FRONTIERS IN EDUCATION—HAVE WE MADE A DIFFERENCE? IF SO, WHAT?

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***Abstract*— The IEEE Education Society started the Frontiers in Education Conference (FIE) in 1971, a time of concern for its survival for financial and membership reasons, a time of unrest in the engineering education community around the world, and as is so common, a time of great challenge and opportunities. FIE began with about 100 attendees in Atlanta, led by Demetrius Paris. It expanded by adding the Educational Research and Methods (ERM) Division of ASEE in 1973, and the IEEE Computer Society (CS) in 1995. FIE ventured outside the USA in 1974, and continued taking on new challenges, and by giving young scholars in engineering education research a venue for interaction and evaluation of their work. These scholars are asking good questions—important questions, questions that challenge us all, and are getting answers that are improving our education. In turn, these answers lead to new and more challenging questions. This is a journey, not a destination. While not the only contributor, this conference has made a difference—it is small enough for much interaction, big enough for bringing together new scholars with "old-timers." Both authors have complete files of all FIE Proceedings. Some of this history will be traced, but the emphasis will be on results and a look at the future.**

Keywords—FIE History, Engineering Education, Research

I. INTRODUCTION

The engineering profession has long been interested in improving engineering education—and it is hard to say when this interest began. In the USA, the American Society for Engineering Education (ASEE, formerly the Society for Promotion of Engineering Education (SPEE)) held its first annual conference as a part of the World Exposition in Chicago in 1893. Perhaps the first formal study was the Mann Report (Mann, 1918). Many other studies have appeared following studies by the ASEE (1994), the National Science Foundation (USA), the National Academy of *Engineering, Educating the Engineer of 2020* (2005), the Austria-based International Society for Engineering Pedagogy (IGIP), the Belgian-based European Federation of National Engineering Associations (FEANI), ABET, and associations based elsewhere in the world. Conferences, such as FIE, play a crucial role in these improvements by enabling the practitioners of the art and science of engineering education to implement the ideas in an atmosphere of professional interactions, critical evaluations, and friendships that last many years.

II. PLANNING FOR THE 1ST FIE

In the beginning before the first FIE Conference, Benjamin J. Dasher had become president of the Education Group of IEEE, Luke Noggle vice president, Sid Shamis treasurer, and Jim Rowland secretary. These 1968 officers transitioned the Education Group to become the IEEE Education Society within the next year or two in accordance with movements of other societies of the IEEE Technical Activities Board. Officer meetings were held at IEEE Headquarters in NY City. Established IEEE leaders who spoke at these meetings referred to "young turks" as the future of the Society.

Dasher wanted to start a conference for the Society for two reasons: to stimulate membership growth and to bring in funds. He feared that a competing European society for education would detract from our Society and so tried to form an alliance with that society to the point of bringing the 4th FIE Conference to Europe. That alliance did not develop further.

The first conference was held at Georgia Tech in 1971, with Demetrius Paris as general chair [1]. The attendance was approximately 100 people, nearly all male and US-based. Six sessions comprised the conference, and it was possible to attend all sessions. After the 1st FIE was over and all income and expenses had been tallied, Dasher confided that the primary reason it made money was the automatic library subscriptions for conference proceedings.

FIEs 2, 3, and 4 were held at Arizona, Purdue, and London. Dasher passed from this life sometime during those years. He has been greatly missed; the FIE Conference became his legacy. The award for Best Paper at the Conference each year is named in his honor.

An important event in 1973 was the partnership with the Educational Research and Methods Division of ASEE (ERM-ASEE), and, in 1995, a partnership with the IEEE Computer Society. Today, a typical attendance is 600 individuals from 20 or more nations, a wide range of ages, many women educators, and ethnic groups within the nations. The number of papers is in the hundreds, and the acceptance rate has dropped as the quality has risen. It is not possible to attend all sessions.

Quality is one of those features that is usually hard to define but easy to recognize. Every year, the conference quality improves. The papers presented deal with soundly-based research focused on important questions facing today's engineering educator who must prepare students for the modern world. More important, the papers present workable ideas that today's educator can implement, and many are doing so. The emphasis on careful selection of students followed by a higher retention rate is evidence that supports this conclusion.

III. THE DECADE OF 1975 TO 1985

A new ES volunteer, Joseph Biedenbach of South Carolina, had emerged as an FIE personality/leader by this time. He and Larry Grayson edited the FIE Proceedings for several years thereafter. Ed Jones, John Lindenlaub, and Lyle Feisel served as Society officers. It was significant that John had been very active in ASEE ERM as well, a plus in connecting the two organizations which now formed the joint sponsors of FIE. Highly successful FIEs were held at the University of Illinois (1977), Lake Buena Vista FL (1978) and at Niagara Falls Canada (1979). During the 1980 to 1985 years, Joe Bordogna, Jim Rowland, and Bruce Eisenstein of became the ES officers, while John Lindenlaub, Billy Koen, and Dendy Sloan chaired ERM. FIE was held in Houston, Rapid City, Worcester, and Philadelphia. Both Joe and Bruce became future IEEE Presidents. FIE attendance was growing, yet the tendency to host the conference with volunteer work from department staff remained. At some point, it appeared that FIE would grow beyond what this staff could handle and additional support would be needed. In the meantime, FIE income could be funneled directly into the ES and ERM budgets without costs for outside support. The partnership with the University of Kansas Continuing Education has enhanced all aspects of the conference.

IV. A LOOK AT THE PRESENT STATE OF FIE

Two important questions are: (1) Is FIE regarded as a key international forum that focuses on the cutting edge of engineering education themes? and (2) Is FIE regarded as an attractive conference that promotes a lively exchange of new ideas?

In the first case, a measure of success is that many participants continue to present their best results at FIE year after year, looking forward to discussing emerging concepts among trusted colleagues. Papers presented at FIE often cite preliminary results that develop into archival journal papers. Works in Progress have become a popular mechanism for receiving early criticisms for projects later submitted for National Science Foundation awards. A strong review system before accepting papers for the FIE Conferences guarantees that only worthy and interesting ideas are scheduled for presentation and FIE Proceedings. Among the frontiers identified are active learning, on-line courses, engineering education learning and research methods, and adjusting to ABET criteria changes for program improvements over the years. The emergence of engineering education departments at a number of universities has enhanced opportunities for scholarly research and promotions within the university system.

The authors have prepared a spreadsheet identifying names of conference leaders along with data regarding the number of papers, plenaries, and workshops. It is much too large to present as a part of this paper, but is available from the authors upon request.

Some selected data from the 45 conferences to date follow:

a. The number of papers presented has increased from 34 (1971) to 95 (1985), 390 (2000), and over 400 (2015).

b. The number of sessions has increased from 6 (1971) to 28 (1985), 90 (2000), and 97 (2015).

c. The first workshop was held in 1972, and today, the number of such events varies from 10 to 18, depending on developments.

V. NOTABLE MOMENTS IN FIE HISTORY

From the very first FIE, it is easy to cite those memories that endear us to the conference. One speaker at the first FIE session caused a mild rush to the aisle when he took a crinkled envelope from his jacket pocket and pretended to read the words "Four score and seven years ago…", then tossing it into the aisle with the remark that the envelope had obviously already been used. Several attendees grabbed for the envelope, thinking it might have great value, but found it to be blank. Moving ahead to the 10th FIE (Houston), a special outside speaker was introduced as a British wit who had traveled from London to come to our conference. When he arrived at Dallas, he said he must get to Houston in the "worst way" and was told to take Southwest Airlines. One person, possibly Ed Jones, spotted that he must be a fake because he proceeded to make critical remarks about the Queen. At the end, this "British" speaker revealed that his appearance was an act and he was actually a local radio/TV personality named Cactus Pryor from San Antonio.

FIE has been from its very beginning a friendly venue for authors and attendees alike. Remarks are meant to be helpful, not harsh criticisms at FIE or people. Participants are eager to volunteer constructive advice and are especially encouraging to a cadre of New Engineering Educators identified at each FIE Conference. To show the volunteer nature of FIE participants, a young assistant professor of theater was called upon to conduct a workshop at the FIE in 1978 at Lake Buena Vista in Florida. He began by admitting that he was intimated by all the experts in the room and asked if anyone would volunteer to help him with his first demonstration. Amazingly, every single person in the standing-room-only audience of about 40 FIEers took one giant step forward as a volunteer. We laughed at the spontaneity. It was a special moment in FIE history that encapsulates the friendly and encouraging nature of the conference.

High moments at FIE inevitably focused on relaxing outside social events arranged by the local conference committee. These memorable events ranged from visits to Old Tucson

(1975), Niagara Falls (1979), The Art Museum in Philadelphia (1984), Billy Bobs in Ft. Worth (1986), Grand Ole Opry and General Lee boat dinner (1992), the cruise down the Danube River, when it was in flood stage (1990), Rustler's Roost with native performers (1998), The Museum of Armor in Worcester (2002), Horse Racing Museum (2008), and Mount Rushmore's Four Faces (1981/2011), Madrid in 2014, among many others.

VI. A LOOK AHEAD

The engineering educator, as in other professions, is on a journey. Each person's time "on the train" lasts for part or all of a career, but the train continues, as it probably started in the days of apprenticeships, and will never stop. What have we seen and what will we participate in? Some background and ideas follow:

Distance Education. Distance education probably started with the correspondence courses in the late 19th century. Travelling educators spent a lot of time on trains and in planes into the 1950s and 1960s. Televised courses began in engineering in the late 1960s, with a videotape medium and package delivery services. Then, satellite delivery enabled distribution around the world, though many receivers downloaded the tapes for greater flexibility in study times.

Today, the internet is the predominant distance education medium, while MOOCs and similar programs are becoming more and more important and effective. What will social media lead to? One possibility is ever-greater "real-time" interaction of students in various locations with other students and with instructors.

Increasing cooperation between social sciences and scholars of engineering education will likely improve learning and efficiency of students, and their continued learning throughout a career. Increasing cooperation between professions will be common. These advances will depend on scholars of engineering education cooperating with scholars in scholars in education in the other fields working together. Fortunately this is happening, in the physical, natural, and social sciences. Basic business education will be more common.

Outcomes Assessment. A major transformation now underway is the process by which educators evaluate the progress of their students. Grades, the usual 5-letter system, with variations, have been around for more than a century. The goal of a grading system is to evaluate what the students have learned—or, "what do they know?"

While the origin of the idea of "outcomes assessment" is unclear, ABET introduced this idea to engineering accreditation in the 1990s. (Prados, 2007). Initially known as EC-2000, (ABET, Inc, 1997) it was based on studies by the ASEE, by the National Academy of Engineering, and the Engineering Dean's Council. Perhaps the fundamental idea here is to ask the question—"what are our students able to do at the time of graduation?" This is an easy question to ask, but not to answer. Much attention in FIE has been made to learn effective, efficient answers to this question, and no doubt this will continue.

Barriers. Two major barriers to international education are time zones and language proficiencies. Great progress is being made with simultaneous translation programs, and this may well enable greater interactions between students in around the world studying classes simultaneously in a variety of languages, and also interacting "in real time." Perhaps we will all use Greenwich Mean Time (GMT), adjusting our start and stop times so that we can work in sunlight at whatever times the sun rises locally, and yet have a common clock around the world? Improvements here could also facilitate continuing professional development. It is fair to say that today's scholars have not solved all problems, but rather have opened some doors and started a path for future journeys.

International. The IEEE Education Society, in cooperation with engineering education entities around the world, is helping to organize engineering education conferences around the world, meeting needs in those areas and bringing ideas back to the USA. These activities are most welcome to all concerned, and should be of great benefit to students and future engineers.

Publicity. Greater publicity for the FIE Conference could be emphasized in both local media and in technical publications, not only as the 50th conference approaches in 2020, but for every year before and after the event. Headlines that declare "FIE Conference identifies the emerging frontiers as …." More alliances could be formed with other IEEE Societies, with other ASEE Divisions; and internationally. Each entity has an engineering education committee in most cases and at least area interests in others. These need not be a sharing of conference funds but instead a promotion and advertisement of interests by these other entities. International speakers should be scheduled to attract this higher level of participation.

Workshops. The growth in attendance at and the number of workshops demonstrates their value—they occur before and after, but usually not during, the conference. They provide an efficient way for educators to study new technological developments as well as new methods to improve the classroom experiences for students. Company exhibits are an important part of the workshop programs.

FIE paper presentations should be expected to use the most modern technology with interactive demonstrations, movies, and live student participation. With the increased emphasis in engineering education departments, it is expected to see more FIE papers that focus on a melding of IEEE Education Society and ASEE ERM interests.

A primary conclusion of the studies reported at FIE, and of course elsewhere, is that the beliefs of students about Engineering vary by institution and ethnicity, as well as gender. Practitioners and educators who speak with Community College (CC) students would do well to try to understand the students at any particular school in order to better focus their message in trying to get students to put ENGR on their radar as a possible career.

Future work should include securing evaluations from the students after our presentation to see if we are eliminating any of these myths and misunderstandings and to determine which parts of our message are the most effective.

Future work includes comparing the CC student views with high school students to see if our message needs to be different for high school students. We also want to do additional analysis with respect to gender and ethnicity, as well as to analyze the difference in beliefs between students who are interested, neutral, or not interested in ENGR. We encourage others who are speaking in CCs and high schools to better understand the population of students to whom they are speaker in order to make their presentations have more impact by speaking to students about areas in which they little information or have misinformation, as well as those areas in which they are most interested.

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