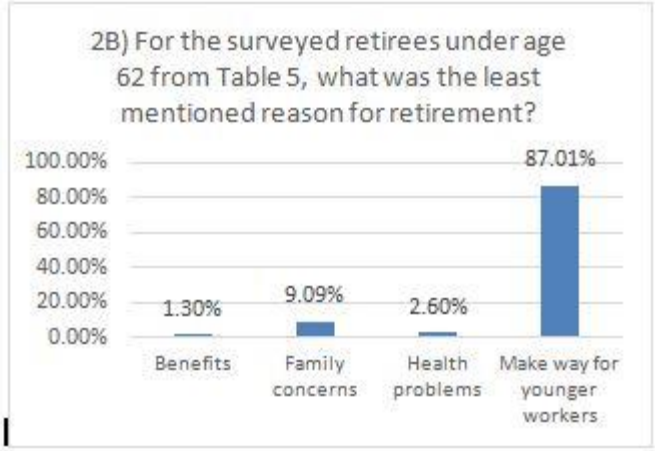
Appendix A

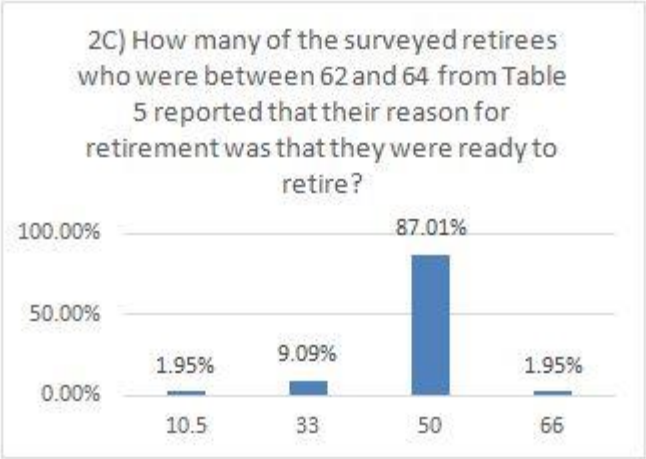
Spring 2017, Math 118 Assessment Pilot
Overall Performance

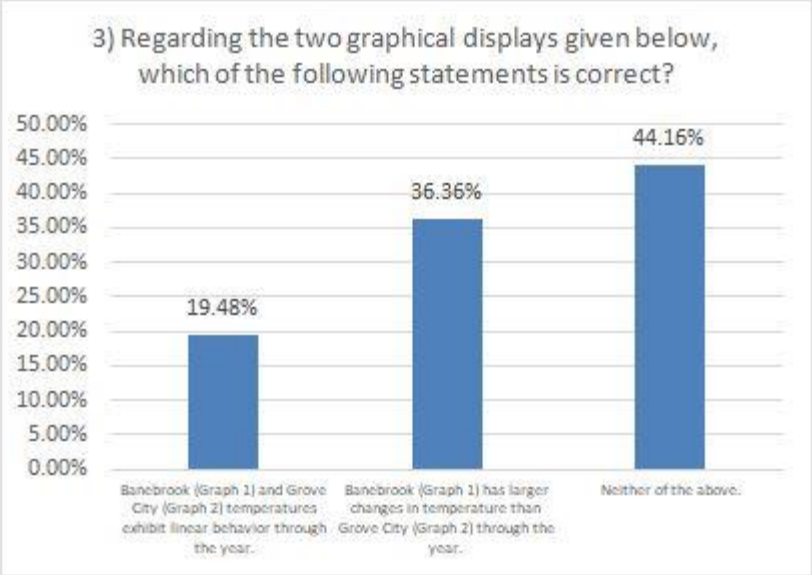
Note: The original sample consisted of 172 responses; however, there were a few duplicate responses (a few students completed the pilot more than once). For these duplicates, only the first response (as indicated by the timestamp) was kept, while the others were removed from the data. This resulted in 154 different responses.


1) Water boils at 212°F. What is this temperature in Celsius degrees?
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
92.21%
2.60%
5.19%
100°
32°
85.78°


2A) What is the total number of surveyed retirees on which Table 5 is based?
100.00%
50.00%
0.00%
3.25%
1.95%
88.96%
5.84%
76
100
190
200


2B) For the surveyed retirees under age 62 from Table 5, what was the least mentioned reason for retirement?
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
1.30%
9.09%
2.60%
87.01%
Benefits
Family concerns
Health problems
Make way for younger workers





Appendix B

Math 118 Pre-Test Assessment Tool **Fall 2017**

1. Use the formula below that expresses the relationship between temperature in Celsius degrees, C, and Fahrenheit degrees, F, to answer the question below.

$$C = \frac{5}{9}(F - 32)$$

One of the highest temperature ever recorded in Chicago was 104°F. What is this temperature in Celsius degrees?

a) 40˚C

b) 25.78˚C

c) 219.2˚C

2. Study the table below and answer the following 3 questions.

Table 5. Reasons for Retirement by Age at Retirement			
	Age at Retirement		
Reason for retirement	Under 62	Between 62-64	65 or older
Age	10.5	21.6	64.6
Ready to retire	10.5	50	14.6
Health problems	26.3	11.9	8.3
Plant closed	10.5	1.5	-
Benefits	10.5	3	-
Make way for younger workers	2.6	1.5	6.0
Bad work conditions/industry uncertainty	5.3	4.5	-
Family concerns	7.9	-	2.9
Enjoy life	7.9	1.5	2.1
Other	7.9	4.5	2.1
	100%	100%	100%
n =	76	66	48

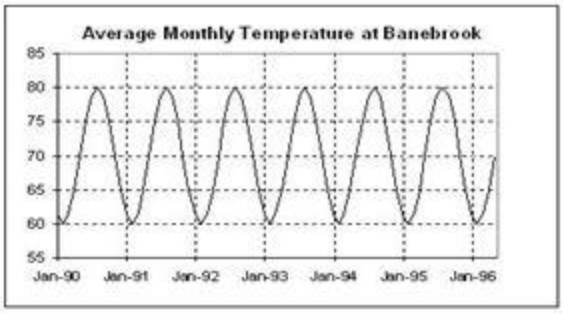
2A. What is the total number of surveyed retirees on which Table 5 is based?
a) 76
b) 200
c) 190
d) 100

2B. For the surveyed retirees under age 62 from Table 5, what was the least mentioned reason for retirement?
a) Family concerns
b) Benefits
c) Health problems
d) Make way for younger workers

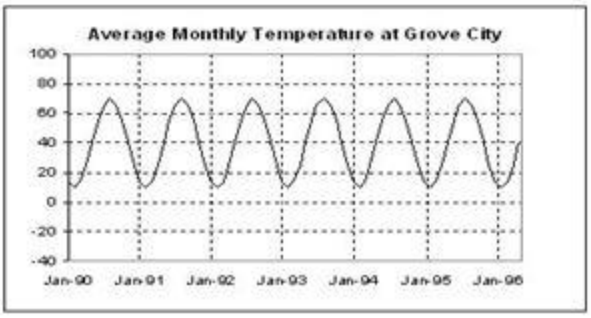
2C. How many of the surveyed retirees who were between 62 and 64 from Table 5 reported that their reason for retirement was that they were “Ready to retire”?
a) 10.5
b) 33
c) 50
d) 66

3. Regarding the two graphical displays given below, which of the following statements is correct?
a) Banebrook (Graph 1) and Grove City (Graph 2) temperatures exhibit linear behavior through the year.
b) Banebrook (Graph 1) has the largest changes in temperature than Grove City (Graph 2) through the year.
c) Neither of the above.

Graph 1



Graph 2



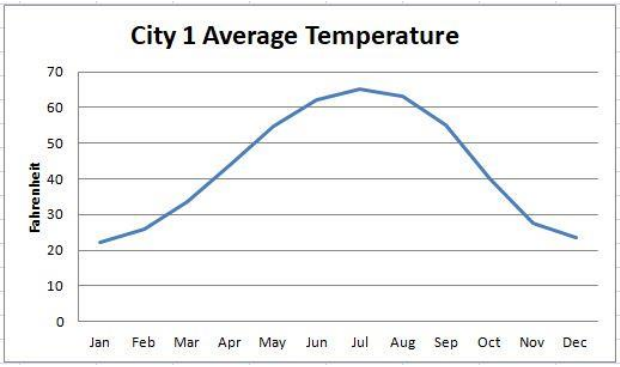
Adopted from 2017 Madison Assessment LLC.

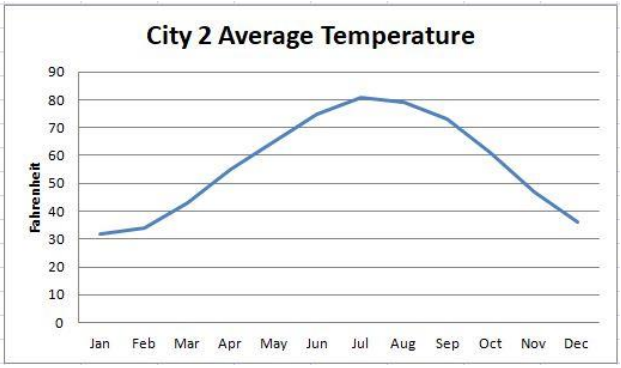
Appendix C

Spring 2018 Pre-Test Change

3) Regarding the two graphical displays given below, which of the following statements is correct? *

- ◯ City 1 and City 2 average temperatures exhibit linear behavior through the year.
- ◯ City 1 has larger change in temperature from winter to summer than City 2 through the year.
- ◯ Neither of the above.





Appendix D

Fall 2017, Math 118 Assessment
Comparison of Pre-test vs Post-test Results

General Comments

· Only 59 students took both the pretest and posttest. Of these, only 50 took Math 118 in exclusively one format (14 F2F, 10 hybrid, and 26 online). The comparison analysis between the three instructional modes was performed on these students only.

· Despite some difference in performance, no statistically significant difference was detected between the pretest and posttest results.

Face-to-Face

Percentage of Correct Responses (F2F)

Question	Pre-test	Post-test
1)	92.86%	71.43%
2A)	92.86%	64.29%
2B)	78.57%	85.71%
2C)	7.14%	0.00%
3)	42.86%	7.14%

A Fisher's exact test of independence was performed for each question. We used this test to check whether there was a statistically significant difference in the proportion of correct responses between the two groups (Pretest and Posttest). No statistically significant difference was detected.

Hybrid

Percentage of Correct Responses (HYB)

Question	Pre-test	Post-test
1)	90.00%	80.00%
2A)	70.00%	90.00%
2B)	90.00%	80.00%
2C)	0.00%	10.00%
3)	40.00%	50.00%

A Fisher's exact test of independence was performed for each question. We used this test to check whether there was a statistically significant difference in the proportion of correct responses between the two groups (Pretest and Posttest). No statistically significant difference was detected.

Online

Percentage of Correct Responses (WWW)

Question	Pre-test	Post-test
1)	92.31%	96.15%
2A)	84.62%	80.77%
2B)	92.31%	92.31%
2C)	3.85%	3.85%
3)	23.08%	23.08%

A Fisher's exact test of independence was performed for each question. We used this test to check whether there was a statistically significant difference in the proportion of correct responses between the two groups (Pretest and Posttest). No statistically significant difference was detected.