SUMMARY

The Southeast Michigan Alliance for Reinvestment in Technological Education (SMARTE) is a consortium of community colleges, school systems, Wayne State University (WSU), and businesses in southeast Michigan formed in September 1993. The alliance exists to promote communication and cooperation among its partners to address mutual needs pertaining to education of the technological workforce. The specific mission of this virtual center is to collaboratively focus on restructuring product design curricula and teaching practices with authentic activities in an application mode.

In the fast changing world of science and technology, there exists a need for an integrated educational experience for middle school students so that students and their parents appreciate the fact that technical education provides viable career opportunities. Students at the middle school level should be nourished to become talented technicians, technologists, and engineers as they proceed into the world of technological development. One of the important activities of the consortium is to organize enrichment activities of middle school students. A curriculum is designed for 8th grade students. In a lab based setting, CAD/CAM, computers and programming, engineering principles, and electrical/electronics are taught jointly by a team of faculty from community college, university, and middle school.

A total of 62 students participated in pilot settings of three sessions. One program was organized over two consecutive Saturdays at Oakland Community College (OCC) and a similar program for a different group of students was organized at Schoolcraft College. A two week long session for a third group of students was offered at WSU. This paper shares the curriculum components, students learning, laboratory setting, students’ perceptions of technical curricula, and lessons learned. Additionally, this brief report identifies outcomes of this enrichment activity for 8th grade students.

INTRODUCTION

According to the 1986 report, A Nation Prepared, there is a direct link between economic growth in the United States and the skills and abilities of the people who contribute to that growth [4]. According to the US Bureau of Labor Statistics, under represented groups, including women, will represent nearly 70% of the new entrants into the labor force by the year 2000 [5,6]. Population projections indicate that the non-white racial/ethnic groups will constitute an increasing percentage of the total US population. Demographic realities indicate an urgent need for intervention to assist and promote the representation of all people and especially under represented ethnic/racial groups and women in careers that contribute to society through education, creation of new learning environments, and transfer of skills to future generations.

In the areas of science, engineering, and technology, Public Law 99-383 gives special, directed purpose for increasing the representation of under represented groups. The task force established under the auspices of the legislation reported the following: America faces a shortfall of scientists and engineers by the year 2000; and these shortfalls can only be met by utilizing all of our nations’ talent, i.e., women and under represented ethnic/racial groups [7].
The Southeast Michigan Alliance for Reinvestment in Technological Education (SMARTE) is a consortium of community colleges, school systems, WSU, and businesses in southeast Michigan formed in September 1993. The alliance exists to promote communication and cooperation among its partners to address mutual needs pertaining to education of the technological workforce. Its mission is to work collaboratively in a virtual center that focuses its efforts on restructuring of technical curricula and teaching practices in mathematics and science with integration of authentic activities in an application mode.

During the last year, three enrichment programs for middle school students were organized by the consortium. This paper explains curriculum components, teaching pedagogy, recruitment of students, interactions with parents, impressions of students, and other lessons learned to address the pipeline issue of the technical workforce.

ENRICHMENT PROGRAM

In today’s technological environment, technical curricula both at associate and baccalaureate levels can benefit tremendously in many ways from integrated education [8,9,10,11]. Instruction in engineering education calls for urgent attention to preparing proficient technicians, technologists, and engineers for the scientific and technological world. Hence, there is an urgent need to look at the technical curricula in order to decide on the foremost ways to integrate basic sciences, mathematics, computers, and communications to make technical discipline more inviting. This should be extended to K-12 education as well. Various models are presently available to give contemporary students applied scientific knowledge to prepare them to face the demands of a technological environment [11].

The SMARTE Enrichment Program was prepared and taught jointly by a team of faculty and educators from WSU, Oakland Community College, Schoolcraft College, and Detroit Public Schools. The primary focus of the project is to increase student interest in technical disciplines. A curriculum was designed for 8th grade students to explore applications in engineering and technology. A first pilot program, for two Saturdays in May 96, was organized for 20 students at the Auburn Hills Campus of OCC. The curriculum involved 90 minute long lab based sessions on computer programming, electrical/electronics, CAD/CAM, and engineering principles. Table 2 shows a typical program for whole day. A similar two Saturday program was also organized in October 96 at Schoolcraft College. A two week program was organized in June 96 at WSU. Table 3 shows enrichment program participation by 8th grade students and their parents.

RECRUITMENT OF STUDENTS

Initially, a colleague from the WSU College of Education contacted principals/counselors at each middle school that was targeted by this project. For each program, letters of invitation were mailed to principals and counselors at the area middle schools. The following information was also sent: SMARTE Brochure, SMARTE latest newsletter, table showing the full curriculum and activity, orientation program, student application forms, and student essay forms. Application forms required parent’s and counselor’s endorsements. Our goal was to provide this enrichment activity to an average student. Also, the invitation letters were signed by faculty members from Engineering Technology and Education. About ten days prior to the application due date, a telephone contact was made with each middle school.

WORKSHOP ORIENTATION PROGRAM

Upon selection of students, letters were sent to parents and principals of middle schools. A special orientation program was organized for parents and students as shown in Table 1. This was an important opportunity to reach out to general populous publicizing the fact that technical education provides a viable career. A film, viz., Skill Trades and Engineering: Explore the Possibilities, was shown as part of the program. Many parents had not visited a neighboring college and this was our opportunity to promote technical programs as well as other opportunities the institution provided.

There was a lot of informal interaction with parents pertaining to their children’s schools, career paths, etc.
Parents were also given a separate packet of information containing class schedules, room numbers, faculty/teacher names, and coalition contact persons. Parents were required to provide health insurance information and were required to sign release forms to allow use of their child’s pictures and names in our publications. Each student was provided a T-shirt which displayed our logo, list of participating institutions, and NSF support recognition.

STUDENT AND PARENT PERCEPTIONS

At the last class of the program, each student was asked to fill out an assessment of their perceptions of the enrichment program. Table 4 contains specific answers for all three sessions combined. Almost all the comments and evaluations were positive. In general, students were very impressed with their exposure to technical disciplines. Many asked if they would be invited to a similar program again. An award ceremony was organized at the conclusion of the program which was well attended by students’ families. A group picture of students, their parents, and teachers/faculty was taken for publication on the web page (http://ozric.eng.wayne.edu/SMARTE). Parents and students were invited to contact teachers/faculty for career counseling. Some parents and students requested information about various courses and programs offered by the host institution.

CONCLUSIONS/RECOMMENDATIONS

In the era of declining enrollments and tremendous need for technically trained personnel, it is very important that the engineering and technology faculty take on this task of spreading the message that technical education provides viable careers. A major challenge for professional curricula is to develop an appropriate response to the rapid advances in technology and needs of the workforce. Suitable curricula should provide students with a solid purpose to pursue new challenges. With a view to serve the needs of the technological community, this activity was conducted using existing models that were tailored to invite future professionals.

The curriculum presented to 8th grade students was well received by students. There were concerns on part of faculty about our ability to teach middle school students and to our ability to explain the technical subject matter. In the first session, some faculty had to reach out for additional things to do beyond what was planned. Since the teaching was taking place in lab setting, it was not difficult to introduce additional material. About 2-3 additional teachers/faculty and graduate/undergraduate students were available to help the subject area lead faculty. General consensus was that if middle school students are exposed to more technical skills and knowledge, more they were willing to learn. We did not observe boredom among them.

It is equally important that our faculty continue to work with school teachers to address and explore techniques for similar models to be used in school systems.

ACKNOWLEDGMENTS

The authors would like to thank the following for their very valuable contributions and dedication in developing various curriculum components and this program: Cora Eubanks and Gary Gold from Detroit Public Schools, Robert Powell from Oakland Community College, Catherine Ferman from Schoolcraft College, Rahmatollah Golshan from Wayne County Community College, and Lisa Anneberg and Chih-Ping Yeh from WSU. Special note of appreciation goes to our graduate student, Puneet Dhaka for taking care of so many details. This project was funded by National Science Foundation’s Advanced Technological (ATE) Program Grant # 9553692.

BIBLIOGRAPHY

1983.

Table 1. SMARTE Enrichment Workshop
Orientation for 8th Grade Students and Parents

| Place: OCC Auburn Hills Campus, Room T1 |
| Time: 7:00 pm               Date: April 29, 1996 |

**Agenda:**

- Welcome Joella Gipson-Simpson, WSU
- Barbara Einhardt, Interim OCC Auburn
- President, Hills Campus
- Introductions Robert A Powell, OCC
- History of SMARTE Mulchand S Rathod, WSU
- Purpose of Workshop Catherine Ferman, Schoolcraft C
- Industry Perspective Erin McReynolds and Jean Ball
- OCC Co-op Students, United Technologies
- UAW GM Film [12]
- Workshop Guidelines Cora Eubanks, DPS
- Questions/Concerns
- Lab Tour

Table 2. SMARTE Enrichment Workshop for 8th Grade Students

<table>
<thead>
<tr>
<th>First Day</th>
<th>Last Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30 am</td>
<td>Registration T6</td>
</tr>
<tr>
<td>9:00 am to 10:30 am</td>
<td>Computer Lab A360/A350B Lisa Anneberg</td>
</tr>
<tr>
<td>10:40 am to 12:10 pm</td>
<td>Electrical/Electronics A360/A350B Chih-Ping Yeh</td>
</tr>
<tr>
<td>12:10 pm to 12:50 pm</td>
<td>Lunch T6 Joella Gipson</td>
</tr>
<tr>
<td>12:50 pm to 2:20 pm</td>
<td>CAD/CAM A417 Gary Gold</td>
</tr>
<tr>
<td>2:30 pm to 4:00 pm</td>
<td>Engineering Principles A109 Robert Powell</td>
</tr>
<tr>
<td>4:10 pm to 4:30 pm</td>
<td>Awards Program</td>
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</table>
Table 3. Enrichment Program Participation

<table>
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<tr>
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<th>OCC</th>
<th>WSU</th>
<th>Schoolcraft</th>
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</thead>
<tbody>
<tr>
<td>Orientation</td>
<td>31 F</td>
<td>18 F</td>
<td>29 Female</td>
</tr>
<tr>
<td>Program</td>
<td>17 M</td>
<td>11 M</td>
<td>31 Male</td>
</tr>
<tr>
<td>Workshop</td>
<td>23 F</td>
<td>11 F</td>
<td>9 Female</td>
</tr>
<tr>
<td></td>
<td>2 M</td>
<td>5 M</td>
<td>12 Male</td>
</tr>
<tr>
<td>Award Ceremony</td>
<td>35 F</td>
<td>27 F</td>
<td>28 Female</td>
</tr>
<tr>
<td></td>
<td>19 M</td>
<td>21 M</td>
<td>29 Male</td>
</tr>
</tbody>
</table>

Table 4. Workshop Evaluation Summary

Number of Responses: 52

<table>
<thead>
<tr>
<th></th>
<th>Unsatisfactory</th>
<th>Satisfactory</th>
<th>Good</th>
<th>Very Good</th>
<th>Excellent</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Computers</td>
<td>0</td>
<td>2</td>
<td>19</td>
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<td>48</td>
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<tr>
<td>Electrical/Electronics</td>
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<td>10</td>
<td>19</td>
<td>31</td>
<td>40</td>
</tr>
<tr>
<td>CAD/CAM</td>
<td>4</td>
<td>2</td>
<td>12</td>
<td>25</td>
<td>58</td>
</tr>
<tr>
<td>Engineering Principles</td>
<td>10</td>
<td>25</td>
<td>21</td>
<td>17</td>
<td>27</td>
</tr>
</tbody>
</table>

2. What have you gained from the workshop?

A. How to use CAD/CAM, draw on computers
B. Vectors, Scalars, How to crate screen savers.
C. More familiar with computer problems.
D. Where technology can used.
E. Gained new knowledge of engineering, how it benefits world around you.
F. Learned more about engineering principles, electronics, etc.
G. How to use QBASIC, different computer programs.
H. How to actually understand computers.
I. Problem solving strategies.
J. Learned what engineers to do.
K. Learned some new terms.
L. Frequencies, oscilloscopes, generators, meters.
M. Ability to withstand tremendous boredom.
| 3. What did you like the most? | A. Working on CAD/CAM, drawing on computer.  
B. Computer class, playing music, QBASIC, Internet, happy face, screen saver.  
C. Electrical/Electronics, switchboard radio.  
D. Internet.  
E. The whole thing.  
F. Engineering principles, physics balance machine.  
G. Lunch. |
|---|---|
| 4. What did you like the least? | A. Engineering principles - too boring (21)  
B. Electrical/Electronics - class too loud, too high tech (12)  
C. CAD/CAM - confusing, boring, did not work, examples (6)  
D. I liked them all, none, too short, expensive vending machine (7)  |
| 5. Comments/Suggestions: | Make classes shorter; provide better food, better-T-shirt color; make program longer; would like to come back; it was true experience for me; what I learned I would probably never learn at my school; program was excellent; it helped me understand what technology is about; at times it was boring; this is a very good program; would like to participate in other SMARTE program; what I have learned I will be able to use in future; I think there are more exciting things to learn; the computer world is advancing and there are more exciting things to learn; the program was excellent!!! |

### BIOGRAPHY OF AUTHORS

**Mulchand S. Rathod:** Mulchand S. Rathod, PhD, PE is the Chair and Professor of Division of Engineering Technology at Wayne State University since 1987. Upon joining WSU, he has been instrumental in starting three new undergraduate and a graduate program. He established student chapters of SME and Tau Alpha Pi and is the founding leader of the Professional Order of Engineering Technology. His prior appointments include State University of New York at Binghamton, Tuskegee University, Jet Propulsion Laboratory, and IBM. A registered Professional Engineer, he is active in ASME at regional and national levels, SME, ASHRAE, and ASEE. He served as a Commissioner on the TAC of ABET during 1989-95 period. A holder of numerous publications and inventions, he is listed in several Who’s Who publications. He was awarded the 1995 Dedicated Service Award by ASME and is a recipient of Certificates of Recognition from NASA and IBM for technical innovation. Also, a recipient of numerous grants and contracts, Dr. Rathod is a nationally known leader in Engineering Technology education arena.

**Joella Gipson:** Joella Gipson, PhD, is a professor in the College of Education at Wayne State University since 1972. Her special academic areas include mathematics education, curriculum and instruction and computers. She serves as a Co-Director of Students’ Opportunities in the Sciences, a program for 7th grade girls in mathematics, computers, physics and astronomy funded by the National Science Foundation. She is a member of the SMARTe Project for parents and 8th grade students in computers and engineering principles. Dr. Gipson served as an administrator, mathematics department chairperson and teacher in the Los Angeles Unified School District during the period 1960-69. She received a baccalaureate degree from Mount Saint Mary’s College, a master’s degree from the State University of Iowa, and a doctorate degree from the University of Illinois. A Fulbright Scholar, Dr. Gipson is a member of several professional organizations for mathematics teachers.
SUMMARY

The Southeast Michigan Alliance for Reinvestment in Technological Education (SMARTe) is a consortium of community colleges, school systems, Wayne State University, and businesses in southeast Michigan formed in September 1993. The alliance exists to promote communication and cooperation among its partners to address mutual needs pertaining to education of technological workforce. The specific mission of this virtual center is to collaboratively focus on restructuring product design curricula and teaching practices with authentic activities in an application mode.

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A total of 63 students participated in pilot settings of two sessions, each for two Saturdays at community colleges and a two week session at WSU. This paper will share the curriculum components, students learning, laboratory setting, students’ perceptions of technical curriculum, and lessons learned. Additionally, this brief report will identify and compare outcomes of this enrichment activity for 8th grade students.
RATIONAL
Technological Environment
NSF & Other Agencies
Engineering Professionals
Student Motivation
Teacher Preparation
Team Building

MODELS OF INTEGRATION
(a) Engineering & Physical Sciences
(b) Math into Engg
(c) Sc/Math/Computer into Engg
(d) Computers and Engg (Dynamics)
(e) Engg Math Tutorials
(f) Computer/Sc & Engg (Faculty)
(g) Graduate Courses (Mfg)
(h) Sc/Communication & Engg

COMPARATIVE STUDY
54 Models Compared
1. GA Tech - Design, Econ in Engg Courses
7. EVITECH, Finland - Problem Solving, Concurrent
Engg, Team work, Communication in B Engg Program
17. ECSEL - Integrated Engg Sciences Modules for
Engg Core Courses
26. Santa Clara U - Workstation Based Engg Math
42. U Houston - Math for E T
53. Colorado School - Humanities and Engg
(Reading and Writing)
CONCLUSIONS/RECOMMENDATIONS
Rapid Advances
Technology and Curricula
Excellent Models
High School Curricula?

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