Experimental Study Group

The Experimental Study Group (ESG), now in its 38th year, continues to offer innovative opportunities in teaching and learning to a variety of MIT undergraduates, faculty, staff, and alumni. In keeping with our original mission, ESG provides first-year students at MIT with personalized instruction in the core subjects within a close-knit community environment. This instruction includes flexibility in pace and scheduling and small classes where students can easily ask questions and get to know fellow students and instructors. Over the years, students have consistently said that ESG's small group learning and community atmosphere were some of the most rewarding aspects of their MIT education.

Each year, ESG offers approximately 40 undergraduates the opportunity to assist in some aspect of teaching at ESG. All student instructors receive midterm and end-of-term evaluations from freshmen and meet regularly with staff members for supervision. New student instructors participate in a weekly teaching seminar run by senior ESG staff. Experienced student instructors who have demonstrated excellent teaching skills are able to develop their own pass/fail seminars under faculty supervision or work relatively independently in teaching core subjects.

Over the past 15 years, ESG has served as a center for educational innovation in the undergraduate program by offering a series of hands-on, interactive seminars in a variety of subjects not otherwise offered at MIT. These seminars provide all MIT undergraduates with the opportunity to participate in the ESG style of learning (small, interactive classes). Non-ESG students who take these seminars frequently say the seminars are the only opportunity they have had since their freshman year to participate in a small interpersonal class with a hands-on focus. This year, we were able to run 16 seminars through a combination of funds from the dean of the School of Science and from our own alumni. We are strongly committed to continuing these seminars and promoting their growth by working closely with various parts of MIT, outside sources, and our own alumni to secure funding for these seminars.

Student Statistics

Sixty-seven freshmen were enrolled for one or more terms in ESG this year, with another 21 students waitlisted in the fall term. Fifty-eight percent of our students were female, 33 percent were underrepresented minorities, and 6 percent were international students. In addition to these 67 students, we enrolled 7 upperclassmen in our core subjects, and 144 students in our seminar program (70 percent of whom had never been in ESG as freshmen). Forty-seven undergraduates served as teaching assistants, graders, and student instructors. These upperclassmen collectively maintained an impressive 4.6 grade point average.

Staff and Faculty

ESG's administration was headed by Professor Alexander Slocum and included associate directors Dr. Peter Dourmashkin and Dr. Holly Sweet and program coordinator Graham Ramsay. The physics staff was headed by Dr. Dourmashkin and included Toby Ayer (1996), David Custer (1983), and Dr. Sahana Murthy, a specialist in physics education research. Michael Shaw (2007) assisted Dr. Dourmashkin in teaching 8.02 and 8.022. The mathematics staff was headed by Dr. Jeremy Orloff and included Dr. John Lewis and Dr. Gabrielle Stoy (previously a faculty member in the Department of Mathematics at Oxford University in England). Graduate student Finale Doshi (an ESG alumna and a recent Marshall Scholarship winner) assisted Dr. Orloff in teaching 18.01A.

The chemistry and biology offerings at ESG were headed by Dr. Patricia Christie, assisted by ESG alumna Brigid Dwyer (2006). In fall 2006, ESG offered 21W.730 Expository Writing (taught by Mr. Custer) and SP.2H3 Ancient Philosophy and Mathematics (taught by Dr. Lee Perlman). In the spring term, Dr. Perlman again offered SP.2H3. ESG offered a section of 6.001 under the guidance of graduate student Austin Clements, who was assisted by three ESG undergraduates and an ESG alumnus.

One of the important aspects of ESG is that many of the staff are integrally connected with other MIT departments and programs. Dr. Christie taught in the 2006 Interphase program and is course coordinator for 5.111 and 5.112 in the Chemistry Department. Dr. Lewis, Dr. Murthy, and Dr. Orloff teach in the Concourse Program, and Mr. Custer teaches in the MIT Writing Program. Dr. Dourmashkin is a senior lecturer in the Physics Department and is in charge of 8.01 TEAL in the regular curriculum. Dr. Dourmashkin is also a co-principal investigator in a research project led by Professor John Belcher called "Force Field: E&M Visualizations for Introductory Physics." This research is supported by the National Science Foundation in the division of Course, Curriculum, and Laboratory Improvement/ Educational Materials Development.

Academic Initiatives

Undergraduate Seminar Series

Because of its small size and experimental educational focus, ESG provides an ideal environment in which staff, faculty, and students can develop new subjects and new approaches to existing subjects. This year we continued the ESG Undergraduate Seminar Series with 16 seminars, 25 percent of which were developed and run by undergraduate students under staff supervision. Seminars offered for the first time this year included The Making of a Dance Concert, The History of ESG, Global Warming, The Chemistry of Sports, Pharmacology, The Artist in the World, Learning as Changing the Brain, and Building Legal Structures in Africa.

Interdisciplinary Subjects

In fall 2006, ESG offered a version of 8.01 with sports applications. The course was taught by Mr. Custer, with assistance from gymnastics coach Noah Riskin and track coach Halston Taylor from the MIT Department of Athletics. This subject included the regular 8.01 curriculum as well as sports labs, which took place in MIT's athletics

facilities in the context of physical education instruction. Mr. Ramsay and Dr. Sweet taught a seminar on self-exploration through creative methods, which combined psychology and the visual arts. In spring 2007, Dr. Perlman co-designed and taught 10.04 Energy: An Intellectual History along with Professor Bernhardt Trout from the Department of Chemical Engineering, and Dr. Christie taught a seminar on the Chemistry of Sports.

Improvements to 18.03

In spring 2007, Dr. Orloff and Dr. Lewis interviewed three engineering faculty who teach classes with 18.03 as an immediate prerequisite. In the interviews, faculty discussed what they wanted students to know from 18.03, what they've observed students retain from 18.03, and ideas for contextualized problems (applied problems students will see in later classes). Key points raised included the need for improvement with regard to students' retention and the engineering faculty's belief that 18.03 is very important. Dr. Orloff and Dr. Lewis, working with graduate student Andreas Malmendier, introduced a few small contextualized problems into several ESG and Concourse classes. The goal of using contextualized problems is to motivate students and to help improve retention. Dr. Orloff and Dr. Lewis plan to finish writing contextualized problems in summer 2007 and will include them in 18.03 classes taught in the coming year. Assessment will be carried out in part through the Teaching and Learning Laboratory at MIT.

Dr. Orloff and Dr. Lewis also spearheaded a project to organize much of the past and present materials used in 18.03 by ESG, Concourse, and the Mathematics Department into a searchable annotated database. The goal of this project is to develop a useful resource for teachers of 18.03 and to serve as a model for databases for other classes at MIT. A sample version of the database has been constructed and a strategy for tagging problems and other materials for inclusion in the database has been mapped out. Further work on this project will be carried out in the coming year.

Active Learning in the Classroom

Dr. Murthy implemented a peer-review process in 8.01 and 8.02 in which students assess their peers' homework using problem-solving rubrics. Dr. Murthy presented a paper on this topic at a national conference on physics education and has submitted a related paper to the American Institute of Physics *Proceedings of the 2007 Physics Education Research Conference*. To promote independent learning and student teaching, Dr. Murthy had students learn a new physics topic (such as angular momentum and gyroscope, momentum change, and rocket propulsion) on their own (with the help of books, papers, and other resources) and teach a 45-minute lesson to their peers. They developed a problem on that topic and facilitated a problem-solving session during the lesson.

Curriculum Integration

Dr. Dourmashkin has been working collaboratively with Professor Haynes Miller of the MIT Department of Mathematics in developing and implementing new physics applets for use in the 8.02 and 8.01 classrooms. This work is part of a project on curriculum integration at MIT funded by the Spencer Foundation.

MIT OpenCourseWare

ESG now has its own page on the MIT OpenCourseWare website (http://ocw.mit.edu/OcwWeb/Experimental-Study-Group). Fourteen new ESG subjects have been posted there since January 2007, including Gender Issues in Academics and Academia, AIDS and Poverty in Africa, the Physics of Rock Climbing, Women's Novels, Poetry in Translation, and the Art of Color.

International Focus

Dr. Perlman was invited by the Zambian government to visit Zambia in August 2007 and consult on a publication aimed at educating Zambia's youth. He will meet with the President of Zambia, the Chancellor of the University of Zambia, and other Zambian officials. This invitation was facilitated by Raja Bobbili (20'07), an ESG student from Zambia who has designed and taught several ESG undergraduate seminars on African policy issues under Dr. Perlman's supervision.

ESG Surveys of Freshmen, Upperclassmen, and Alumni

In spring 2007, a survey was sent to 1,500 ESG alumni, 150 current ESG upperclassmen, and 65 ESG freshmen, asking for information about their experiences in ESG. Of the 212 alumni surveys returned, alumni mentioned five main ways in which ESG had an impact on them personally: having a smoother transition to MIT, making new friends, increasing self-confidence, becoming more self-directed, and growing in academic skills. The most commonly mentioned ways ESG changed their views on education included a belief that learning should be cooperative, self-directed, and done in small groups. The most commonly mentioned impact on their professional development included greater professional success and increased ability to work in teams.

Of the 32 upperclass surveys returned, 87 percent said they would join ESG if they had to do it over again. Sixty-three percent of the respondents said that instruction in ESG was superior to that in the regular curriculum (with only 3 percent reporting inferior instruction). The main reason cited for student satisfaction with ESG included accessible and skilled instructors, small classes, and a chance to take an active role in their education. Half the respondents said they were more likely to ask questions in class, ask for help in class, and build relationships with faculty after being in ESG. Students who taught in ESG (75 percent of the respondents) said that teaching in ESG was very important because it allowed them stay connected with the program, helped them learn the material better, and assisted them in learning how to teach.

Of 39 freshman surveys returned, 86 percent said they would join ESG if they had to do it over again. The factors contributing to their satisfaction, which they rated at a "very good" to "excellent" level, included small class size, ability to interact with teachers, opportunity to ask questions, ability to interact with peers, quality of the teaching staff, peer instruction, and overall sense of community. Freshmen also said that participation in ESG had changed their views of education in the following ways: they valued learning through interactive methods more, they enjoyed learning in small groups, and they liked having a broader exposure to different learning styles and teaching methods.

Staff Presentations and Publications

In July 2006, Dr. Murthy presented a talk on "Peer Assessment of Homework Using Rubrics" at the Physics Education Research Conference in Syracuse, NY. In August 2006, Dr. Sweet presented material from the psychology and visual arts seminar she has been teaching at MIT at the annual American Psychological Association convention in New Orleans, LA. In April 2007, Mr. Custer delivered a presentation on "The Evolution of Climbing Standards" at the Climbing Wall Summit and Managers' Symposium in Boulder, CO. In June 2007, Dr. Orloff and Dr. Dourmashkin gave talks about contextualized problems at the CDIO conference in Cambridge, MA, which looked at ways to teach students how to apply engineering fundamentals to real-world problems.

Several members of the ESG staff have been working on books for the ESG Book Series. Mr. Ramsay and Dr. Sweet are finishing their book (*Self-Reflections: Exploration of Self through Visual Art and Writing*) based on a seminar they have been teaching at MIT for the past three years. Dr. Perlman continued to work on his text on Greek mathematics and philosophy under a grant from the D'Arbeloff Foundation. Dr. Dourmashkin and Professor Eric Mazur (Harvard University) have finished a freshman physics textbook that will be published by Addison-Wesley in January 2008.

Awards

ESG gave its own set of annual awards in May 2007, including the Peter and Sharon Fiekowsky Community Service Award (for outstanding contributions to the ESG community) and the Todd Anderson Excellence in Teaching Award (given to graduating seniors who have demonstrated excellence in teaching at ESG over a sustained period of time). Both Mr. Fiekowsky and Mr. Anderson are graduates of MIT and have established funding for annual ESG prizes. This year Jeremy Hurwitz (2008) and Daniel Whitlow (2010) were awarded the Fiekowsky award for community service to ESG. The Anderson award was given to graduating seniors Nia Beckley, Ting Ting Fu, Lara Hershcovitch, and Michael Shaw for their outstanding work in teaching chemistry and physics subjects.

The Anderson award was also given to graduating senior Raja Bobbili for his work in developing and teaching three new undergraduate seminars (Information and Communication Technology in Africa, AIDS and Poverty in Africa, and Building Legal Structures in Africa). Mr. Bobbili is currently working with the Zambian government in developing public policy, based in part on these seminars.

Alumni Involvement

The ESG alumni steering committee is headed by Richard Hilliard (1976) and includes Ian Eslick (1991), Peter Fiekowsky (1977), David Glazer (1981), David Henkel-Wallace (1986), Andrea McGimsey (1987), James Rising (2003), Jocelyn Rodal (2006), and Matthew Wilbert (1980). The committee met three times during the year to give input to the ESG staff about a variety of issues, including finding ways to fund the ESG seminar series, organizing reunions, and reviewing current educational policy and initiatives.

Faculty Involvement

Professor Robert Silbey, dean of the School of Science, reorganized the ESG faculty advisory committee in spring 2007. Members of the committee include Professor Silbey (Chair), Professor Graham Walker (Biology), Professor John Guttag (Computer Science), Professor Charles Stewart (Political Science), Professor David Vogan (Mathematics), Professor John Belcher (Physics), and a representative from the Office of the Dean of the School of Science. Ex-officio members of the committee include Professor Kim Vandiver (ESG director from 1984 to1989) and Professor Slocum (current ESG director). The committee meets twice a year to provide oversight for the ESG program, including staffing and funding issues, educational policy, and exploration of academic initiatives for the program.

Future Developments

Endowment of the ESG Seminar Program

ESG is starting a fundraising campaign to raise $1 million over a 10-year period to endow the ESG seminar series on a permanent basis. Potential sources of income include ESG staff, alumni, matching funds from MIT, industry contributions, and grant-giving foundations. A business plan has been developed and was reviewed by the ESG alumni steering committee in August 2007.

Increased Involvement of ESG Alumni

We would like to serve as a model for the Institute on how to increase alumni interaction in MIT undergraduate education. Currently, our director, Professor Slocum, is an ESG alumnus and two of our staff members are ESG alumni. We also have an active alumni steering committee working with us regularly to oversee all aspects of our program related to alumni concerns.

Space Change

We are short on classroom space, which forces us to have larger classes. An extra classroom at ESG would mean we could experiment with the development of new teaching methods associated with new technologies.

ESG Publications

We are hoping to expand our book series in the future, with a specific focus on books that have an interactive and hands-on orientation and are able to be adopted by both high schools and universities. We are also planning on submitting a paper about ESG to a national journal of education in fall 2007.

Conclusion

We are dedicated to offering undergraduates the opportunity to teach and learn in a collaborative and interactive environment. We are proud of our history of educational experimentation, including our undergraduate seminars and the development of staff textbooks based on materials developed at ESG. We will work on increasing faculty and

alumni involvement with ESG, especially in connection with our alumni-student dinner seminars, our seminar series, and our faculty advisory committee. We will also continue to find ways to export successful ESG educational experiments to the regular curriculum and to educational settings outside of MIT.

Peter Dourmashkin
Associate Director of ESG
Senior Lecturer in Physics

Alexander Slocum
Director of ESG
Professor of Mechanical Engineering

Holly Sweet
Associate Director of ESG
Lecturer

More information about the Experimental Study Group can be found at http://web.mit.edu/esg/.