

Materials Education 2004 Topical Trends and Outreach Efforts

Mary B. Vollaro, Craig Johnson

Western New England College / Central Washington University

Abstract

This research explores the history of topical trends in the ASEE Materials Division. This history will be compared with national trends. It is observed that creative materials education efforts in non-major curricula are highly sought, following national trends of higher contact numbers of students in related engineering programs versus relatively small numbers of students in materials programs. Issues of implementing laboratory curricula reflect the increasing attention to safety and liability concerns. Every year, at least one session topic has been multi-disciplinary and co-sponsored with another division.

Analysis of other efforts in Materials Education will be presented, along with any interaction the ASEE Materials Division has with these efforts. Specific mention will be made of efforts by TMS, ASM, MRS and ACERS. Efforts of these organizations have been largely independent and compartmental.

The data presented in this study will be used during the business meeting to generate discussion and selection of future materials division session topics. It will also be used as a focus for a discussion on any outreach efforts that the materials division may enact.

Introduction

American Society for Engineering Education (ASEE) has a mission to support engineering education within its own organization and through interactions with other technical societies promoting similar goals. Specifically, ASEE is structured with 'divisions' (by technical topic) and the Materials Division has been a small, but active division for the last three decades. The internal efforts of the Materials Division include hosting technical sessions at the annual national conferences and contributing relevant articles to the organization's journals, i.e., PRISM and Journal of Engineering Education. The primary focus of this analysis is to look at the internal engineering education effort of the Materials Division and the activity of the division at the annual national conference over the last five years. The Materials Division has also been involved in external activities, such as joint sponsorship of an appropriate conference or faculty development opportunities with National Aeronautics and Space Administration (NASA). Additionally, this analysis will acknowledge our current collaborators and help identify new potential 'partners' as resources for our membership of engineering educators.

American Society for Engineering Education Divisions has the responsibility of supporting the organizations efforts in their discipline. The Materials Division follows this model, which includes publishing 'requests for papers' in the summer PRISM journal issue, and implementing

the paper acceptance, review and presentation policies for the annual national conference. It is usual practice that the divisions operate autonomously, only occasionally co-sponsoring a conference session with another division. ASEE sets forth guidelines for management of these activities and outlines the responsibilities of the Division Chair, Program Chair, etc. for each division. As typical in many divisions, the by-laws in the Materials Division result in a regular turnover of officers. This is reflected in limited awareness of what session topics have been presented in the past and the breadth of activity going on in materials education both internally (at ASEE) and externally. The Materials Division being relatively small and has not kept a history of its efforts in newsletter, website or other ‘corporate memory’ format. A record of session topics in particular would be of value to the division officers¹.

Beyond the internal responsibilities, the division could benefit from (and involvement with) external efforts in materials education. Some on-going efforts include our support of the annual ‘National Educators’ Workshop’² (NEW), which shares experiments and demonstrations developed and presented by faculty, scientists, and engineers at their conference. The NEW organization and its participants also focus on better teaching methods for technical subjects, across the range of educational levels (K-20) and over a breadth of new and traditional materials. Other efforts in materials education are founded in our peer organizations. For instance, included under the umbrella of ‘materials’ are organizations and technical societies focusing on metals (TMS and ASM), ceramics (ACERS), polymers and plastics (SPE), advanced electronic materials (MRS) and nanotechnology / nanomaterials (ASME). As engineering educators and researchers, these organizations may provide valuable resources for the members of our division, increasing awareness of our peer’s work, exposure to new professional development opportunities for faculty and students, effective educational and outreach programs, and industry/academia collaborations.

ASEE Materials Division Efforts

In order to create a record of the activities of the Materials Division, the session information for the last five years has been tabulated below^{3,4,5,6}. From this data, assessment efforts can be refined, trends in our technical field as well as within our membership may be identified, and better planning by the Materials Division officers and members for future conferences may be facilitated.

<i>Session #</i>	<i>ASEE 1999 DESCRIPTION³:</i>	<i># PAPERS (25 abstracts total)</i>
0564	NEW Experiments	7
1364	Matl’s Eng. In the Real World	3
1464	ABET 2000 for Matl’s Eng.	1
1564	Matl’s Division Poster Session	Cancelled
1664	Active Learning in Matl’s Educ.	4
2564	Establishing Objectives for Mat’ls	Workshop
2764	Materials Division Dinner	NA
3264	Innovative Matl’s Experiments	3
3464	Materials Div. Business Mtg.	NA

<i>Session #</i>	<i>ASEE 2000 DESCRIPTION⁴:</i>	<i># PAPERS (30 abstracts total)</i>
1464	Matl's Design and Mech Behavior	5
2464	Innovations in Matl's Curricula	5
2664	Materials Div. Business Meeting	NA
2764	Materials Div. Get-together	NA
3264	NEW:A Picture Says 1000 Words	7
3464	Materials is More than Metals	5
3664	Active Learning in Materials Sci	5

<i>Session #</i>	<i>ASEE 2001 DESCRIPTION⁵:</i>	<i># PAPERS (25 abstracts total)</i>
1464	Teaching Fracture and Failure	5
1664	Intro. Materials Experiences	5
1764	Matl's Division Get-together	NA
2264	Matl's Div. Business Meeting	NA
2464	Integration with Other Curricula	5
3264	NEW: 2000 Update	8
3464	Upper-Level Courses & New	5

<i>Session #</i>	<i>ASEE 2002 DESCRIPTION⁶:</i>	<i># PAPERS (48 abstracts total)</i>
1464	Modeling in Matl's Education	5
2264	Matl's Div. Business Meeting	NA
2364	Teaching Matl's to Non-Majors	NA
2464	Teaching Ceramics, Polymers &	3
3064	NEW: Experiment Set-up	NA
3264	NEW: Matl's Lab Experiments	8
3464	Materials & Mech. Engineering	3

<i>Session #</i>	<i>ASEE 2003 DESCRIPTION⁶:</i>	<i># PAPERS (31 abstracts total)</i>
1464	Demos & Labs in Matl's Educ	5
2164	K-20 Activities in Matl's Educ	6
2264	Matl's Div. Business Meeting	NA
2464	Modeling and Math in Matl's	6
3164	NEW: Experiment Set-up	NA
3264	NEW: Matl's Lab Experiments	8
3464	Diversity in Courses and Matl's	5
NONE	Life Cycle Analysis:no abstracts	0

At first glance, a number of statistics may be of use for planning purposes. The topics themselves are of interest, as well as how many abstracts were submitted. Attendance figures as well as background and interests of our audience, has not yet been acquired. In the latter, planning and assessment may be improved by surveying our audience with respect to their role at their academic institution, e.g., primarily teaching or research, majors or non-majors, undergraduate and/or graduate program, etc. Specific qualitative observations based on this information have been summarized below:

Activities, laboratories and experiments of various sorts appear as a mainstay over the years. These efforts are above and beyond our interaction with NEW. These experiments have been focused by education level (K-12, K-20, lower division/undergraduate, upper division/graduate, majors, non-majors), but have appeared in all five years.

Curricula development has appeared regularly. Some of this has been oriented toward accreditation, but most is of a general nature (e.g. ‘materials curricula’).

Teaching methods is also a common topic. This is folded into curricula development in some cases, or even the ‘Activities’ category. However, it is has a specific meaning and was responsible for a sizable number of abstracts in 2002.

There have also been ‘*alternate materials*’ of various titles through the years. These include: ‘more than metals’ and ceramics, polymers and electronics materials.

Special topics have surfaced over the years. These include ‘Fracture and Failure’, ‘Materials Design and Mechanical Behavior’, ‘Material and Mechanical Engineering’ and an attempt to create a session on ‘Life Cycle Analysis’.

A last observation is that of ‘*modeling and design*’ in materials. With the computational resources available, more interest and activity is occurring in modeling of materials systems. The resulting ability to design with respect to materials is reflected in more abstract submissions.

In summary, our focus on materials science and engineering education is maintained. Creative experiments for students at all educational levels, novel teaching and assessment methods are a prevalent ‘thread’ through all our conferences, (nicely in-line with the mission of ASEE). Although not obvious from the session titles, papers on special topics including nanomaterials/nanotechnology, polymeric and electronic materials, have been presented at our recent conferences.

External Materials Education Efforts

A direct support of external education is the ASEE Materials Division’s continued support of the National Educators’ Workshop (since 1996). One entire session at the ASEE Annual Conference supports NEW, and brings 6-8 educators to present their work in an interactive, hands-on format.

International efforts of ASEE include an annual conference supporting the various disciplines (3rd International Colloquium on Engineering Education at Tsinghua University in Beijing, China September 7-10, 2004.) However, there is limited communication within the disciplines between the US and international efforts.

Traditional support for materials education is conducted through organizations such as TMS⁷, ASM⁸ and MRS⁹, ACERS¹⁰, ASME¹¹ and SPE¹².

A partial list of materials education organizations is shown in the following table. Some efforts of these organizations are discussed in the paragraphs following the table.

Organization	Discipline/Division	Internet URL / contact:
American Society for Engineering Education, Materials Division	Materials Education	www.asee.org
ASM International	Materials Education Foundation, Outreach Student Chapter	www.asminternational.org
TMS-AIME (The Minerals, Metals & Materials Society)	Education Committee Joint Student Chapter	www.tms.org
MRS (Materials Research Society)		www.mrs.org
AcerS (American Ceramic Society)	Education Council	www.acers.org
ASME (American Society of Mechanical Engineers)	Materials Division Continuing Education Faculty / Student	www.asme.org
Society of Plastics Engineers	Education Division K-12 Outreach Student Chapter	www.4spe.org
Smithsonian Institution	Center for Materials Research and Education	www.si.edu

It is interesting to explore the various organizations and determine what kind of education efforts are being made. There are efforts from K-12 through universities and into industry. For example, ASM is known for its industry support through literature and courses, but it also sponsors a Materials Camp for pre-college students and has a foundation that awards grants to K-12 teachers¹³.

Whereas ASM may be a strategic provider of literature and information to industry, ‘Centers’ are key in providing academic support to Materials. The National Science Foundation (NSF)¹⁴ has ‘Centers’ at universities related to many disciplines within materials. Many NSF grants for advanced materials research have educational components and dissemination requirements that are beneficial to educators, especially those at smaller, teaching institutions and involved in outreach programs. Frequently, these efforts have been presented in our sessions at the national ASEE conference.

Summary and Future Plans

Five years of ASEE Materials Division information has been presented. It was observed that internal annual conference efforts to promote materials education have typically focused on improved curricula. However, specific areas of interest include; curricula development, teaching materials to non-majors and ‘activities’ of various types.

Entities with similar materials education missions have been identified. Plans could be made to identify contacts from ASEE to interface with these organizations and promote synergy.

This document is offered as a living ‘corporate memory’ of the ASEE Materials Division. The division leadership intends to use this information at their business meeting for planning purposes and as an assessment tool of activities of the ASEE Materials Division.

Acknowledgements

Thanks to Central Washington University, it’s College of Education and Professional Studies, and it’s Department of Industrial & Engineering Technology for continued support of efforts in materials science and engineering education. Also, the support for materials science and engineering education from the Mechanical Engineering Department at Western New England College is sincerely appreciated.

Bibliography

1. ASEE Materials Business Meeting, Montreal, Canada, 2002.
2. National Educators’ Workshop, <http://www.engr.sjsu.edu/cme/NEW/> , 2002.
3. ASEE Annual Conference & Exposition, <http://www.asee.org> ,1999.
4. ASEE Annual Conference & Exposition, <http://www.asee.org> ,2000.
5. ASEE Annual Conference & Exposition, <http://www.asee.org> ,2001.
6. ASEE Annual Conference & Exposition, <http://www.asee.org> ,2002.
7. The Minerals, Metals & Materials Society, <http://www.tms.org> ,2004.
8. The Materials Information Society, <http://www.asm-intl.org> ,2004
9. The Materials Research Society, <http://www.mrs.org> ,2004
10. The American Ceramics Society, <http://www.acers.org> ,2004
11. The American Society of Mechanical Engineering, <http://www.asme.org> ,2004.
12. Society of Plastics Engineers, <http://www.4spe.org> , 2004
13. Advanced Materials and Processes, pg 53, December,2003.
14. National Science Foundation, <http://www.nsf.gov> , 2004

MARY B. VOLLARO

Mary B. Vollaro is Associate Professor of Engineering at Western New England College in Springfield, Massachusetts. Dr. Vollaro received her Ph.D. at the University of Connecticut, her M.S. at Rensselaer Polytechnic Institute, and her B.S.M.E. at Western New England College. She has held engineering positions in industry (in particular, the materials science area). She is the ASEE Materials Division Program Chair.

CRAIG JOHNSON

Craig Johnson is the Coordinator of the Mechanical Engineering Technology Program at Central Wash. Univ. He is the Foundry Education Foundation Key Professor (www.cwu.edu/~cjohnson) and has a P.E. in Metallurgical Engineering. Dr. J. is the ASEE Materials Division Chair. He specializes in test design, material & interface characterization and process optimization (forming & casting).