Innovation in Laboratory Instruction Award

Essy Behravesh, Ph.D.
Wallace H. Coulter Department of Biomedical Engineering

CETL Award Nomination for Innovation and Laboratory Instruction

Since 2006, Dr. Essy Behravesh has been the Director of Instructional Labs for the Biomedical Engineering Department. Soon after taking on this challenging position, he realized the need for more student engagement in the required laboratory courses. Because of this, Dr. Behravesh designed an IRB approved controlled study in 2007 using two lab sections for a BME Cell Biology course to compare the benefits of problem-based laboratory instruction when compared to a traditional step-by-step laboratory. Findings of an end-of-term survey showed multiple benefits of the problem-based section including better student application of learned skills and students who were more engaged in laboratory activities.[1, 2] What was surprising was the lack of confidence the problem-based students exhibited despite the fact that this group was better able to carry out common laboratory techniques. However, instructor time to manage problem-based laboratories has been a limiting factor for the large BME undergraduate enrollment.

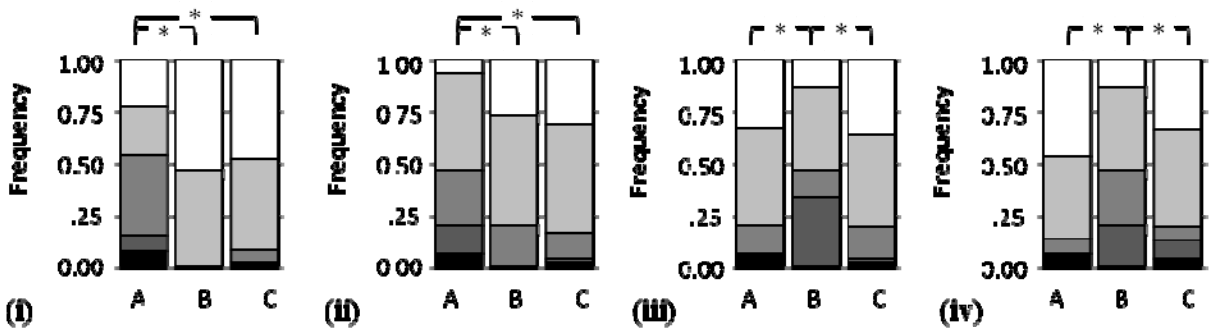
Goals and Audience:

The current iteration of the required instructional labs rely on three main goals: to engage students in the laboratory by a problem-based approach to better strengthen learning outcomes of lecture-based courses, to improve student confidence in the lab setting, and to provide the structure necessary for a scalable course that can withstand growing student enrollment.

Several key steps were necessary to achieve these goals. First, after training in safety rules and procedures, students were given 24-hour access to the instructional labs, allowing them to work on their own schedule. Next, the labs were created in a way that allowed students to use inexpensive components to design and build required hardware for completion of lab objectives, e.g. web-cam based extensometry and Nintendo Wii balance boards for biomechanics experiments. Students were encouraged to take things apart allowing them to gain valuable psychomotor skills that are so undeveloped in this generation of engineering students. Finally, students were allowed to select projects that interested them which further enhanced their engagement. Several course features in the initial modules allow the students to slowly gain independence including proper guidelines for project selection in-line with specific learning objectives of the particular lab module, step-by-step Standard Operating Procedures for basic lab procedures that students must follow, grading rubrics that are rigorous but detailed and transparent, and teaching assistant support. The redesigned course is more in-line with key outcomes of engineering instructional laboratories and gives our students an engaging laboratory experience that reinforces lecture courses and builds confidence in their skills so they can better apply them in their future careers.

Evaluation:

The effectiveness of this approach was evaluated in two ways including an end-of-term survey similar to the one given in 2007 that initiated this new lab approach and ABET departmental outcomes relating to the instructional labs. The Fall 2011 end-of-term survey of this redesign compared to 2007 are shown below (*Submitted: 2012 ASEE annual meeting*).



Final survey examining student perception of (i) TA's ability to allow team to make their own decision and development in (ii) conducting self-directed inquiry, (iii) execution of lab techniques, and (iv) confidence in a lab setting with lab equipment, where A, B, and C, and the Traditional, problem-based, and current groups, respectively. The frequency of responses is shown as grayscale bars on a 5 point Likert scale, where ''strongly agree'' corresponds to white and strongly disagree corresponds to black bars. The asterisk (*) represents a significant difference between indicated groups ($p<0.1$).

Similar Likert scores between the problem-based approach in 2007 and the current redesign of the lab course demonstrates that students were still able to make their own decisions and conduct self-directed inquiry in the more structured laboratory course. Also, the current redesign showed an improvement in student perception for confidence in executing laboratory techniques and working with equipment when compared to the problem-based course, similar to levels of the traditional step-by-step approach.

Through required assessment for ABET accreditation, the instructional labs has been used to demonstrate effectiveness of departmental outcome 4: an ability to design and conduct experiments as well as to measure, analyze, and interpret experimental data from living systems.

Adaptation:

The design and re-design of the laboratory courses have culminated in presentations at Biomedical Engineering Society[2] and American Society for Engineering Education[3]. This work was also part of a publication in the Annals of Biomedical Engineering.[1] Adaptation to other departments or universities requires backwards course design based on the departments specific educational outcomes and skill sets which they want to reinforce.

References:

1. W.C. Newstetter**, E. Behravesh**, N.J. Nersessian, and B.B. Fasse (2010) Design Principles for Problem-Driven Learning Laboratories in Biomedical Engineering Education. *Annals of Biomed Eng.* 38(10), 3257-3267.
2. **E. Behravesh**, B.B. Fasse, M.C. Mancini, W. C. Newstetter, and B. D. Boyan (2007) A Comparative Study of Traditional and Problem-Based Learning Instructional Methods in a Lab Setting. Annual Fall Meeting of the Biomedical Engineering Society, Los Angeles, CA.
3. **E. Behravesh,** A. Roy, S. Duncan, and C. Tuthill (2008) Development of RFID-Based Real-Time Inventory Tracking as a Project Assessment Tool in a Problem-Based Laboratory Environment. Annual meeting of the Southeastern section of the American Society of Engineering Education, Atlanta, GA.

Georgia Institute of Technology
The Wallace H. Coulter
Department of Biomedical Engineering
at Georgia Tech and Emory University
EMORY UNIVERSITY
SCHOOL OF MEDICINE

February 6, 2012

Dear Esteemed Awards Committee:

With pleasure and enthusiasm, I support the nomination of Dr. Essy Behravesh for the Center for Enhancement and Learning's Innovation in Laboratory Instruction Award.

Since joining the Wallace H. Coulter Department of Biomedical Engineering as the Director of Instructional Labs in 2006, Dr. Behravesh has had a tremendous impact on innovating the department's approach to lab instruction. His broad experience in working in national labs at renowned places such as NASA, Johnson Space Center and Industry at Zimmer, Inc. gave him the insight to recognize an opportunity to improve student engagement in the required laboratory courses. Dr. Behravesh designed an IRB-approved controlled study in 2007 using two lab sections for a BME Cell Biology course to compare the benefits of problem-based laboratory instruction when compared to a traditional step-by-step laboratory. With highly satisfactory results, the department implemented this innovative approach to integrate key learning outcomes and incorporates basic knowledge to aid student understanding of difficult topics.

Dr. Behravesh continually strives to better student learning by incorporating student feedback to course structure and design. Additionally, he continues to adapt instructional labs to accommodate a growing BME student population, which is currently over 300 students per year. He collaborates with department administration to ensure safe laboratory practices and procedures in the instructional labs while providing students with 24-hour access. As chairman, he is a highly valuable member of the BME Undergraduate Curriculum Committee.

His talent for mentoring students has been recognized by winning the NASA outstanding Mentor award and the Class of 1969 Teaching Scholar award. Dr. Behravesh is diligent and tireless in his efforts to create the best instructional lab experience for his students. He is highly revered by his colleagues and students. His commitment and devotion is inspiring.

I highly encourage the Awards Committee for the Center for Enhancement and Learning select Dr. Essy Behravesh for Innovation in Laboratory Instruction Award.

Sincerely,

Larry V. McIntire, Ph.D.
Wallace H. Coulter Chair and Professor

Georgia Institute of Technology
The Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech and Emory University
EMORY UNIVERSITY SCHOOL OF MEDICINE

GT Faculty Awards Committee
CETL Innovation in Laboratory Instruction Award

February 2, 2012

Esteemed Awards Committee:

It is my great pleasure to offer my enthusiastic support for the nomination of Dr. Essy Behravesh for CETL's Innovation in Laboratory Instruction Award. I have worked closely with Dr Behravesh since he joined our department as the Director of our instructional laboratory program. At that time, our two-course bench top sequence was poorly designed and poorly executed for three reasons. First, neither course had a close or obvious connection with the companion lecture courses because they had never been designed as coherent or connected pairs. Instead, we had two lecture courses in the area of Systems Physiology and two laboratory courses essentially untethered from the companion lecture courses. A second problem was that the cell level course was essentially a cell biology course for biologists not designed for engineering students. Students just followed step-by-step procedures like Western Blots or PCR, techniques that they as biomedical engineers might request but not actually do in industry. Finally there was no clear connection between the two laboratory courses. In fact there was a serious disjuncture. In the first course, students did computer-based modules using BioPac software and then in the second they shifted to pipettes and sterile technique. When Dr Behravesh inherited these legacy courses, he knew immediately that things needed to change dramatically.

Over the next year, he experimented with shifting the cell level course from a technique-driven to a problem-driven learning environment. He put students on teams and gave them problems or dilemmas to solve in the laboratory. One involved identifying the species of an unidentified tissue from a serum sample. In a comparative study conducted using this new approach and the technique-drive approach, Dr Behravesh was able to demonstrate greater learning gains for the experimental problem-driven students, a study that was published in the *Annals of Biomedical Engineering.* Encouraged by these results, he developed a totally new concept for the two laboratory courses that would entail a year long coherent laboratory learning experience that built skills in the first term and then had students use those skills in open-ended problem posing and solving in the second. Essentially, he was seeking to create a learning trajectory over two terms that replicated learning in a biomedical engineering research laboratory. He convinced the undergraduate curriculum committee this was a more appropriate set of courses and they concurred, As a result, a total curricular redesign was undertaken.

The two-course sequence is now a demanding, rigorous pair of carefully designed set of modules that builds problem-solving skills, software skills and engineering analysis techniques. Dr Behravesh has infused this course with the kinds of activities that practicing biomedical

engineers in industry will need. His insightfulness, careful design, and bench top mentoring have made these courses an essential learning experience for our BME students.

These new models for laboratory instruction are direly needed in post-secondary education and Dr Behravesh can be counted among the true innovators. He often stops in my office to talk about things happening in this revised class and to seek new ideas, which he readily incorporates, always desirous of making the learning experience as rich and rewarding as possible. I can say without reservation that Dr Behravesh is a committed and innovative teacher, one who truly enjoys working with and interacting with undergraduate students. And one who has developed a transformative approach to instructional design in the laboratory.

I strongly urge you to give his nomination every consideration.

Respectfully,

Wendy C. Newstetter, Ph.D.
Director of Learning Sciences Research

January 25,2012

GT Faculty Honors Committee:

It is my pleasure to recommend Dr. Esfandiar "Essy" Behravesh for the Center for the Enhancement of Teaching and Learning (CETL) Innovation in Laboratory Instruction Award. He is deserving of this award for developing and implementing novel pedagogical practices in the Department of Biomedical Engineering (BME) instructional laboratory as well as the energy he devotes daily to the goal of assuring his students' successful participation in meaningful and professionally appropriate learning activities.

My collaboration with Essy began in the Spring 2007 semester when he sought my advice on learning issues related to re-engineering the BME instructional lab curriculum. After observing the irrelevance of "recipe-style" assignments that are traditionally typical of biology lab instruction, Essy developed and implemented a novel approach based on the principles of Problem-Based Learning (PBL) and his experiences as a biomedical engineer. With industry's expectations in mind, he reverse-engineered the lab instruction to reflect the practices that are expected of BME graduates in the field. That first semester he conducted a comparative study of student performance in sections using the traditional curriculum and one section of the new curriculum to assure that his methods would accomplish the goals. Receiving confirmation, he forged ahead enacting the curriculum across all of the instructional lab coursework. The BME lab instruction continues to evolve with Essy self-consciously and iteratively evaluating the curriculum after each semester and then implementing the lessons learned into the next iteration of course design.

An abbreviated description of the Quantitative Engineering Physiology Laboratory II course can best serve as an illustration of Essy's classroom innovation. The goal of this course is to incorporate common cell and molecular biology techniques and to reinforce selected engineering principles appropriate for biomedical engineers. Students practice *in vitro* cell culturing to develop an understanding of the variability of biological systems within the context of a real-world problem requiring integration and application of content knowledge. Additionally the course supports team skills, communication, intellectual curiosity, independence, learning from failure, time and project management, human and material resource allocation. Using a team-based PBL-like curriculum, students are challenged to conduct a literature search to identify a real world problem with bench-top applicability that they can initiate, replicate, or extend in experiments of their own. After presenting their proposals to the class, each team places a materials order in order to execute original research, from designing the experiment through data analysis and public presentation. Essy and a team of graduate teaching assistants (GTA) leverage the learning opportunities in the open-ended work by closely monitoring and supervising the student-driven research.

Essy is tireless in his commitment to relevant lab instruction. An intense amount of concentrated focus, energy, and hours are required to maintain the vitality of this unique learning-centered curriculum and to manage approximately 50 teams of students across the lab courses every semester-- each performing independently of the others yet as members of a shared community. In addition, he mentors the GTAs as they learn how to teach effectively by assisting him in guiding the undergraduate students. His efforts to create the best possible learning environment are unflagging.

It is without reservation that I heartily endorse Dr. Esfandiar "Essy" Behravesh for the CETL Innovation in Laboratory Instruction Award. Please feel free to contact me for any additional information, supporting evidence, or data to assist with your consideration of him for this award that he richly deserves.

Sincerely,

Barbara Burks Fasse, PhD
Senior Research Scientist
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February 1, 2012

To Whom It May Concern:

This letter is to formally document the impact and the value of the coursework of Dr. Essy Behravesh and the classes he manages in the biomedical engineering curriculum at Georgia Tech. The innovation and dedication with which Dr. Behravesh facilitates his laboratory courses thoroughly prepared me for my career as a new product engineer and set me up for success as a problem solver and team member.

Dr. Behravesh's taught me how to teach myself new technology. I can think of no greater skill than that in today's engineering environment. I didn't fully realize the impact of this skill until I began working myself, and found myself constantly in a place where I had quickly come up to speed on a new machine or laboratory techniques that I needed to solve a problem or answer a questions. The structure and format of Dr. Behravesh's laboratory courses is conducive of an understanding far greater than cell function and cellular systems – the primary topics of the courses. Dr. Behravesh creates an environment that allows students the opportunity to research and replicate a real world problem. And, most importantly, Dr. Behravesh's courses foster an environment in which students can understand the mechanisms necessary to *solve* that problem.

Dr. Behravesh structures his courses so that students work in teams, solving several different problems in those teams throughout the semester. He opens up a large variety of state-of-the-art lab equipment and computer programs as tools available to students, and is always excited to bring in new technology students feel would be helpful to solve their problems. Dr. Behravesh is a great wealth of information on any type of experimental set-up and execution. However, Dr. Behravesh's course is most impactful because of the hands-off approach that he takes as he lets his students learn how to solve problems independently.

Once Dr. Behravesh has adequately explained how certain key laboratory tools function, he steps back and lets students apply what he has taught in whatever contexts the students feel is appropriate. There were many late nights I spent working to understand the technology necessary to solve my team's problems, and, quite honestly, many frustrating dead ends. And I am so thankful for those late nights and those dead ends. By allowing his students to learn independently and troubleshoot through problems they encountered, Dr. Behravesh replicates a real world engineering environment. He taught us all how to be diligent and driven scientists who work to utilize the best, sometimes unfamiliar, technology to solve our problems.

There are many days when I walk into the laboratory at work and see an unfamiliar pieces of machinery or equipment. I smile to myself and think back to the days of Dr. Behravesh's labs, when every time I would walk into the lab I would see something new to learn. Because of those days, I walk into my labs now with confidence. Unfamiliar technology does not intimidate me, instead I am excited about the opportunity to apply technology to my real world problems in efficient and effective ways. Thank you, Dr. Behravesh.

Sincerely,

Shelley Eckert

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February 1, 2012

To Whom It May Concern:

I am writing this letter in regards to Essy Behravesh's nomination for one of the Enhancement of Teaching and Learning (CETL) Innovation in Laboratory Instruction awards. I am a Tech graduate that took Dr. Behravesh's courses (BMED 3110 and BMED 3610) in the summer and fall of 2009. I think I speak for most when I say that there aren't any classes like these in the Biomedical Engineering program. They are the true definition of problem based learning and group problem solving that are emphasized so much in our program here and they had a big impact on my education. At first it is a little bit frightening to be taking a class with a different structure but when I look back on the experience of taking these labs I realized how much I learned. The class has a structure in which the TA is the main contact and guidance and Dr. Behravesh is an additional source. He is always available to help students and his only requirement is that you first know what you are trying to accomplish and then he will offer any guidance necessary to carry out that goal.

The main thing I learned was how to problem solve and use each person's skill set on a team to accomplish things together. A big challenge was the programming language that we use, LabView, especially if you are not very familiar with programming. However, Dr. Behravesh gives us the tools we need to use our pre-requisites (such as Digital Signal Processing) to learn this new program by thinking about it in a different way. Besides learning programming, which happens quickly - within the first 2 weeks, the remainder of the lab stresses experimental design, analyzing results appropriately, and effectively communicating those results by way of report. It is the class where you take what you have learned from Statistics and introductory BMED classes and actually put it to use. Time management, thinking deeply about what you are trying to accomplish and the best way to accomplish it, effective planning, and teamwork are all key points that you need to succeed in this class and in life.

I definitely learned all of these lessons from the labs and things have only gotten better over time. I now work as an undergraduate research coordinator for these labs and I have seen how the labs have evolved over the past 3 years. Dr. Behravesh uses many tools to ensure that the class is improving from semester to semester and is always open to any constructive criticism from the students and TAs. He strives to ensure that the students are in fact mastering the objectives of the courses and learning all they possibly can in the two short semesters. I think these instructional labs are a key part of our program and Dr. Behravesh is very dedicated to making them as effective and educational as possible.

-Ashley Grozier

To whom it may concern:

Dr. Essy Behravesh is the most effective laboratory instructor that I've had during my years as a student. His open-ended, problem-based approach for undergraduate labs in the BME department at Georgia Tech was instrumental in honing my ability to conduct original research, and I know that many students have also benefited from his labs, regardless of the career they have chosen to pursue. Furthermore, Dr. Behravesh's willingness to assist in matters beyond the required scope of labs demonstrates a genuine interest in students' success that sets him a level above any other lab instructor.

Dr. Behravesh directs his lab courses in a way that encourages the essential qualities of engineering students. In particular, the laboratory assignments are loosely defined so that students must use their creativity to independently design and execute the appropriate experiments. After completing multiple team projects in each lab course, I became a master of the routine: receive the generalized assignment, conduct a literature search to narrow the scope and define a particular research question, develop and perform experiments, then analyze the data and draw conclusions. Perhaps the best example of a typical project was to develop an algorithm to identify an unknown neurotransmitter, based on its effects on spontaneous smooth muscle contractions in earthworm intestines. We had to look up the working concentrations and expected effects of the 5 possible drugs, run initial force-testing experiments, devise quantitative metrics to distinguish each individual drug, and actually test our algorithm on an unknown drug. Other projects included writing software to diagnose heart diseases based on acquired heart sounds, testing the effects of environmental cues on the differentiation of progenitor cells into osteoblasts, etc. While the ability to design experiments like these is especially helpful to me in graduate school, students who choose to work in industry are also thrown into similar situations where they must quickly educate themselves on a new subject and decide the direction in which they will take a particular job assignment. Thus, I found the structure of Dr. Behravesh's labs to be extremely helpful in the academic development of engineers.

In addition, Dr. Behravesh was always willing to provide meaningful assistance to students who sought it. He seemed to live in the basement of the BME building and spend the vast majority of the day consulting with individuals or small groups about their particular projects. In my personal experiences with him, I especially liked his tendency to help us find solutions to our own questions, instead of just giving the easy answers. Dr. Behravesh was also very responsive to our requests for new equipment and/or reagents that were needed when we wanted to do a new experiment. He gave outstanding feedback to us on both ideas during the project and the final reports at the end of the project, such that we made significant improvements as the course progressed. Finally, one of my most lasting impressions of Dr. Behravesh is when he helped my senior design group with our project, even though he has no connections to the senior design course whatsoever. He gave us advice on the hardware for our device and the accompanying LabView software, simply out of good nature and a desire to help us succeed in a different class. To me, that work done outside of his job description is a hallmark of an exceptional academic professional.

I understand that you are considering many faculty members for the Innovation in Laboratory Instruction award, but please take into consideration my highest recommendation for Dr. Essy Behravesh. The structure of his labs helped me realize my desire to conduct graduate research, and I am only one of many students who have been aided by the devotion that he puts into his work.

Sincerely,

Chris Jackman
B.S. in Biomedical Engineering, 2011
Biomedical Engineering PhD Student
Duke University
chris.jackman@duke.edu

To Whom It May Concern:

My name is Ariel Livica, and I am writing this message to express my full support on Dr. Esfandiar Behravesh's nomination for the Center for the Enhancement of Teaching and Learning (CETL) in Laboratory Instruction award.

As part of the Biomedical Engineering curriculum, Dr. Behravesh's Qualitative Engineering Physiology Lab I and II provides a novel, hands-on approach to solving engineering based problems. Each module in the first lab course emphasizes the fundamentals, fundamentals in statistical analysis, technical writing, and the scientific process. The second of the lab courses extends these fundamentals into the cell laboratory environment, focusing on aseptic techniques and cell culturing/testing protocols.

Overall, the lab courses are everything cumulative lab courses should be; however, the thing that separates these courses from any other course I have ever taken before is how much more they truly are. At the start of the semester, Dr. Essy begins by saying, "This course will be whatever you put into it." At that instant, the tone for the rest of the semester is set. Every student is, ultimately, responsible for how the class goes. Throughout the semester, students are given problems to solve; each student is given the tools and equipment needed to solve the problems, but it is up to each individual to learn how to utilize those tools. Dr. Essy does a great job teaching by stimulating and promoting self-directed learning. In this sense, each student gains a sense of autonomy. In the class, every student begins to gain a mentality that the answer is out there but it is up to them to find it. I remember asking him for advice on a specific module; after giving me advice he mentioned that he was telling me a direction I could go, but was not necessarily the right way. Though ambiguous and at that moment discouraging, the statement he made helped make a good point: ultimately, it was my responsibility to be critical about my approaches to solving these problems. From there on in, I began to have a clear understanding of how to address and assess practical engineering problems.

The modules themselves were just as thoroughly planned and implemented and equally educational. The one thing I continue to praise about the class to other students is how well the lab courses take theory learned prior and apply them into a practical setting. Dr. Essy does a great job in understanding the BME curriculum and designing modules that help take the knowledge the students have learned and consolidate them into a rigorous but rewarding engineering problem. As expected, whenever problems got of tough, Dr. Essy was always there to lend a hand. He never failed to drop in during lab times to see students' progress and was always willing to spend time outside of class whenever he could.

Ultimately, Dr. Essy's program taught me – and countless of other students – essential tools and skills that all engineers need to be successful, skills that fully extend into both academia and industry. I truly believe that Dr. Esfandiar Behravesh truly deserves the CETL in Laboratory Instruction award because of his innovative approach to teaching by promoting self-directed learning through an interactive program for solving engineering-based problems.

Thank you for your time,
Sincerely,

Ariel James E. Livica

February 1, 2012

To Whom It May Concern:

I am writing this email on behalf of Dr. Esfandiar Behravesh and his nomination for the CETL award. I must say that I learned more from my time with Dr. Behravesh than any other class/instructor during my college career. Prior to taking his class I had just been readmitted from academic probation. Dr. Behravesh is well known for his demeanor and approach to class and was initially taken back from the potential difficulties of his course. However, the course was unlike any I had previously taken at Georgia Tech. The structure was fairly open and enabled all students to take initiative in their course progression. BME 3110 was somewhat structured as students were given a 5 project semester in which the inspiration for all projects were clearly laid out while the experimentation component was completely up to the individual groups. Experimental design is stressed and proper use of +/- controls, methodology and the importance of planning and flow charting. BME 3610 was highly open for all students to propose and design various experiments based on the cellular level. In my opinion this course was the culmination of my degree and all that I learned as an engineer. More so than other classes (including senior design) the course forces students to apply the knowledge from various courses throughout their undergraduate career as well as engineering principles to successfully navigate the laboratory. Having such freedom for the design and implementation was a great benefit and allowed some sense of accomplishment and validation as a "soon to be" engineer. Of course all proposed experiments had to receive the approval from Dr. Behravesh and this was critical in understanding the importance of quality control and identification of variables/controls. I liked to think of this as a verification of the design engineer's proposal by the project engineer. He forced us to check our samples, to validate controls, to plan gantt and flow charts and to understand the necessity for appropriate planning prior to execution.

As I have stated I learned much more from Dr. Behravesh's course and principles. He is old school and pushes the key components that my father (mechanical engineer '78) always told me growing up. I loved both course that he taught and appreciated most the method in which these courses were taught. They made me feel like an engineer having minimal limitation, high exceptions and constant feedback. I hope these words help you in your decision and from my standing/opinion no professor in BME is more deserving of this award.

Regards,
Sergio Mazul

To whom it may concern:

I have taken two Instructional Laboratory classes with Dr. Behravesh, BMED 3610 and BMED 3110. I have also sought advice from Dr. Behravesh on matters such as applying to graduate school, and applying for fellowships. He helped my senior design group with our project, both by consulting and informing us of what equipment he could access. Clearly, I am well acquainted with Dr. Behravesh's teaching strategies and personality in general.

I can say without hesitation that Dr. Behravesh is my favorite professor and that his instructional laboratories have been my favorite classes. These laboratories provide incremental challenges to ensure that the students learn with every module. The first challenge is learning to use LabVIEW, which while difficult, adds a new skill to each student's repertoire. The following modules in BMED 3110(approximately six total) teach the students to fuse certain aspects of their knowledge of physiology with an experimental setup, to learn something new. Each module is collaborative and the students work in teams of 3-4 for the entire semester. Dr. Behravesh's instructional labs provide students the ideal environment to learn to break down a problem, so that each team member may apply his or her strengths, to solve the problems well and quickly. Because the lab modules are open-ended, the labs require a good deal of outside research using peer-reviewed literature. This allows students to hone their skills in both finding and dissecting scientific papers.

The second course, BMED 3610, takes a more advanced approach. Using the skills developed in BMED 3110, the student teams must design their own experiments for each module. This teaches experimental design while also teaching basic cell laboratory techniques. The second module of this course requires each student to find a peer-reviewed journal article and hold a journal club, where he or she presents the paper and critiques it. This is a valuable skill, especially for anyone pursuing further education.

Overall, I have learned a great deal from these two labs. The teachings of these laboratory classes far exceeds the techniques and academic material covered. I learned much about leadership, by trying to help lead a team to complete projects on time. I learned how to function well as a team player and how to read scientific papers efficiently and thoroughly. Most importantly, I learned how to take everything that I have learned in my other courses and apply it to solving a problem.

Dr. Behravesh has taught me more than any other professor. He has an open door policy and inviting attitude that allows for students to visit him and have their questions answered at any time throughout the day. The instructional laboratories that Dr. Behravesh has created are in a league of their own and teach students much more than laboratory techniques. Dr. Behravesh and his instructional laboratories provide the ideal candidate for an award for Innovation in Laboratory Instruction.

Sincerely,

Aaron Morris
Senior Undergraduate Student
Biomedical Engineering