

# Annual Report for Assessment of Outcomes - MTH

## (For Degree, Certificate or Core Outcomes)

To complete this Assessment Report, please address the questions below, and send to [learningassessment@pcc.edu](mailto:learningassessment@pcc.edu) by June 20, 2011; subject line: REPORT Assessment [SAC]

**1. Describe changes that have been implemented towards improving students' attainment of outcomes that resulted from outcome assessments carried out in the previous academic year.**

*(Information provided here may be referenced, inserted into or summarized in Program Review 2.C.iii (for Core Outcomes) or 6.B.iii (for CTE Degree and Certificate outcomes).*

No changes were made in the mathematics curriculum based on last year's work.

Changes to the problem and process were significantly altered: Last year, a subcommittee of about seven faculty members formed to assess the core outcome of Critical Thinking and Problem Solving. An assessment was given in a small number of courses (it was not a statistically significant sample since the courses chosen was not random and the total number of pieces of student work was too small). The problem used last year did not align well with some of our thoughts on what of critical thinking is in mathematics. Given the limited amount of time available, we focused on developing a new problem and having a statistically meaningful sample for this year's work. The student work from last year has been kept in case we wish to revisit the data.

**2. Identify the outcomes assessed this year, and describe the methods used.**

**What were the results of the assessment (i.e., what did you learn about how well students are meeting the outcomes)?**

*(Information provided here may be referenced, inserted into or summarized in Program Review 2.C.i& ii (for Core Outcomes) or 6.B.i & ii (for CTE Degree and Certificate outcomes)*

**a. Describe the method(s) you used.**

1. The Math Learning Assessment Standing subcommittee (Math LAS) of about 14 members of the Mathematics SAC was formed to do this work. (Note: The Mathematics SAC has approximately 134 members with 43 full-time and temporary-full time members.) Four other full-time SAC members contributed to various parts of the assessment process. The Math LAS is represented by members at each main campus with the following breakdown: six full-time instructors, five full-time temporary instructors, and three part-time instructors. The subcommittee was co-chaired by two full-time faculty members: a senior faculty member and new faculty member. It was critical to have a senior faculty member on this committee, who is well versed in SAC and PCC history. The Math LAS was given autonomy by the Mathematics SAC to develop the problem and assess the work. This was critical for making progress without having to wait for SAC approval at every stage of the process. Members of the Mathematics SAC will participate in the follow-up discussion.
2. The Math LAS chose to assess Problem Solving/Critical Thinking and Communication within in the context of two mathematics classes, MTH 65 and MTH 244. MTH 65 was chosen because it is the last

mathematics course required for several degrees and certificates; similarly, MTH 244 is also the last mathematics course taken by many students.

3. The Math LAS had conversations about what Critical Thinking/Problem Solving and Communication in mathematics looks like. We worked with the college's definitions of these outcomes, as well as how these are related to the course outcomes. This part of the process was not completed with satisfaction from many of the members. Due to time constraints, we had to move forward to the development of the process.
4. We developed three problems for MTH 65 and one for MTH 244 to assess both core outcomes. These problems were piloted prior to the assessment. The MTH 65 problem was selected because pilot data indicated that students' reasoning was built more upon the course content for MTH 65 than the other two problems and the problem had the greatest potential for measuring critical thinking and communication skills. However, we realized that it might be difficult to create rubrics for assessing these abilities and the problem itself did not have well-defined expectations for critical thinking, which would make building the rubric additionally difficult. Both the MTH 65 and the MTH 244 problem were revised based on student work from the pilot.
5. Sample size was discussed both within the Math LAS, statistics instructor at PCC, and with faculty at other institutions who have experience with sampling similar data. It was decided that we needed 300 pieces of student work for a statistically significant sample. MTH 244 did not have this many students, so all 11 campus sections were assessed. Ideally the 300 pieces would be from a random sample of all students taking MTH 65. However, this would require all sections to give the sample. For our first attempt at this process, we decided this was not a realistic goal. We decided to do a random sample of 13 sections (72 sections of MTH 65 were offered that term) with the expectation that each section would have 30 students enrolled by the second week of class. The extra 90 over our desired 300 would be for withdrawals and absentees.
6. At the end of Winter Term the MTH 65 problem was administered in a random sample of 12 MTH 65 sections – taught by both full-time and part-time faculty. Note: The drop from 13 to 12 was because we were unable to assess in a distance learning section as planned. The sample was chosen so that we had a number of sections proportional to the number of sections offered at each of PCC's campuses/centers.
7. Sample work was kept anonymous in two ways: Student information was removed and also instructor information was removed. We felt it very important to keep instructor information anonymous because (1) this is an overall review of our discipline and not a review of an individual faculty member's performance and (2) it reduces the likelihood that a faculty member would feel threatened by this process. Instructors sent the work to an administrative assistant at one of the campuses who removed faculty names. All faculty members, but one, who were selected did the assessment (it is unknown if this was a MTH 65 or MTH 244 instructor).
8. Two subcommittees – one working with the data from MTH 65 and the other with the data from MTH 244 – developed rubrics to assess students' solutions with respect to Problem Solving/Critical Thinking and Communication. These rubrics were developed in collaboration with members from the Program Assessment for Learning (PAL) subcommittee of the Learning Assessment Council (LAC).
9. The MTH 65 rubric was on a 1-5 scale with 3 representing "acceptable work." We had descriptors for rubric scores of 1, 3, and 5 only. This was to allow flexibility when scoring. If a sample work met some of the descriptors for a "1" and some for a "3", we could call it a "2". We felt this would decrease the likelihood of "rubric inflation" – giving a student a "3" if torn between a "1" and a "3". This also allowed for quicker rubric scoring.

10. The Math LAS subcommittee plus two additional Math SAC members were normed to the MTH 65 rubric. Then we scored the MTH 65 work against the rubric. The committee was broken up into two groups, one scored Communication and the other scored Critical Thinking. Each paper was scored only once. A third group continued work on the MTH 244 rubric during this meeting. After scoring of the MTH 65 work, we discussed the meaning of the results.
11. We grouped rubric scores in three groups: 1-2, 3, 4-5. This was done to show the number of students who were below expectations (1-2), met expectation (3), and exceeded expectation (4-5).
12. At this point in the process we had a SAC meeting. The Math LAS took 90 minutes of the SAC meeting to share our work. We shared the problem, features of the assessment process, and the preliminary results from the assessment of MTH 65 to the whole Mathematics SAC. Since this type of assessment is new to SAC members, we broke it down in a way that we hoped would encourage thoughtful evaluation of the problem and the process:
  - a. SAC members were asked to solve the problem and discuss how they would expect a MTH 65 student to solve the problem. The second question was critical to encourage faculty discussion about the expectations they of students in regard to critical thinking with the problem. Faculty had a few minutes to think privately, then discussed in small groups and a member of each group reported to the SAC.
  - b. Faculty members were given the rubric and scored several sample solutions.
  - c. Suggestions for improvement to the rubric and the overall process were collected.
13. The Math LAS subcommittee met again to do a trend analysis with the data. This work was done with members of the Program Assessment for Learning (PAL). Purpose: Rubric scoring gave us a sense of what work fell into the categories of “met expectations” “below expectations” and “exceeded expectations.” However, rubric scoring did not give us a good understanding of what was behind the score.
14. Trends were broken down into the following categories: Critical Thinking, Communication, Other Content Related Errors, Other. The Math LAS subcommittee discussed the meaning of the trends and what discipline-related changes would address the issues.
15. As of June 2011, we have not had a chance to bring the final results and suggested changes to the entire SAC. This will be done at one of the Fall SAC meetings.

## b. Results: What did you learn?

(If your assessment was scored in some way, it would be helpful to report some of that information. Scores that can be taken apart into meaningful components are often helpful in determining areas that might need attention.)

How well did your students do?

### Rubric scores:

Critical Thinking and Problem Solving for MTH 65 (240 pieces of student work)

1 and 2	3	4 and 5
55%	35%	10%

Communication for MTH 65 (240 pieces of student work)

1 and 2	3	4 and 5
50%	28%	22%

Rubric scoring for the assessment given for MTH 244 has not been completed.

### Trends:

A break down of the trend analysis is given as an attachment (picture format).

Do the assessment results match your aspirations for your students?

No, the rubric scores were lower than desired, but they do correspond pretty well to the pass rates for MTH 65.

There were some concerns brought out by the trend analysis.

Did your assessment indicate any areas or aspects in which student achievement could be better?

Yes. We found more useful information from the trend analysis than from the rubric scores.

From trend analysis we had the following main observations:

1. Many students did not seem to realize that not all data are linear.
2. Many students were not able to give a well-supported conclusion.
3. Students typically do not represent equivalence correctly.
4. Many students incorrectly applied the idea of percentage.

## 3. Identify any changes that should, as a result of this assessment, be implemented towards improving students' attainment of outcomes.

*(Information provided here may be referenced, inserted into or summarized in Program Review 2.C.iii (for Core Outcomes) or 6.B.iii (for CTE Degree and Certificate outcomes)*

This is an important part of what is expected as a result of assessment. It is not enough to say "we are doing great". We are expected to be self-examining, and curious about what we might do better.

We have broken down changes into three categories:

I: Improvement in the assessment

II: Improvement for the program based on the assessment results.

III: Support: What we could do if there were more support from the college.

### **I: For Improvement of the assessment (all suggestions are for MTH 65, unless otherwise specified):**

- Revisit the assessment used: The problem we used is not something that is directly specified in the MTH 65 CCOG. The SAC needs to have more conversations about what critical thinking and communication is in

mathematics and if critical thinking is indeed an outcome of the MTH 65 course. We may need to adjust the problem once we have these conversations.

- Online courses were dropped from the assessment process: Students are required to take at least 2 on-campus proctored exams for our online courses. Our assessment was supposed to be an in-class activity. There was not enough time for online instructors to administer the problem during the exam. We did not feel this problem should be included as an exam problem. We need to discuss the possibility of having a common assignment or test question that could be assessed more easily for all courses, but in particular for online courses.
- Include department chairs to the process: The information sent out to instructors included the contact information for both the Math LAS co-chairs. However, some of the part-time instructors asked questions of the person they knew best: their department chair. The department chairs had not been participating in the discussion of the assessment process, which made addressing faculty concerns difficult.
- Time management: The Math LAS met many times over the year (probably at least 13 times over the year). Meetings typically were scheduled for 2 hours, but routinely ran late. Co-chair time investment was substantial. Rubric evaluation and assessment of the data needed much more time than we realized. This process, although valuable, requires a considerable amount of faculty time. If the process requires too much time few faculty members will be willing to make the commitment.
- More samples should be used for norming: Rubric development included finding examples for each rubric score in order to norm the rubric. Unfortunately, since the rubric development was rushed, we only had one example of each rubric score. We should have had at least three to four examples for each score, but this requires time.
- SAC shouldn't evaluate data artifacts without norming process: We asked the SAC to score some sample work so they would have a sense of the process we used. We asked the SAC members to raise their hands if they assigned a particular score. Since the SAC was not normed, they had a large spread for scoring. Without understanding what it means to be normed to a rubric, some SAC members felt that it was impossible to score an "unmeasurable" outcome such as critical thinking. The Math LAS needs to discuss if we want to have the SAC score again or not, but if we do, we need to take the time to norm to the rubric.
- Specialized courses may prove challenging: The reason that the MTH 244 work is still underway is because there are only two members of our Math LAS subcommittee who are knowledgeable enough in statistics to evaluate the work. Although two additional SAC members helped some, this was still not enough people to complete this work in Spring Quarter. We need to be sure that the courses we pick have enough committed faculty to complete the work in a reasonable amount of time to not burn out the individuals who are stuck doing the work when the rest of the larger subcommittee does not have the needed expertise.
- We should consider separating out the work of students who did not pass the class: The core outcomes of the college read as "the graduates of PCC will...". We did not separate out students who failed the course (so they would not be graduating). We will likely request that instructors keep the student work until final course grades are given and then mark the work for who passed and who did not pass the course. It may be interesting to still assess students who failed the course for discipline-level changes.
- Feedback from SAC: The Math SAC gave some ideas for the rubric descriptors that the Math LAS subcommittee needs to discuss and incorporate.
- Rubric that has a checklist or a checklist instead of a rubric: Instead of doing rubric scoring, we need to consider having more of a checklist. It was difficult to keep in mind all the various aspects we wanted to focus on. Having a checklist would help the evaluator not miss important items (which would throw off

our results). The categories that emerged from the trend analysis will help us alter the rubric or come up with a different approach.

- Streamline the assessment: Ideally we would like to look at each piece of student work once (we went through it twice fully and partially for other parts of the process). A checklist may make this possible. The concern is that we are still too new to this process to know exactly what we want to look for. If we change the problem, this concern would be amplified.
- SAC involvement: We need to bring in more members to the Math LAS from both full-time and part-time.
- Sample size: We need to have more instructors give the assessment to reach 300 pieces of work for a statistically adequate sample space. We expected sampling 12 sections to bring in 360 artifacts, but we only had 240.
- Face to face conversations and accountability: Ideally a member of the Math LAS would talk to each selected instructor about the purpose and importance of this work (especially important for part-time faculty who are not a part of the larger conversation). We were fortunate that 22 of the 23 instructors who were asked to administer the assessment did so. There needs to be more discussion about ways to encourage faculty involvement overall.

**II: Improvement for the program based on the assessment results (all suggestions are for MTH 65, unless otherwise specified):**

**NOTE: The following are suggestions the Math LAS subcommittee will be taking to the SAC for further discussion in Fall Quarter. None of the following ideas are SAC approved for program change.**

- To address students' misconceptions that all data is linear: We need to adjust the CCOG and perhaps add problems to the course supplement.
- To address students' inability to support their conclusions: We need to adjust the CCOG and perhaps add problems to the course supplement.
- To address students' misunderstanding of equivalence: At this time, equivalence is not an explicit topic in our CCOGs.
- To address student's misuse of percentage: We need to adjust the CCOG and perhaps add problems to the course supplement. We also need to discuss the needs of the CTE programs for use of percentage.

**III: Support.** In the discussion of what we would like to do, we realize that it is difficult to do more without additional support from the college. Here is our wish list:

- Required course orientation for new part-time faculty: This orientation might be online. Experienced part-time faculty might be interested in this orientation as well.
- Rotating release time for experienced faculty to mentor new faculty: Although we may not require mentoring, but we can create a culture that values mentoring and it will self-promote and be built into our culture.
- Compensation for part-time faculty: To encourage involvement in mentoring process, team-level meetings, SAC meetings, assessment, etc.
- Information to part-time faculty re: CCOG's: Part-time faculty may not be aware of the CCOGs or the importance of them. Even if they are, they may not understand our intention. CCOGs may not give a sense of the relative importance topics.
- Pedagogy/Best Practices/Collaboration: Most mathematics faculty members are trained as mathematicians, not mathematics educators. Having opportunities to discuss best practices in mathematics teaching is critical. Collaboration between faculty members should be valued by and supported by the college with release time for full-time faculty and compensation for part-time faculty. One outcome of the assessment process was a discussion about discipline specific Critical Friends groups or setting up Learning Communities for faculty to discuss how various concepts are important to the discipline, why certain topics may be conceptually difficult for students (considering research if available), discuss approaches used to teach particular concepts, and try different approaches in the classroom, reporting back to the group.
- SAC time that is specified for assessment related activities: This assessment process is very time-intensive. The Math SAC has so much other business that pulling 90 minutes to share the work of the Math LAS subcommittee was difficult to do. If we had a day (or two) that was intended for assessment only activity, the assessment process would be more manageable and there would be more time to focus on discipline-related changes to improve student learning. It is critically important that the time set aside for this allows for part-time faculty involvement. If this level of work continues indefinitely, faculty will burn out quickly and the interest that exists now for the process may evaporate. However, the time should interfere with instructing students; no more inservice days should be scheduled during the term.
- Students: There has been little involvement in students for what assessment means (or should mean) to them. With time and support, math faculty (and all faculty) could begin to find ways to involve students in the assessment process in a meaningful and beneficial way.