

Puget Sound Consortium for Manufacturing Excellence Module Curriculum Report¹

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August 2003

BACKGROUND

The Puget Sound Consortium for Manufacturing Excellence (CME) is a dynamic education-industry partnership working towards building the connection between manufacturing technology education, student career goals, and private sector demand. The CME is working with its partners to modularize manufacturing technology curriculum based on existing industry skill standards. Modularized instruction will provide for customization of instruction for students potentially leading to degree obtainment. CME partner institutions and industry will have the ability to integrate CME modules into their programs.

The CME developed and/or revised a 19-module manufacturing curriculum. The curriculum was pilot tested by administering three modules to high school students at a summer workshop, and through curriculum reviews conducted by educator interns. The Office of Educational Assessment (OEA) was contracted to survey pilot participants' perceptions of the module curriculum for purposes of curriculum improvement. Surveys were administered to the high school student participants, module instructor, and educator interns. Feedback from these three sources is summarized in this report.

METHOD

High school students participated in three modules, Career Exploration, Shop Skills, and Manufacturing Engineering Field Trip, during a summer workshop. One instructor, with the assistance of a technical aide, facilitated all of the modules. Instruction was provided at Shoreline Community College utilizing the Manufacturing/Machining Lab, classrooms, and Computer Lab. The Manufacturing Engineering Field Trip was to a small factory, ACCRA Manufacturing, Inc., in Bothell, WA. ACCRA Manufacturing, Inc. is a world class supplier of precision machined details and assemblies. At the end of each module the students and the instructor completed surveys (see Appendix) that assessed their perceptions of the module. However, the instructor did not complete a survey for Career Exploration.

Instructors from a variety of disciplines and a variety of schools attended an Educator Intern Workshop facilitated by The Boeing Company. Participants were instructed to review the module curriculum. Each educator intern was assigned 1 or 2 modules to review using an MTAG Curriculum Evaluation Form. Educator interns reviewed the modules independently, or in a group of 2-3 people. At the conclusion of this process, educator interns completed a survey (see Appendix) assessing their perceptions of the curriculum modules that they had reviewed.

Responses to the surveys were coded and the quantitative data was analyzed with the Statistical Package for the Social Sciences (SPSS) version 10.0. 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. The results for each participant group are presented below.

¹Submitted as part of the evaluation of the Puget Sound Consortium for Manufacturing Excellence.

RESULTS

High School Students

Six high school students participated in the summer workshop, and almost all students completed a survey for each module (Career Exploration N=5, Shop Skills N=6, Manufacturing Engineering Field Trip N=6). All students will be in the 12th grade in the fall of 2003. There were five (83%) male students, and one (17%) female student. The participants were from diverse backgrounds: Asian American (n=3, 50%), White/Caucasian American (n=1, 17%), and other (Ukrainian, Vietnamese) (n=2, 33%).

Overall, students were not very challenged by the modules, but they reported that the module exercises were effective in helping them learn the material. Moreover, students indicated that it was easy to stay focused on the modules. Table 1 presents mean responses, with standard deviations, for three quantitative survey items. 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). The Shop Skills module was rated as most challenging, with the most effective exercises, and it was most easy to stay focused on this module.

Table 1. High School Student Survey Results for Items 5, 6, and 7

Question	Career Exploration (N=5) Mean, SD	Shop Skills (N=6) Mean, SD	Manufacturing Engineering Field Trip (N=6) Mean, SD
How challenging was the module? (very unchallenging – very challenging)	2.60, .55	3.00, .00	2.00, .00
How effective were the module exercises in helping you learn the material? (very ineffective – very effective)	3.20, .45	3.83, .41	3.17, .40
How easy was it to stay focused on the module? (very difficult – very easy)	3.00, .00	3.17, .75	3.00, .71

Students also reported that the 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. 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 Shop Skills module and Manufacturing Engineering Field Trip module had clear objectives that were met by the end of the module.

Table 2. High School Student Survey Results for Items 8 and 9

Question	Career Exploration (N=5) Mean, SD	Shop Skills (N=6) Mean, SD	Manufacturing Engineering Field Trip (N=6) Mean, SD
Were the objectives clear?	5.00, .00	1.00, .00	1.00, .00
At the end of the module, did you feel that you met the objectives?	1.20, .45	1.00, .00	1.00, .00

Students were asked three open-ended questions. Responses to these questions were analyzed for emergent themes. The themes and frequency of occurrence are presented for each question in Table 3

on page four. The responses may not sum to the number of participants because of non-response and/or multiple responses.

Instructors

One instructor taught the three modules that were pilot tested, but only completed a survey for two modules, Shop Skills and Manufacturing Engineering Field Trip. It is not informative to report the instructor's responses in aggregate, given that only two modules were rated. CME module curriculum developers are encouraged to review the instructor's surveys in order to make module specific improvements. However, for both modules, this instructor's ratings ranged between "average" and "very good." The instructor reported the need to create additional materials for both modules, identified student gains, made suggestions for additions and deletions to the modules, identified challenges to using the modules, and made additional comments.

Educator Interns

Twenty-seven instructors participated in the Educator Intern Workshop. Twenty-three educator intern surveys were completed. Two surveys were excluded from the analysis because one respondent indicated his/her ratings were based on perceptions of the module as if it had been revised, and the other survey was excluded because the respondent did not indicate which module was reviewed. The educator interns teach in a variety of disciplines. The respondents teach courses in English, Spanish, math, science, business, social studies, special education, computers/technology, leadership, career planning, media studies, construction, and automotive and small engine repairs.

Of the nineteen modules, nine were reviewed by the educator interns: Module 2) Interpersonal Effectiveness, Module 3) Safety in Manufacturing, Module 4) Hazardous Materials, Module 6) Career Exploration, Module 9) Total Quality Management (TQM), Module 11) Computer Applications, Module 13) Applied Mathematics, Module 14) Precision Measurement, and Module 18) Job Readiness. Respondents indicated their perceptions of each module on several criteria using a five-point scale (1=poor, 2=fair, 3=average, 4=good, 5=very good). Table 4 presents the rating criteria and the mean ratings with standard deviations for each module.

Respondents could provide additional comments about the modules they reviewed. Comments were provided for modules 4, 6, 9, 11, 13, and 18 and they are summarized below.

Module 4: Hazardous Materials

- Good, needs sequencing work (2)
- Important topic, module needs strengthening (1)
- Rewrite, include higher levels of thinking and greater relevance (1)

Module 6: Career Exploration

- Base module on assessment tests (1)
- speakers need one hour each (1)
- should be exploratory not definitive (1)
- encourage students to leave comfort zones (1)
- show students (hands-on) they have the ability for vocational fields (1)

Table 3. High School Student Survey Results for Items 10, 11, and 12

Question	Career Exploration (N=5)	Shop Skills (N=6)	Manufacturing Engineering Field Trip (N=6)
What did you like best about the module?	<ul style="list-style-type: none"> • Future planning/career information (3) • Other (2): campus tour, H-7 timeline 	<ul style="list-style-type: none"> • Using/seeing/understanding machines/technology (6) 	<ul style="list-style-type: none"> • Future planning/career information (1) • Using/seeing/understanding machines/technology (3) • Visiting a factory (4)
What was the most important thing that you learned?	<ul style="list-style-type: none"> • Career information/variety/what's right for me/future planning (3) • Specifics about engineering/programming: work environment/pressure (2) 	<ul style="list-style-type: none"> • How machines work/how to use machines (4) • Importance of safety (2) • Other (1): the Bridgeport 	<ul style="list-style-type: none"> • Career information/variety/what's right for me/future planning (2) • Specifics about engineering/programming: work environment/pressure (2) • Manufacturing process/is a process (2) • How machines work/how to use machines (1) • Other (1): teamwork
What would you suggest to make the module better?	<ul style="list-style-type: none"> • Clearer/more specific instructions/explanations/louder speakers (2) • More career information/job title lists/college offerings (3) • Good/no suggestions (1) • Other (1): more interaction 	<ul style="list-style-type: none"> • Clearer/more specific instructions/explanations/louder speakers (1) • More fun/useful projects/choice of projects/do a project at the factory (3) • Good/no suggestions (2) • Other (1): more time with each tool 	<ul style="list-style-type: none"> • Clearer/more specific instructions/explanations/louder speakers (2) • More fun/useful projects/choice of projects/do a project at the factory (1) • Good/no suggestions (1) • Other (3): need chairs, show more details on site, more actual machining

Table 4. Educator Intern Survey Responses

Criteria (1=poor, 2=fair, 3=average, 4=good, 5=very good)	Module Number* Mean (SD)								
	2 n=2	3 n=3	4 n=4	6 n=3	9 n=1	11 n=2	13 n=3	14 n=1	18 n=2
Quality of learning activities in the module	4.00 (0)	4.00 (0)	3.75 (1.50)	2.00 (1.00)	5.00	1.00 (0)	3.00 (1.00)	3.00	3.50 (.71)
Module's ability to maintain students' interest	4.00 (0)	3.00 (1.00)	3.75 (1.50)	1.33 (.58)	4.00	1.00 (0)	2.00 (1.00)	5.00	3.50 (.71)
Accuracy of module content	4.00 (0)	4.33 (1.15)	3.50 (1.91)	1.67 (.58)	4.00	2.00 (1.41)	4.00 (0)	4.00	3.50 (.71)
Sequence of module activities builds conceptual understanding	3.00 (0)	4.00 (0)	2.75 (.96)	1.00 (0)	4.00	2.00 (1.41)	3.00 (0)	4.00	3.00 (0)
Module provides opportunities for students to apply new knowledge	3.00 (0)	3.67 (.58)	3.50 (1.29)	2.00 (1.00)	5.00	1.00 (0)	2.33 (.58)	3.00	3.50 (.71)
Module content's ability to address MTAG standards	4.00 (0)	4.33 (.58)	3.75 (1.50)	2.33 (.58)	4.00	1.50 (.71)	2.33 (.58)	5.00	4.00 (0)
Alignment of module objectives with module assessments	3.50 (.71)	3.67 (.58)	3.50 (1.29)	2.33 (.58)	3.00	1.00 (0)	3.33 (1.15)	4.00	3.50 (.71)
Module's transferability to college-level instruction	2.50 (.71)	3.67 (1.15)	2.33 (1.52)	2.00 (1.73)	4.00	1.50 (.71)	2.00 (0)	4.00	3.00 (0)
Relevance to all students based on their own cultural/social experience	3.00 (0)	4.00 (1.00)	3.00 (1.83)	2.67 (1.15)	3.00	1.00 (0)	3.33 (.58)	4.00	5.00 (0)
Readiness of module for instruction	3.00 (1.41)	3.67 (.58)	3.00 (1.83)	1.33 (.58)	5.00	1.00 (0)	2.33 (.58)	4.00	2.50 (.71)
Clarity of module instructions for teachers	2.50 (.71)	4.33 (.58)	3.25 (1.50)	1.33 (.58)	4.00	1.00 (0)	3.33 (.58)	4.00	3.00 (0)
Flexibility of module for instructor modifications	3.50 (.71)	4.00 (1.00)	3.50 (1.29)	2.33 (.58)	3.00	1.00 (0)	3.33 (.58)	4.00	4.00 (0)
Module's usefulness as a teaching resource	4.00 (0)	4.00 (0)	3.25 (1.71)	2.00 (0)	5.00	1.00 (0)	2.67 (.58)	4.00	3.50 (.71)

*Module 2: Interpersonal Effectiveness, Module 3: Safety in Manufacturing, Module 4: Hazardous Materials, Module 6: Career Exploration, Module 9: Total Quality Management (TQM), Module 11: Computer Applications, Module 13: Applied Mathematics, Module 14: Precision Measurement, and Module 18: Job Readiness

Module 9: Total Quality Management

- Module's effectiveness depends on instructor's ability to lead discussions (1)

Module 11: Computer Applications

- Very poor: requires complete revision: too much material, too much lecturing, no resources (1)
- Break into 4/5 modules (1)
- Bring in more activities (1)
- Make suggested changes (1)

Module 13: Applied Mathematics

- Math problems were not applied (2)
- Could address more competencies (1)
- Grammatical/spelling errors (1)
- Few connections to core competencies (1)
- Handouts lacking/missing (1)

Module 18: Job Readiness

- Refine for post-secondary level and emphasize setting themselves apart from other applicants (1)

The educator interns rated modules 6) Career Exploration and 11) Computer Applications least favorably. The most favorable ratings were allocated to module 3) Safety in Manufacturing, 9) Total Quality Management, and 14) Precision Measurement. It is important to note that only one person rated module 9 and 14, and thus, the ratings represent one opinion. Respondents' additional comments focused on module improvements. Curriculum developers may want to consider these suggestions when revising the modules.

CONCLUSIONS

The manufacturing technology module curriculum was pilot tested with three participant groups: high school students, instructors, and educator interns. Overall, the high school students reported positive impressions of the modules. Students reported that the objectives were clear and that objectives were met by the modules' end. In addition, the high school students indicated that it was easy to stay focused on the module and the exercises were helpful in learning the material, but they did not find the modules very challenging. The instructor who facilitated the modules also reported favorable perceptions of the two modules for which surveys were completed. On the other hand, the educator interns were less favorable in their ratings of the nine modules reviewed. Furthermore, educator interns made several suggestions for revisions to improve the modules that they reviewed such as include more activities, subdivide the modules, and address more competencies. CME curriculum developers may want to consider making the modules more challenging for students, and they may want to implement the specific suggestions for improvement made by the pilot instructor and the educator interns. Once revisions have been made to the module curriculum, additional pilot testing could be conducted to further refine the modules.

Appendix

PUGET SOUND CONSORTIUM FOR MANUFACTURING EXCELLENCE (CME)

MODULE CURRICULUM TEACHER SURVEY

This questionnaire is intended to provide information for CME planning and continued refinement of the Module Curriculum. Responses to the survey will be summarized by the UW Office of Educational Assessment.

Question 1:

Which module did you teach: (Circle one.)

Career Exploration

Manufacturing Engineering Field Trip

Shop Skills

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. What could be added to the module (please specify which module)?

18. *What could be deleted from the module (please specify which module)?*

19. *What were the challenges of using the module (please specify which module)?*

Additional comments on module: (Please include any comments students made while working on module activities.)

PUGET SOUND CONSORTIUM FOR MANUFACTURING EXCELLENCE (CME) AND MANUFACTURING TECHNOLOGY ADVISORY GROUP

MODULE CURRICULUM EDUCATOR INTERNS SURVEY

This questionnaire is intended to provide information for CME planning and continued refinement of the Module Curriculum. Responses to the survey will be summarized by the UW Office of Educational Assessment.

Question 1: Which module did you review? (Circle one)

- MTAG Orientation
- Interpersonal Effectiveness
- Safety in Manufacturing
- Hazardous Materials
- Introduction to Manufacturing
- Career Exploration
- Manufacturing Engineering Field Trip
- Quality and the Customer
- Total Quality Management (TQM)
- Statistical Process Control
- Computer Applications
- Technical Drawing Interpretation
- Applied Mathematics
- Precision Measurement
- Manufacturing Planning
- Labor in Industry
- Shop Skills
- Job Readiness
- Capstone Project

Question 2: Please list the categories of subjects you teach (i.e., math, science, computers, English):

Questions 3-15: Please indicate your perceptions the module on the following scale.

Poor	Fair	Average	Good	Very Good
16. Quality of learning activities in the module:	1	2	3	4 5
17. Module's ability to maintain students' interest:	1	2	3	4 5
18. Accuracy of module content:	1	2	3	4 5
19. Sequence of module activities builds conceptual understanding:	1	2	3	4 5
20. Module provides opportunities for students to apply new knowledge:	1	2	3	4 5
21. Module content's ability to address MTAG standards:	1	2	3	4 5
22. Alignment of module objectives with student assessments:	1	2	3	4 5
23. Module's transferability to college-level instruction:	1	2	3	4 5
24. Relevance to all students based on their own cultural/social experience:	1	2	3	4 5
25. Readiness of module for instruction:	1	2	3	4 5
26. Clarity of module instructions for teachers:	1	2	3	4 5
27. Flexibility of module for instructor modifications:	1	2	3	4 5
28. Module's usefulness as a teaching resource:	1	2	3	4 5

Question 16: Additional comments?