Annual Report for Assessment of Outcomes – MT

(For Degree, Certificate or Core Outcomes)

To complete this Assessment Report, please address the questions below, and send to *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).

The main conclusion of 2010 assessment was that we needed to expand our curriculum dedicated to equipment trouble-shooting. Even though equipment trouble-shooting skill has always been listed as the most important outcome of this program, very little time was dedicated for its training. Most of our equipment curriculum focused on teaching students to understand how equipment works. This is necessary as understanding of how equipment works is crucial in equipment trouble-shooting. And this understanding does take time to develop. After forced to be accountable for our stated program outcome, we quickly realized, however, that more time is needed to address trouble-shooting skills in our curriculum. Otherwise, it would be impossible to meet skill level desired by some of the employers of our students.

In 2009-2010 school year, our dedicated equipment trouble-shooting curriculum consisted of 32 in-class hours, 4 instructor demo scenarios and 7 student practice problems. (In addition to this, we also have separate circuit trouble-shooting training and vacuum trouble-shooting in other parts of the MT curriculum.) In 2010-2011 school year, we had 32 in-class hours, 9 instructor demo scenarios and 11 student practice problems. The total number of scenarios students go through (demo + practice) went from 11 last year to the current 20—almost doubled. This expansion of our equipment trouble-shooting curriculum ("The surge") definitely helped our students to become significantly more familiar with trouble-shooting.

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)

This report addresses the equipment trouble-shooting skill part of MT program outcome1.

a. Describe the method(s) you used.

We assessed 15 students altogether from 2 sessions at the end of term of MT228 (capstone class), which is at the end of their associate degree. We used on-demand performance of a trouble-shooting task as our assessment method. Instructors stage an error on equipment for a student to trouble-shoot. The student is assessed on his/her trouble-shooting process. The assessment was evaluated by the only instructor teaching this course against a rubric. See Appendix A for a description of the assessment.

b. Results: What did you learn?

After the expansion of our trouble-shooting curriculum, students overall did well in this assessment. Out of the total of 15 students assessed, 11 students were deemed proficient (79%), 3 were deemed non-proficient (21%) and 1 was an outlier. (The outlier student did not take vacuum class which was a pre-requisite to this class and he was mistakenly given a vacuum problem to trouble-shoot. So his failure did not represent his lack of trouble-shooting ability.) This result was better than I expected. It certainly serves as an assurance that the quality of our trouble-shooting curriculum can meet the requirement of the industry we are serving.

Some other lessons learned:

1. All 3 failures are related to electric signal trouble-shooting. Teacher shares some responsibility in that. Student learning there was not solid enough. Instructions in that area need to be more systematic. Should work out the order of wafer transfer demo examples better to introduce trouble-shooting methodology in ELL more systematically, sensor side 1st, then actuator side, then signal path, then interlock and software, etc.
2. In the same electric signal area, needs more hand-holding teaching and practice in electric probing. For some students, the electrical signal part is still quite "mysterious". Need to help them to demystify it. Some students did not get to practice this in their homework problems. In general, homework problems have to practice what we go over in class immediately after the topic is covered. May also need to cover electric signal probing twice: once in MT227 when covering wafer transfer systems, once in MT228 when covering trouble-shooting of wafer transfer systems.
3. Have demo examples documented down in handouts ready so that students can review the structure of trouble-shooting in demo cases.
4. Force students to write up the report while trouble-shooting, not after, to re-enforce the structure of trouble-shooting
5. Some students are still having problems with study method. Do not know how to review. Teacher has to force them to review through tests or homework. Otherwise they do not learn on their own. Raise this issue to the SAC.
6. Reading of complex gas flow schematics is difficult for students. Need a written homework assignment to re-enforce the learning on this once.
7. Can design written homework problems to practice test result interpretation to help with students who are not good at studying on their own
8. Go over the meta-thinking in trouble-shooting so that students can learn the methodology to trouble-shoot even unfamiliar problems
9. Time permitting, go over one advanced problem, how to deal with incomplete understanding and thus seemingly conflicting results, how to weigh various evidence strategically to decide on direction, how to isolate an interactive problem such as cutting off the interaction--such as software dictated interaction during overall etcher initialization by going through individual robot initialization (overall initialization tends to depend on many conditions of many stations)
10. Explain the overall context of systematic isolation method. Explain when one should skip the steps and observe clues directly ,etc.
11. Instructor should read through some literature on trouble-shooting methodology
12. Time permitting, always ask students to design the isolation tests first before instructor giving the answer in demo problems so that students develop the capability to solve problems on unfamiliar systems.
13. Wafer transfer trouble-shooting hw problems in MT227 were too simple, need to be more advanced.

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)

See above table.

Appendix A:

MT Troubleshooting Practical Test Description

<u>Test Description</u>:

Test Time: At the end of MT228 class, which is also usually the end of a student's MT curriculum. Each test can take up to 4~7 hours.

Test format: individual practical exam

Description: Instructor to set up one error scenario on a Lam Rainbow etcher ahead of time. Students are asked to trouble-shoot and fix the problem. The student can access schematics of the etcher. In the 1st part of the test, the student is asked to isolate the problem down to ever smaller blocks of the system using a systematic approach. After the problem is reasonably isolated, the student is given the freedom to solve the problem without following a systematic methodology in the second part.

Step 1: Perform a prescribed task on the etcher during which the student will discover an error. At this point the student will be asked to write down a problem statement.

Step2: Draw a block diagram of the whole system involved in the problem, including all the component blocks involved and their relations. Identify all possible culprit blocks and describe how they can produce the problem.

Step3: Design an isolation test for each block to see if that block is responsible for the problem. The test needs to be as much as possible definitive, comprehensive, and easy to implement. When writing out the tests in the following format:

Test description	Possible outcome	Conclusion

Step4: Prioritize the order of the tests based on the balance between how likely the cause is and how easy it is to implement the test.

Step 5: Implement the tests

Step6: Correctly interpret the test results and draw conclusion as to which one of the

After the first round of isolation, more rounds of isolation may be needed. However, students are no longer required to write down the steps. But the instructor can still choose to follow and grade the student in the isolation process.

Grading rubric: current version of the rubric only differentiates between two levels of performance: proficient and non-proficient. Proficiency criteria:

a) Can demonstrate a consistent pattern of being able to systematically isolate the problem. B) And with non-substantial help, can solve an intermediate problem. Or,

a) Can demonstrate a consistent pattern of being able to systematically isolate the problem. B) And with some substantial help, but not in majority of the time, can solve a difficult problem.

(From the trial run in 2011, students who can do a) can also do b) and vice versa.)

Failure to accomplish the above constitutes non-proficiency.

Gauging step/parts definition: of the steps required in systematic trouble-shooting above, these are the gauging steps upon which student proficiency level will be judged: breaking a system into blocks, identification of possible causes, design of isolation test, interpretation of test results.

Non-substantial help definition:

1) Any help in any of the non-gauging parts of the exam is not counted as substantial help. Example 1: help in defining the problem statement is not counted as substantial help. For example, if the ELL arm extension to load point was short. A student may not have noticed that. Then the arm would refuse to retract which caught the attention of the student. As a result, the student may think the problem is the failure to retract problem not the short extension problem, each with a somewhat different nature and possible cause. Instructor can shine some light on the real problem. It would not count as substantial help here. Example 2: In test implementation, if a student forgot to turn 24V actuator switch back before taking a sensor reading which requires 24V power on in implementing a test, and an instructor reminds the student of that, it is not counted as substantial help here. Example3, in test implementation, a student needs to shut of the main gas shut off valve. He thought it was called V2 instead of V5, an instructor corrects him, it is not counted as substantial.
2) After a student is able to demonstrate a consistent pattern of being able to perform a gauging task, if she makes a mistake in that area, and the instructor has to correct her, this help is not counted as substantial.
3) Help in interpretation of test that are factual in nature is not counted as substantial help (e.g. An instructor can provide a fact to a student which is needed to interpret a test result, such as “this sensor is active high, not low). Help in the logic of the test interpretation is substantial help.

Difficulty Level definition:

Intermediate level (two categories A+B):

Category A: Systems familiar to students (pneumatics, vacuum, gas delivery, entrance load lock arm, shuttle arm, load point lifter.)

1) Isolation tests: most if not all isolation test designs are known to students in a generic form. They may have to customize the design to their specific case.
2) Unlikely to identify it by chance or obvious clues
3) >= 2 rounds of isolation before getting to the culprit component.
4) No components in the system strongly interact with others (not an interactive problem). Not an intermittent problem.

Category B: Systems unfamiliar to students (pre-aligner, indexer, gap drive etc.)

1) Unlikely to identify it by chance or obvious clues
2) No restriction on minimal rounds of isolation
3) No components in the system strongly interact with others (not an interactive problem). Not an intermittent problem.

Difficult Level:

1) Not immediately obvious which system is responsible for the error: wafer transfer initialization error, multiple stations involved, Or
2) >= 3 rounds of isolation necessary to identify the culprit component, Or
3) Very complex system: many blocks at same level to eliminate from, Or
4) Isolation test is difficult to design, or
5) Unfamiliar system with medium complexity, or
6) Interactive problems, but
7) Not intermittent.

Annual Report for Assessment of Outcomes -- MT

(For Degree, Certificate or Core Outcomes)

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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.

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   This was not part of the critical thinking skills assessment of last year.

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)

This report addresses the component level understanding of process equipment part of MT program outcome1 (MT224).

a. Describe the method(s) you used.

We assessed this in the 2nd year class MT224 where this knowledge was covered. There was only one session of 18 students this year. All participated in this assessment. We used a written final exam and a practical final exam to assess students. The exam was then graded against the following rubric.

Rubric:

To construct a rubric, understanding of process equipment at a component level is broken down into the following aspects:

1) Identify basic components of a modern control system such as controllers, various sensor types, DC motors, stepper motors, AC motors, etc.
2) Understand the proper functions of each component. And be able to measure to discern whether a component functions properly.
3) Understand how these components work (e.g. describe how a stepper motor take discrete steps)
4) Perform simple calculations on the functionalities of these components (tell what resolution a 12 bit A/D converter gives; given the torque-speed curve of a motor, tell what torque is available at what speed)
5) Build, in an laboratory setting, simple systems in which these components can perform their basic functions (be able to use a computer to instruct a stepper motor to go 10 steps clock wise and 2 steps counter clock wise.)
6) Build a simple system where the various components can work together to achieve automatic control (be able to build a close loop control system with sensors, controllers and actuators to perform desired control tasks.)

   There is no curving in the scoring of the problems in the exams.

Aspects	Average score	Is this a problematic area?	% of students failed	What level students failed?*

		(Y if average <75%)		
1 Component ID	84	N	17%	2F+1C
2 Understand Functions	82	N	17%	3F
3. Understand Mechanism	85	N	11%	2F
4. Simple Calculations	78	N	22%	3F+1C
5+6 Build systems**	77	N	22%	2F+1B+1C

- Level of a student is defined by her overall score in the written final. (2F+1C) means 2 students with an F and one student with a C in the overall written final exam failed this problem.
- 5+6 require more advanced problem solving skills.

b. Results: What did you learn?

1. Students did well in most areas as evident by the averages. There are no problematic areas.

2. The only area that is somewhat weak is the simple calculations area. (Here we exclude system building area because it requires more advanced problem solving skills). We have known this for a while that our students are not strong in quantitative analysis, even simple ones. This area, however, is not such an important qualification to help them to become a good technician in the industry.

3. The F students are the ones who tend to fail in all areas. This fact, combined with the high average scores, suggests that the greatest cause of failure may be problematic individuals. Of the three failed students, one had health problems and skipped many classes, one had a busy schedule outside of class so did not have enough to study.

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)

Since the quantitative analysis part of this course is not so important in their future job, it may be useful to reduce coverage on it and shift the time resource to cover mechanical systems, which is not currently covered but is very important in trouble-shooting and maintenance later on.

Besides personal issues, another problem that probably played a large role in student failure is study habit. Many students are still in the "obligatory student" mode, not active learning mode. If there is no test on something, they may not spend time studying it. No accountability—no effort. For that reason, it is important to institute more tests in the term. Currently we do not even have a midterm and all lab grades are from group performance.

We cover quite a lot of material in this course. The instructor should emphasize to students what is important at the beginning and throughout the term not just at the end as it is done now.

Problem 3 and 4 in the written final tested students' ability to reason through a chain of cause-and-effect to predict the behavior of a system. To improve student performance, we should consider adding more exercises like them in the homework that work out a chain like this for hypothetical systems.

Test result from subsequent courses shows that students have a weakness in probing active circuit devices such as a transistor or a diode. Need to cover how to probe failures of active devices in MT224 or in earlier classes.

Annual Report for Assessment of Outcomes

Submitted: June 20, 2011

SAC: MT: Microelectronics Technology

Outcomes Assessed: MT AAS (and options): Troubleshoot Electronic Circuits (maps to Core Outcome: Critical thinking/Problem solving)

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)

Results from this focus on assessment of outcomes are only now becoming available. Thus at this point no changes have been made. Due to the extra focus this year on designing assessments to meet both PCC standards and Perkins standards it is likely faculty have spent less time on improving deficiencies exhibited under the normal assessments currently in use.

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)*

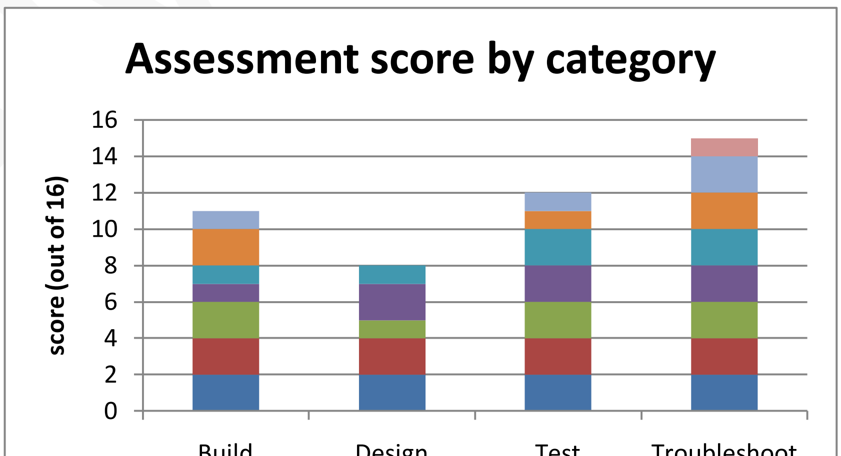
a. Describe the method(s) you used.

Critical Thinking and Problem Solving: This assessment was given at the end of spring term in MT113 Electronic Circuits and Devices III. The assessment is a one hour performance test in a lab setting. Students are required to design, build and test a circuit defined in the lab. The design requires use of skills learned in the course; building and testing the circuit requires skills developed in the lab over the three course sequence. This assessment involved one class of eight students.

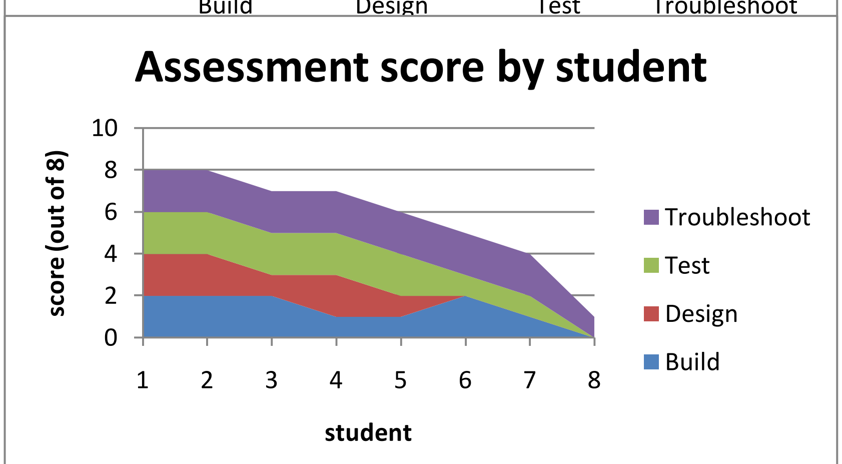
Assessed Outcome	Description	Evaluation
Build the circuit	Given a circuit schematic and the necessary parts the student should be able to connect the parts and necessary power supplies.	Two points each for successful completion, one point if successful with assistance, no points otherwise. Maximum 8 points possible.
Design the circuit/calculate specified test values	Utilize circuit analysis techniques covered in the classes the student should determine voltages and currents within the circuit	
Test the circuit	Using the available test equipment the student should be able to measure current and voltage at various points within the circuit.	
Troubleshoot the circuit	Given a description of improper operation of the circuit the student should be able to design and implement a set of tests to determine and explain what is wrong with the circuit.	

ii. Results: What did you learn?

The first figure shows the score for each student, organized by tested category. The weakest scores were in the design/calculation skills, the strongest in troubleshooting skills.



The second figure shows scores organizes by student. The area of each skill reaffirms the strong/weak relationship mentioned above, but this figure emphasizes how the scores also depend on the student.



Conclusions: I consider the first five students shown in the second figure as adequately demonstrating the outcome of problem solving in the environment of circuit analysis. Students six and seven also were able to successfully troubleshoot the circuit (think critically and solve the problem.) These students are trained to use a variety of tools to solve problems, specifically to examine a circuit to understand how it works, to theoretically calculate how it should work, and to test/measure how it should work. A student should be able to draw on their own strengths to solve the problem, and seven of these eight students were able to do this. What is difficult to conclude is where the shortcomings are. In this particular case student number eight is a transfer student who completed the first two courses of the tested sequence at another school. While that student demonstrates deficiencies in the tested outcome, the source of that deficiency is not in the MT program. Students six and seven also demonstrated specific weaknesses, but again these can be attributable to outside sources (missed classes, transferred credit, etc.)

3. Identify any changes that should, as a result of this assessment, be implemented towards improving students' attainment of degree and certificate 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)*

Careful attention must be paid to the circumstances as well as the assessment results. The greatest sources of deficiency demonstrated in this test are attributable to outside sources:

- Transfer
- Student study/learning habits
- Student life situations

These could be addressed by limiting access to the program, or raising the standards required of the students (effectively restricting access.) This seems unacceptable as it would limit how we can serve the students within our community, and it would also limit how we can serve their employers as we would produce fewer graduates to hire.

Looking at the overall results we could improve this outcome by strengthening the teaching of the design/calculation aspects of the program. This could be achieved by putting additional resources towards the topic: adding credits to the courses, reducing content from certain areas of the program, providing more learning resources (such as tutoring), etc. These factors are constantly considered within the department utilizing Advisory Committee input. It is considered that the current program is the best acceptable compromise between rigor and access.

One recommended modification would be to experiment with lab procedures such as required lab partners and reporting requirements.

Annual Report for Assessment of Outcomes

Submitted: June 20, 2011

SAC: MT: Microelectronics Technology

Outcomes Assessed: MT AAS (and options): Work Effectively in Teams (maps to Core Outcomes: Communication and Professional Competency)

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)

   Results from this focus on assessment of outcomes are only now becoming available. Thus at this point no changes have been made. Due to the extra focus this year on designing assessments to meet both PCC standards and Perkins standards it is likely faculty have spent less time on improving deficiencies exhibited under the normal assessments currently in use.

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)

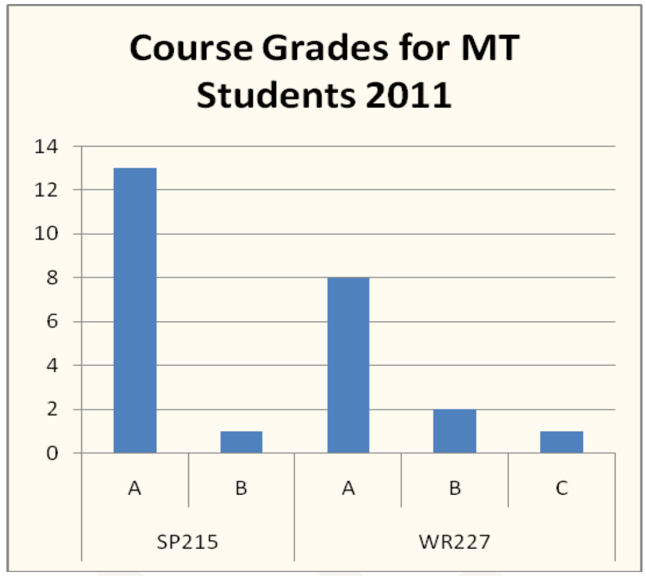
   a. Describe the method(s) you used.

   Currently the MT department includes no specific training or assessment of teamwork. We rely on the stated outcomes of specific general education courses required for the degrees:

   - WR227 Technical/Professional Writing: Work and problem solve effectively with others to achieve a common communication goal, using collaborative techniques, respecting the work of colleagues, and meeting deadlines; listen and speak reflectively.
   - SP215 Small Group Communication: Process and Theory
     1. Continue to adjust communicative behavior in order to improve the quality of small group interactions within various settings
     2. Manage projects, presentations, and small groups through learned communication strategies.
     3. Manage conflict through learned communication strategies within the small group setting.
     4. Use learned active listening skills in order to analyze and explain others' communicative behaviors within the small group

b. Results: What did you learn?

The figure at right shows the course grades earned by MT students in 2011 (fall and winter terms.) It is expected that a student earning an A would have exhibited well all of the outcomes of the courses as defined in the CCOGs. This data shows that 84% of MT students are earning A's in these courses, so it is expected that MT graduates are meeting the outcome for working in teams.



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It is not anticipated that the MT program will make any changes to the MT courses or program regarding the Teamwork outcome. To do so would require significant professional development and course development. Since the Writing and Speech departments already teach to this outcome, and have the expertise, work on this among the MT faculty would be a poor utilization of resources. If the MT department did take on this role it is expected that WR227, SP215 and SP130 would be eliminated from the degree requirements in order to accommodate the additional teaching and assessment time required.

It is expected that the Writing and Speech departments are evaluating their own courses regarding meeting their stated outcomes.

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   This was not part of the critical thinking assessment last year.

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)

This report addresses the system level understanding of process equipment part of MT program outcome1 (MT227).

a. Describe the method(s) you used.

The assessment was done in a written final exam in the MT227 class in which the topic of system level understanding of process equipment is covered. All students taking this class participated in the assessment totally 16. Only the parts from the exam relevant to this topic are analyzed for this assessment. The exam is then graded according to the following rubric.

b. Results: What did you learn?

Topics tested	Average score	Is this a problematic area? (Y if average <75%)	% failed	What level students failed?*
Subsystem list	94	N	0	0
Control system	79	N	19	1F+1D+1C
Signal tracing	74	Y	19	1F+1D+1C
Pneumatic symbols	95	N	0	0
Pneumatic block diagram	82	N	2	1C+1A
Wafer transfer system—ELL arm	56	Y	6	1B+2C+2D+1F
Total	82	N	6%	1F

- Level of a student is defined by her overall score in the written final. (2F+1C) means 2 students with an F and one student with a C failed this problem.

Overall, students did well in the assessment as evident in the decent average of the whole final exam. There are problematic areas though. Students had difficulty with signal tracing and the wafer transfer system. Both topics are considerably more complicated than the rest. With the current aptitude of our students, not all students would be able to successfully master these topics. In addition, wafer transfer system was covered right before the final so there was no homework with which students can reinforce their learning.

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)

Time permitting, instructor can develop some homework problems on wafer transfer system to reinforce the learning. There is no time to collect and grade this homework before the final exam. Instructor can give solution of the homework together with the assignment to students. Because the ELL arm part of the wafer transfer system is complicated, time permitting, instructor can develop a computerized 3-D model of the arm. If the model allows animation, it will be even better. This can help students to visualize the arm motion better.

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   This was not part of critical thinking assessment last year.

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

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This report addresses the equipment maintenance skill part of MT program outcome1.

a. Describe the method(s) you used.

Students in MT228 class were assessed. They were from 2 sessions of the class totally 15 in number. Most students take this class at the end of their degree. Students were graded on their on-demand performance of a maintenance procedure—upper electrode replacement. The procedure is a major part of a basic industry standard maintenance procedure (a wet clean).

The assessment was evaluated by the single instructor who teaches this class. The instructor observes individual student performing a representative part of this procedure (about 1/5 of the whole procedure), then grade him against the following rubric.

Grading Rubric:

Score	Level	Grading Criteria		
		Style and Form	Speed and Familiarity	Quality
90	Good	Minor imperfection	& fluent, no hesitation	& No issue
80	Pass	Substantial imperfections	Or some hesitations	Or Minor issues but no damage
60	Fail	N/A	Can not complete the procedure without major help from the written procedure	Or Damage

Damages to equipment or process examples: scratching the electrode, forget to mount a screw, torque out of spec (even with the help of a written procedure), missed torquing a screw, baffle plates in the wrong order, damaging the ceramic parts, did not align the 3 holes of the lower clamp ring right, etc.

Minor quality issues: potential to create some particles, scratching the baffle plates, O-ring mounting not smooth, did not wipe the oring correctly, did not inspect the o-ring for cracks,

Speed issues: dropped a screw into the lower electrode well, missed a step but recovered later on, etc.

b. Results: What did you learn?

Out of 15 students assessed, 13 passed, 2 failed. Both students who failed did not attend instructor's lecture on this procedure. Thus, they are not all that reflective of the student's inability here. Of the 13 passed, 10 were in the "Good" category. Based on this fact, I feel students learned very well in this area.

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)

Should emphasize to students that while they practice, the instructor is not with them to correct their mistakes. That is why their teammates need to read against the detailed instruction and requirement on this procedure step-by-step to judge and correct their mistakes while they practice this procedure.