

# PUGET SOUND CONSORTIUM FOR MANUFACTURING EXCELLENCE

## PSCME/Boeing Summer Workshop Report

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*October 2004*

The Puget Sound Consortium for Manufacturing Excellence (PSCME) is a dynamic education-industry partnership working towards building the connection between manufacturing technology education, student career goals, and private sector demand. In its final year, the PSCME is working to solidify its legacy in manufacturing technology education by ensuring the sustainability of the programs and processes developed during the funding period.

The PSCME has worked with its partners to modularize manufacturing technology curriculum based on existing industry skill standards. Modularized instruction provides for customization of instruction for students, potentially leading to degree obtainment. The modules have been piloted in a variety of workshops and institutions, and most recently in a Boeing Summer Workshop.

During the summer workshop at Boeing, high school students participated in the pilot of five modules: Safety in Manufacturing, Interpreting Technical Drawing, Precision Measurement, Management, and Interpersonal Effectiveness. At the end of each module the students and the instructor completed surveys (see Appendix) that assessed their perceptions of the module. Responses to the surveys were coded and the quantitative data was analyzed with the Statistical Package for the Social Sciences (SPSS) version 12.0. Frequencies and means were calculated for each closed-ended question. The open-ended responses were analyzed inductively and substantive categories were developed for each question. Students also completed a separate assessment rubric for each module.

### RESULTS

Seven high school students participated in the Boeing Summer Workshop, and almost all students completed a survey for each module (Safety in Manufacturing N=7, Interpreting Technical Drawing N=7, Precision Measurement N=7, Management N=6, and Interpersonal Effectiveness N=7). There were six male students and one female student. The participants' backgrounds included Asian American (N=1) and White/Caucasian American (N=6).

#### High School Student Survey

At the end of each module, students were asked to complete a survey regarding their impressions of the activities and suggestions for learning. It is important to note that some students had previous experience with the content in the Interpreting Technical Drawing and Precision Measurement modules. Overall, students felt they were not very challenged by the modules, with Interpreting Technical Drawing the least challenging. They reported that the module exercises were fairly effective in helping them learn the material, with Precision Measurement the most effective. In addition, students indicated that it was reasonably easy to stay focused on the modules, with the Safety in Manufacturing module the most difficult on which to remain attentive. Table 1 presents mean responses, with standard deviations, for three quantitative survey items pertaining to these topics. Responses were on four-point scales with

larger values indicating more positive attributes (e.g., 1=very unchallenging, 2=unchallenging, 3=challenging, 4=very challenging). It should be noted that some students had previous experience with two of the modules.

Table 1. High School Student Survey Results for Items 2, 3, and 4.

<b>Question</b>	Safety in Manufacturing <b>Mean, SD</b>	Interpreting Technical Drawing * <b>Mean, SD</b>	Precision Measurement * <b>Mean, SD</b>	Management <b>Mean, SD</b>	Interpersonal Effectiveness <b>Mean, SD</b>
How challenging was the module? (very unchallenging – very challenging)	2.14, .38	1.29, .49	1.86, .69	1.67, .52	2.00, .58
How effective were the module exercises in helping you learn the material? (very ineffective – very effective)	2.57, .53	3.00, .00	3.29, .49	2.67, .52	3.14, .38
How easy was it to stay focused on the module? (very difficult – very easy)	2.29, .49	3.00, .58	3.14, .69	2.50, 1.05	3.14, .69

\*Some students had previous experience with this content.

Students also reported that module objectives were clear, and that the objectives were met by the end of the module. Table 2 presents the mean responses, with standard deviations, for two quantitative survey items concerning objectives. Responses were either, yes=1, or no=2. Smaller values are more positive, indicating the modules' objectives were clear and met. Students unanimously agreed that the Precision Measurement and Interpersonal Effectiveness modules had clear objectives that were met by the end of the module.

Table 2. High School Student Survey Results for Items 5 and 6.

<b>Question</b>	Safety in Manufacturing <b>Mean, SD</b>	Interpreting Technical Drawing * <b>Mean, SD</b>	Precision Measurement * <b>Mean, SD</b>	Management <b>Mean, SD</b>	Interpersonal Effectiveness <b>Mean, SD</b>
Were the objectives clear?	1.29, .49	1.14, .38	1.00, .00	1.17, .41	1.00, .00
At the end of the module, did you feel that you met the objectives?	1.43, .53	1.14, .38	1.00, .00	1.17, .41	1.00, .00

\*Some students had previous experience with this content.

Students were also asked to respond to three open-ended questions concerning what they liked, what they learned, and how they would improve the modules. Student comments were analyzed for categories of response, shown in Table 3 below.

Table 3. High School Student Survey Results for Items 7, 8, and 9.

Question*	Safety in Manufacturing	Interpreting Technical Drawing*	Precision Measurement*	Management	Interpersonal Effectiveness
What did you like best about the module?	<ul style="list-style-type: none"> <li>Scoring shop safety (5)</li> <li>Information (1)</li> <li>Video (1)</li> </ul>	<ul style="list-style-type: none"> <li>Drawings (3)</li> <li>Making models (1)</li> <li>Activities (1)</li> </ul>	<ul style="list-style-type: none"> <li>Using tools for measurement (4)</li> <li>Different mechanical processes (1)</li> </ul>	<ul style="list-style-type: none"> <li>Video (3)</li> <li>Deming's 14 points (1)</li> <li>Car exercise (1)</li> <li>It changes the view of what I want to do (1)</li> </ul>	<ul style="list-style-type: none"> <li>Games/interaction (7)</li> <li>Speaker (1)</li> </ul>
What was the most important thing that you learned?	<ul style="list-style-type: none"> <li>Recognizing hazards (4)</li> <li>Recommendations for safety (2)</li> <li>On-the-job injuries and paperwork (1)</li> </ul>	<ul style="list-style-type: none"> <li>How to do drawings (4)</li> <li>Dimensional objects (1)</li> </ul>	<ul style="list-style-type: none"> <li>How to use/read tools (7)</li> </ul>	<ul style="list-style-type: none"> <li>Quality can lower costs (2)</li> <li>Everything is manufactured (1)</li> <li>Mechanical engineering is fun (1)</li> <li>Build for what the customer wants (1)</li> <li>Manufacturing is problem solving and evaluating (1)</li> </ul>	<ul style="list-style-type: none"> <li>It's not always necessary to agree (4)</li> <li>Teamwork is important (4)</li> </ul>
What would you suggest to make the module better?	<ul style="list-style-type: none"> <li>More details and facts (4)</li> <li>Add video (1)</li> <li>Add activities (1)</li> </ul>	<ul style="list-style-type: none"> <li>Adjust time, we had too much time (3)</li> <li>Clarify worksheet drawings and dimensions (2)</li> <li>Activities were too simple (2)</li> </ul>	<ul style="list-style-type: none"> <li>More challenging activities (3)</li> <li>Too much time (1)</li> <li>Use more measuring tools (1)</li> <li>Apply what we learned to a finished product (1)</li> </ul>	<ul style="list-style-type: none"> <li>Better activities &amp; exercises (2)</li> <li>Repeat the videos (1)</li> <li>More interaction (1)</li> <li>Bring in an actual manufacturing engineer (1)</li> </ul>	<ul style="list-style-type: none"> <li>More activities (3)</li> <li>Shorter time (2)</li> </ul>

\*Some students had previous experience with this content.

Note – totals may not add up to seven because of the open-ended nature of the questions and multiple opportunities to respond/not respond.

## Assessment Rubric for Student Learning

One National Visiting Committee (NVC) recommendation to the PSCME was to ensure that learning outcomes are measurable and student learning can be assessed. Toward this end, PSCME staff, the program evaluator, and other leaders developed student assessment rubrics (see Appendix for format). Each module had a slightly different assessment rubric for student learning. Also, for this pilot, students completed their own rubric to assess their understanding of concepts. Table 4 presents mean responses, with standard deviations, for the quantitative items on each rubric. All responses were on a four-point scale with larger values indicating more positive attributes (e.g., 1=poor understanding, 2=limited understanding, 3=good understanding, 4=excellent understanding). The lowest ratings were for the written safety test in the Safety in Manufacturing module. It should be noted that no student assessments were returned for the Management module.

Table 4. High School Student Assessment Rubric Results.

<b>Safety in Manufacturing</b>	<b>Identifying Hazardous Conditions Mean, SD</b>	<b>Accident Report Mean, SD</b>	<b>Written Safety Test Mean, SD</b>	<b>Class Participation Mean, SD</b>
Assessment Scores	3.57, .53	3.14, .69	2.57, .79	3.43, .53

<b>Interpreting Technical Drawing*</b>	<b>Skill Check 1 Mean, SD</b>	<b>Skill Check 2 Mean, SD</b>	<b>Class Participation Mean, SD</b>
Assessment Scores	3.71, .76	3.86, .38	3.57, .79

\*Some students had previous experience with this content.

<b>Precision Measurement*</b>	<b>Final Skill Check Mean, SD</b>	<b>Class Participation Mean, SD</b>
Assessment Scores	3.71, .49	3.71, .49

\*Some students had previous experience with this content.

<b>Interpersonal Effectiveness</b>	<b>Multiple Intelligences Exercise Mean, SD</b>	<b>Team Problem Solving Exercise Mean, SD</b>	<b>Class Participation Mean, SD</b>
Assessment Scores	3.00, .00	3.60, .55	4.00, .00

## **Summer Workshop Instructor Survey**

One instructor taught four of the modules that were pilot tested (Safety in Manufacturing, Interpreting Technical Drawing, Precision Measurement, Management), and a different instructor taught the module on Interpersonal Effectiveness. It is not informative to report an individual instructor's responses on each module, therefore rating sheets will be given to PSCME module curriculum developers. They are encouraged to review the instructor's surveys in order to make module-specific improvements. However, it is useful to report the range of instructor responses. For the Interpersonal Effectiveness module, the instructor's ratings ranged between "good" and "very good." For the Management module, the instructor's ratings were "good," except for an "average" rating for accuracy. For the Precision Measurement module, the instructor's ratings ranged between "average" and "very good." For the Interpreting Technical Drawing module, the instructor's ratings ranged between "fair" and "good." For the Safety in Manufacturing module, the instructor's ratings ranged between "average" and "good." The instructors reported on additional materials that were used, identified student gains, made suggestions for additions and deletions to the modules, identified challenges to using the modules, and made additional summary comments.

## **CONCLUSION**

The Boeing Summer Workshop provided another opportunity for the PSCME to pilot test the modules, make changes to the curriculum, and revise student assessment rubrics. Two instructors taught five different modules to seven students during the workshop. Students reported specific activities they liked in each module and could state what they learned. Students reported that the objectives were clear and were met by the end of the modules. On the other hand, the high school students felt the modules could include more challenging content. Some students felt there were particular modules that included too much time. The instructors who facilitated the modules reported favorable perceptions of the modules and included suggestions for improvement. The Interpreting Technical Drawing module had the lowest instructor ratings.

It is recommended that the PSCME staff and curriculum developer review the results of the student and teacher surveys. All five modules had areas that are in need of improvement according to those who were surveyed. It is also highly recommended that the teacher's responsibility include completion of the student assessment rubric. For this workshop, in which students completed their own assessment rubrics, the ratings were fairly high and did not seem to discriminate between students.

## Appendix

**Puget Sound Consortium for Manufacturing Excellence (PSCME)  
Module Curriculum Student Survey**

We would like to ask you questions about the PSCME Module Curriculum so we can make it better. You don't have to fill out the survey or answer all the questions. Please don't tell us your name. Circle one response for each question.

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1. Which module did you work with?

2. How challenging was the module?

**VERY UNCHALLENGING      UNCHALLENGING      CHALLENGING      VERY CHALLENGING**

3. How effective were the module exercises in helping you learn the material?

**VERY INEFFECTIVE      INEFFECTIVE      EFFECTIVE      VERY EFFECTIVE**

4. How easy was it to stay focused on the module?

**VERY DIFFICULT      DIFFICULT      EASY      VERY EASY**

5. Were the objectives clear?      **YES**      **NO**

6. At the end of the module, did you feel that you met the objectives? **YES NO**

7. What did you like best about the module?

8. What was the most important thing that you learned?

9. What would you suggest to make the module better.

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We want to make sure the module works well for all students.

10. Please describe yourself: (Circle all that apply.)

**BLACK/AFRICAN AMERICAN      PACIFIC ISLANDER      LATINA/O AMERICAN**  
**WHITE/CAUCASIAN AMERICAN      ASIAN AMERICAN      NATIVE AMERICAN/ALASKAN**  
**OTHER \_\_\_\_\_ (SPECIFY)**

11. Your Gender:      **MALE**      **FEMALE**

12. How much previous experience have you had with this content in prior classes?

1. I haven't had any experience – this is my first time exploring the content
2. I have been introduced to the content before – I have some previous knowledge
3. I have dealt with this content in-depth before – I have a lot of previous knowledge

## Example of Student Assessment Rubric

### Total Quality Management Module – Ratings by Activity

- |  |  |   |  |
|--|--|---|--|
| <p>1 =demonstrates poor understanding of core concepts</p> <ul style="list-style-type: none"> <li>• Cannot complete tasks</li> <li>• Makes frequent errors</li> <li>• Offers no suggestions</li> </ul> | <p>2 =demonstrates limited understanding of core concepts</p> <ul style="list-style-type: none"> <li>• can perform complete with supervision</li> <li>• makes occasional errors</li> <li>• offers suggestions</li> </ul> | <p>3 =demonstrates good understanding of core concepts</p> <ul style="list-style-type: none"> <li>• can complete tasks without supervision</li> <li>• makes few errors</li> <li>• offers effective suggestions</li> </ul> | <p>4 = demonstrates excellent understanding of core concepts</p> <ul style="list-style-type: none"> <li>• can teach tasks to others</li> <li>• makes no errors</li> <li>• offers creative &amp; effective suggestions</li> </ul> |
|--|--|---|--|

Activity 1. Quality Criteria Group Reports (G)	1	2	3	4
Reason for Rating:				
Activity 2. Natural Toys Simulation: Writing Group Mission Statements (D, I)	1	2	3	4
Reason for Rating:				
Activity 3. Skill Check 2: Demonstrating Customer Focus (A, D)	1	2	3	4
Reason for Rating:				
Class Participation (A)	1	2	3	4
Reason for Rating:				
<b>TOTAL SCORE</b>				
Summary Comments:				

**PUGET SOUND CONSORTIUM FOR MANUFACTURING EXCELLENCE (PSCME)  
MODULE EVALUATION SURVEY – INSTRUCTOR FORM**

This questionnaire is intended to provide information for PSCME planning and continued refinement of the Module Curriculum.

**Question 1:**

**Which module did you teach: (Circle one.)**

**Questions 2-14: Please indicate your perceptions the module on the following scale.**

	Poor	Fair	Average	Good	Very Good
3. Quality of learning activities in the module:	1	2	3	4	5
4. Module's ability to maintain students' interest:	1	2	3	4	5
5. Accuracy of module content:	1	2	3	4	5
6. Sequence of module activities builds conceptual understanding:	1	2	3	4	5
7. Module provides opportunities for students to apply new knowledge:	1	2	3	4	5
8. Module content's ability to address MTAG standards:	1	2	3	4	5
9. Alignment of module objectives with student assessments:	1	2	3	4	5
10. Module's transferability to college-level instruction:	1	2	3	4	5
11. Relevance to all students based on their own cultural/social experience:	1	2	3	4	5
12. Readiness of module for instruction:	1	2	3	4	5
13. Clarity of module instructions for teachers:	1	2	3	4	5
14. Flexibility of module for instructor modifications:	1	2	3	4	5
15. Module's usefulness as a teaching resource:	1	2	3	4	5

**Please respond to the following questions. Your comments are greatly appreciated!**

15. Was it necessary for you to create materials to use with the module? If so, why and what did you create?

16. From your perspective, what did your students gain from the module?

17. Are there areas of the module that should be strengthened, revised, or eliminated? If so, please list and explain suggested changes.

18. Additional comments: