Global Engineering Education Initiative through Student Organization

Ann M. Sagstetter, Lucas K. Vitzthum, Jonathan R. Meyer, Amit J. Nimunkar, John G. Webster

***Abstract*—Engineering is becoming a more globally aware discipline that is revolutionizing the way individuals interact internationally. Engineering World Health (EWH) – Madison Chapter is a student-initiated organization that has developed opportunities to facilitate both local and global engineering education. Through EWH – Madison Chapter student-initiated activities, this organization has developed an interface between Traditional, Technical, and Translational education mediums. This study attests to the development of global engineering programs in the context of biomedical applications.**

I. Introduction

ENGINEERING is a field of study that must find balance between a local and global markets. Intrinsically engineering is most successful in a localized community, where the design constraints are specific to the environment being assessed. However, with increasing forms of communication and international relations, globalization is becoming more commonplace, even in technical, region –specific disciplines [1]. As a result, globalization is being incorporated into the educational sector to help students develop an '*international perspective*,' before they leave the confines of their academic institution [2].

In this paper, we propose a means of delivering global engineering education to the local and international community through a student-initiated organization at the University of Wisconsin-Madison (UW-Madison) Engineering World Health (EWH) – Madison Chapter. EWH – Madison Chapter is a student-initiated organization that is comprised of engineering students with a united vision to deliver medical expertise and equipment to underserved nations and develop medical instrumentation for the international community. In addition to bioinstrumentation, EWH – Madison Chapter students also engage community members into biomedical engineering dynamics during workshops and seminars on locally and globally related topics. It is by education – through – application that the true meaning of engineering globalization can be practiced.

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A. M. Sagstetter, L. K. Vitzthum, J. R. Meyer, A. J. Nimunkar, J. G. Webster are with the Biomedical Engineering Department, University of Wisconsin, Madison, WI 53706 USA (corresponding author phone: 608-263-1574; fax: 608-265-9239; e-mail: webster@engr.wisc.edu , sagstetter@wisc.edu, lvitzthum@wisc.edu, jrmeyer3@wisc.edu, ajnimunkar@wisc.edu).

II. EWH and the Educational Axes

EWH – Madison Chapter acts as an interface through which global engineering interactions can take place. The global interactions are characterized by three education systems: Traditional education, Technical education, and Translation education. Traditional education uses the Science, Technology, Engineering and Mathematics (STEM) discipline integration techniques to teach the upcoming K-12 generations relevant technology and engineering concepts. Technical education utilizes education forums to teach current engineering students and the general adult population complex engineering concepts. Translational education is the education of the international community to locally developed engineering technologies. These 'three T's' of education are a means to integrate the locally focused engineering concepts into the international community as depicted in figure 1.

III. EWH Tri-Axial Student-Initiated Activities

EWH – Madison Chapter students interact with peers and community members (both locally and globally) to communicate technical engineering knowledge in an approachable manner. All programs listed below are conducted by students in the organization and have a common goal to universally improve the quality of life by making healthcare affordable and perform education outreach to enhance student learning. Such programs include the following:

1) Supplemental Training sessions [3 – 5]
2) Seminars [3,5]
3) Competitions for student learning and acquiring funding
4) Outreach to K-12 students and parents
5) Home schooling curriculum supplemental workshops [7]
6) Publications [3 – 4,7 – 11]
7) Medical repair workshops and manuals for repaired equipment
8) Novel medical devices development projects [8]
9) Medical missions [6, 12]

Figure 2 illustrates how these activities utilize Traditional, Technical and Translational education techniques to enhance engineering globalization.

Through these programs, EWH – Madison Chapter not only offers educational forums for local community members to learn about current medically – related topics, such as health care infrastructure within the country, but also enables participants to interact with the global community

by developing projects for students to consider in an international environment, which is often vastly different than local environment. EWH – Madison Chapter's student – initiated programs provide an interface for community members to interact with the international community as shown in figure 3.

IV. Discussion

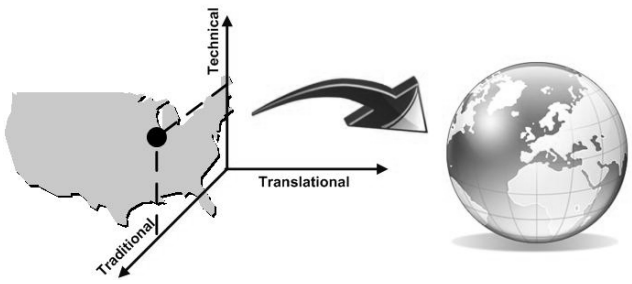

Fig. 1. The three axes of global engineering education translate local focuses into global applications.

A. Community engagement

EWH – Madison Chapter is also focused on stimulating the interaction of local and international community members, through engineering education. Education has often been used as a tool to stimulate discussion and innovation.

For example, teams from EWH – Madison Chapter frequently facilitate educational outreach events for students in grade school through high school (K – 12). These events typically consist of presentations on different aspects of engineering, followed by a hands-on workshop to give students experience on applying engineering concepts. Sagstetter et al describes one such curriculum developed for home – schooled students [7]. EWH – Madison Chapter tailors its events to a wide variety of audiences, including homeschoolers, public and private schools, and students with disabilities.

B. Training events and seminars

Furthermore, through EWH – Madison Chapter there are opportunities for peer – peer learning experiences, as the members of the organization are facilitators of workshops, seminars, and laboratories. For example, EWH – Madison organizes technical training and equipment repair sessions throughout the semester. These opportunities give students hands – on technical experience, as well as an appreciation for the struggles that hospitals in developing countries have as they use donated medical equipment. A large portion of the repair sessions involve testing equipment, to ensure functionality, and writing repair manuals, to assist the recipient in its proper usage. In the repair of these devices and their manuals, EWH-Madison Chapter students must consider problems that follow the use of modern equipment in a developing world hospital setting such as language barriers, power outages, proficiency of users, and lack of disposable parts. The infrastructure of developing world hospitals are further depicted to EWH-Madison Chapter students through guest speakers who have traveled to underprivileged hospitals in countries such as Honduras, Tanzania, India, and others.

C. Design projects

EWH – Madison Chapter also gives students the opportunity to apply their knowledge of global engineering through team – based design challenges. In conjunction with the University of Madison – Wisconsin Biomedical Engineering Department, EWH – Madison Chapter facilitates a variety of semester long design projects. These projects are designed to teach teams of students about the challenges of engineering in a global context, while designing devices to improve healthcare in the developing world. For example, in the spring semester of 2009, three devices were identified as most needed by hospitals in India: spirometer, pulse oximeter, and digital thermometer. Three teams comprised of four undergraduate students each were given the task of developing these medical devices. Simultaneously, a team of seven graduates and senior undergraduates were given the task of developing an inexpensive, intuitive central processing unit to interpret, record, and display data from the above three medical devices [8]. An additional group of undergraduate students analyzed the feasibility of electrically charging these medical devices in developing countries using lead – acid batteries [9]. Another group of students simultaneously reviewed the implementation of electronic medical record keeping systems in developing countries and the design of portable low – cost ultrasound systems [10 – 11]. Through the integration of these design projects, students learned first – hand the challenges of designing products for the developing world, requiring accuracy, reliability, cost, durability, and the need for an intuitive interface.

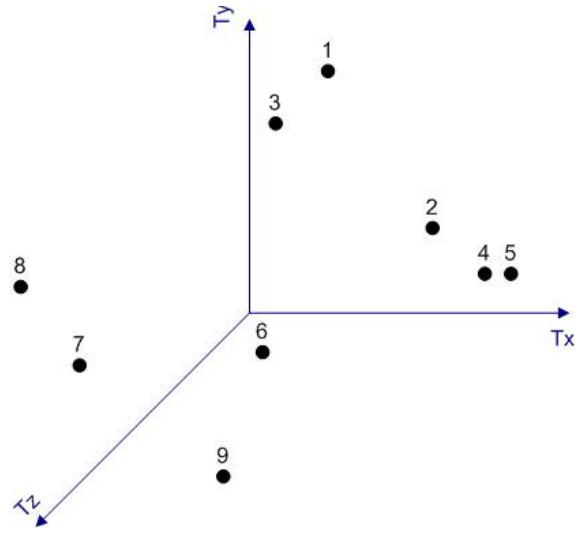

Fig. 2. 3D coordinate system explanation of the tri-axial education for engineering globalization. Numbers correspond to the activities in section III. Tx = Traditional Education, Ty = Technical Education, Tz = Translational Education

D. International experiences

Finally, the most direct exposure EWH – Madison Chapters offers students to global engineering is through international medical trips and internships. EWH – Madison Chapters members have traveled to hospitals Costa Rica, Tanzania, Zimbabwe, Guatemala and Mongolia to repair medical equipments [6, 12]. Experiencing first – hand the challenges in developing world hospitals and working with the local staff has proven to be the most effective way for students to understand the design constraints inherent in engineering equipment for these settings. Because not all members are able to participate in the medical mission programs, traveling students come back to share their experiences with classmates and the community through presentations, videos, and reports.

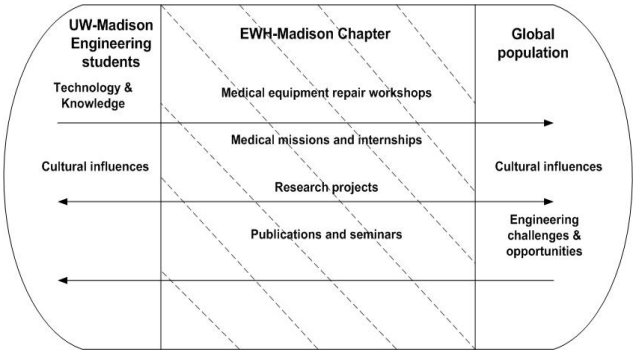

Fig. 3. EWH – Madison Chapter is an interface between the local community and the global population.

V. Conclusion

Through EWH's three T's of education, we have developed an interface to incorporate local engineering concepts into a globalizing world. We have developed activities which allow members to actively participate in Traditional, Technical, and Translational education opportunities. Such activities include supplemental training sessions, seminars, competitions for student learning and organization funding, outreach to K – 12 students and parents, home schooling curriculum supplemental workshops, publications, medical repair workshops and manuals for repaired equipment, novel development projects, and medical missions. These activities not only benefit the local and international community through education, but also enable event facilitators and participants to obtain a more diverse set of engineering skills than previously taught in the instructional setting of a classroom alone.

Acknowledgment

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References

[1] B. Newberry, "Engineering globalization: Oxymoron or opportunity?" *IEEE Technology and Society Magazine*, vol. 24, no. 3, 2005, pp. 8-15.

[2] J.R. Lohmann., "Will our graduates be global players?" *J. Engineering Education*, vol. 92, no. 3, 2003, pp. 195-196.

[3] A.J.Nimunkar, S. Bernardoni, T. Lark and W.J. Tompkins, "Student-Initiated Supplemental Training Curriculum for support of BME Design Projects", *Proc. of 116th ASEE Annual Conf and Exposition 2009.*

[4] A.J. Nimunkar, S. Bernardoni, T. Lark, A. Watchorn and J.G. Webster, "Industry-Student Partnerships in Development and Sharing of Educational content involving LabVIEW", *Proc. of 116th ASEE Annual Conf and Exposition 2009.*

[5] BME 200, Biomedical Engineering Design, University of Wisconsin – Madison 2009, http://ecow.engr.wisc.edu/cgi-bin/get/bme/200/webster/

[6] Engineering World Health – Madison Chapter 2009, http://www.engr.wisc.edu/studentorgs/ewh/

[7] A.M. Sagstetter, A.J. Nimunkar and W.J. Tompkins, "Hands-on Curriculum teaches Biomedical Engineering concepts to Home - schooled Students," *Proc. of 31st Annual International IEEE EMBC* 2009.

[8] A.J. Nimunkar, J.M. Baran, D. Van Sickle and J.G. Webster, "Low – Cost Medical Devices for Developing Countries," *Proc. of 31st Annual International IEEE EMBC 2009.*

[9] A.M. Casanove, A.S. Bray, T.A. Powers and A.J. Nimunkar, "Battery Power Consumption to Charge Medical Devices in Developing Countries," *Proc. of 31st Annual International IEEE EMBC 2009.*

[10] N.A. Kalogriopoulos, J.M. Baran, A.J. Nimunkar and J.G. Webster, "Electronic Medical Record Systems in Developing Countries: Review," *Proc. of 31st Annual International IEEE EMBC* 2009.

[11] J.M. Baran and J.G. Webster, "Design of Low – Cost Portable Ultrasound Systems: Review," *Proc. of 31st Annual International IEEE EMBC* 2009.

[12] earthMed Healing the World, 2009, http://www.earthmed.org/