



## **Assessing Student and Employer Satisfaction in a Liberal Arts/Engineering Bachelor of Arts Degree**

**Dr. Michael Haungs, California Polytechnic State University**

Michael Haungs is an Associate Professor in the Computer Science Department at California Polytechnic State University. He received his B.S. degree in Industrial Engineering and Operations Research from the University of California, Berkeley, his M.S. degree in Computer Science from Clemson University, and his Ph.D in Computer Science from the University of California, Davis. Over the last 8 years, Dr. Haungs has been actively involved in curriculum development and undergraduate education.

**Dr. David Gillette, California Polytechnic State University**

**Dr. Debra L. Valencia-Laver, California Polytechnic State University, San Luis Obispo**

Debra Valencia-Laver is a Professor, Department of Psychology and Child Development, and Associate Dean, College of Liberal Arts at California Polytechnic State University, San Luis Obispo. She has been involved with the development of Cal Poly's Liberal Arts and Engineering Studies initial proposal as a pilot bachelor's degree program and its subsequent program review and conversion to a permanent degree program.

**Dr. Elizabeth Ann Lowham, California Polytechnic State University**

Elizabeth Lowham is an Assistant Professor of Political Science at California Polytechnic State University, San Luis Obispo, where she also serves as director of the Master of Public Policy program. Elizabeth received her B.A. in Geology from Carleton College in 2001. She received her M.A. and Ph.D. in Political Science from the University of Colorado, Boulder, in 2003 and 2007 respectively. Elizabeth's research interests center around collaboration and leadership in environmental policy and research methodology. Elizabeth is a member of the Faculty Advisory Board of the Liberal Arts/Engineering Studies program at Cal Poly.

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### 1. Liberal Arts and Engineering Studies (LAES)

California Polytechnic State University at San Luis Obispo (Cal Poly) is offering a new multidisciplinary Bachelor of Arts degree program in Liberal Arts and Engineering Studies (LAES). This program is a collaboration between the College of Liberal Arts and the College of Engineering and represents a new model for fostering multidisciplinary work on campus. The program was run on a trial basis from 2006-2012. In Spring, 2012, the program was approved to become a permanent part of the university curriculum.

The LAES program prepares students for a wide range of careers in professional fields that combine skills and interests in engineering, the arts, technology, and culture. As part of a quarter system, the LAES program requires 52 quarter units (hereafter referred to as simply “units”) of general education, 40 units of Science and Mathematics, 34 units of Engineering, 24 units of Liberal Arts, and 8 units of study abroad coursework. LAES students also take 16 units of service-based learning combined with their senior project work. Our graduates have successful careers as game designers, media developers, sound engineers, and technical writers, to name just a few. For more information on advising and Engineering/Liberal Arts course selection, please refer to the following web page: <http://laes.calpoly.edu/content/concentrations>.

Before starting the trial-run period, the LAES program had to prove there was a need for this type of program. We referenced a number of national studies that showed how technical employers expect increasingly more interdisciplinary academic backgrounds from new employees, especially some combination of the skills provided by liberal arts study with engineering skills. For example, “Educating the Engineer of 2020”<sup>1</sup> claims there is a nation-wide need for a bachelor of arts in engineering.

During the first five years of our program’s trial run (2006-2012), we tracked the internship and post-graduation employment of our students. In 2011 we conducted a series of surveys and interviews to learn how well the LAES program meets current workplace needs; employers across the board gave our students high marks on their ability to think critically and creatively, work effectively, and serve as responsible, informed citizens in a global culture. We also assessed student perceptions of the program and asked students to offer recommendations for future improvement. Across the board, students felt strongly that LAES helped them achieve personal learning objectives and prepared them to meet their goals as professionals. All students surveyed indicated they would have either left Cal Poly or remained extremely unhappy in their current majors if not offered the opportunity to switch into LAES. Cal Poly now believes the flexibility and interdisciplinary variety offered by LAES is a key element for generating higher student retention.

In this paper, we present the results of our survey and interview work. We discuss how the findings verify the claim made throughout the life of the program that LAES-like

interdisciplinary programs are ideal for helping students become effective members of the 21st century workforce. Our goal is to provide basic structural advice and statistical support for others who are interested in establishing similar interdisciplinary undergraduate degrees.

## 2. Student Perceptions

In May 2011, the LAES Faculty Advisory Board surveyed current LAES students. Of the 39 current students, 27 participated (69% response rate). The goal of the survey was to assess students' perceptions of the program, its abilities to meet its own learning objectives as well as to identify areas for future improvement and growth.

### 2.1 LAES Students: Who are we? Demographics of the Program

Currently, the program is comprised mostly of 3rd, 4th, and 5th year students. Of all respondents, only 7.41% (2 students) were second year students. Given the program's status as a within-University transfer major, this upper-class-heavy trend is not surprising. It is important to note that none of the students who completed the survey indicated they were 6th year or above. The implication here is that the LAES program does not appear to force students into a longer tenure at Cal Poly than expected as compared to traditional academic programs.

This is further evidenced by the fact that a majority of students (nearly 63%) indicated that their planned graduation date is earlier or on time compared to their anticipated graduation date when they enrolled at Cal Poly. For 37% of respondents (10 students), their anticipated graduation date is later than anticipated. Although we do not have data comparing this figure to other majors, we feel it is not out of line with traditional academic programs. Further, the percent that feel their graduation date is later than anticipated probably matches the percent for all students at Cal Poly who transfer majors.

Students within LAES can select from a variety of Engineering and Liberal Arts concentrations, including, for both, an Individualized Course of Study (ICS). In both areas, most students select an Individualized Course of Study; 37% (10 students) select the ICS for Engineering and 59% (16 students) select the ICS for Liberal Arts. Of the pre-designed Engineering Concentrations, Computer Graphics and Industrial/Manufacturing Engineering were the most popular (7 students each). Of the pre-designed Liberal Arts Concentrations, Interactive Communication: Cinematic and Culture, Society and Technology were the most popular (5 and 3 students respectively).

The relatively high number of students who elect to design their own courses of study in both concentrations may indicate that the program should reconsider some of the pre-designed concentrations. Certainly, the flexibility of the program is a strength/advantage of the program, as discussed below. However, the administrative burdens of that flexibility increase the workload for the advisors.

Perhaps most importantly from a program review perspective, 70% of the respondents (19 students) indicated that without LAES, they would have transferred to another university. Equally important, the remaining 8 students all mentioned that though they might have stayed, they would have been extremely unhappy in their major and at the university. Thus, LAES is a

program that has allowed students to remain at Cal Poly and, importantly, remain happy at Cal Poly.

## 2.2 Programmatic Learning Objectives: How do students evaluate the Program?

Students in Spring 2001 were asked to evaluate how well the program learning objectives are met in the (1) core LAES coursework (LAES 301, 411, 461/462), (2) Engineering concentration coursework, and (3) Liberal Arts coursework. Twenty-seven students responded to the survey. They were asked to rank how well each learning objective was met on a scale of 1 to 5, with 1 = Not at all to 5 = Very Well. The mean ratings are shown in the following table:

| Item  | LAES Core | LAES CENG Concentration | LAES CLA Concentration |
|---|-----------|-------------------------|------------------------|
| Think critically and creatively in the process of solving techno-social problems considering philosophical, aesthetic, and expressive concerns.                             | 4.81      | 4.26                    | 4.67                   |
| Communicate effectively through a variety of media in diverse, multi-cultural perspectives and facilitate communication between technical and non-technical collaborators.  | 4.81      | 4.07                    | 4.74                   |
| Use mathematics, science, and engineering principles to produce solutions to problems within the student's Liberal Arts and Engineering concentrations.                     | 4.15      | 4.67                    | 3.63                   |
| Function effectively as a member of interdisciplinary and international teams, formulating sustainable solutions to problems at the intersection of science and technology. | 4.59      | 4.11                    | 4.11                   |
| Demonstrate ethical and professional responsibilities associated with the creation, use and integration of technology.  | 4.56      | 4.30                    | 4.52                   |
| Serve as informed and responsible citizens in a global culture and remain involved with learning and helping society improve.   | 4.63      | 4.18                    | 4.33                   |

On the whole, students feel that the core LAES courses (LAES 301, 411, 461/462) do more than “reasonably well” in meeting stated learning objectives. No students ranked the core courses below neutral in meeting any of the learning objectives. Notably, students feel that the core courses do a particularly great job at meeting the critical/creative thinking and communication learning objectives (77.8% and 81.5% respectively rated these learning objectives as being met “very well” by core courses).

The only learning objective where a majority of the students did not rate the learning objective as being “very well” met was learning objective 3 (the use of math, science and engineering principles). In this case, the largest percentage of students felt that the courses met the learning objective “reasonably well”.

On the whole, students were a bit more varied in their evaluation of their Engineering concentration courses in terms of programmatic learning objectives. A majority of students (66.7%) felt that the Engineering concentration courses met the third learning objective, use mathematics, science and engineering principles, very well. Many students (48.1%) also felt that the Engineering concentration courses helped them develop the ability to think creatively and critically very well. Students were more evenly split on how well the Engineering concentration courses helped them develop effective communication skills. Importantly, 77% of students fell into the “reasonably well” and “very well” categories. However, it is notable that 11% of students rated these courses as neutral and an additional 11% rated these courses as not very effective in their ability to build effective communication skills. A similar pattern (a majority of students falling into the “reasonably well” or “very well” categories and a smaller number of students rating courses as neutral or below) was observed in learning objectives 4 (function as a team member) and 5 (ethical and professional responsibilities).

Notably students were fairly evenly split between neutral, reasonably well and very well in terms of their Engineering concentration meeting the informed citizens learning objective (#6). The overall conclusion is that while most students feel that their Engineering concentration courses meet the programmatic learning objectives, they do not feel their Engineering concentration courses meet the programmatic learning objectives as well as the LAES core courses do.

Similarly, students felt that their Liberal Arts concentration courses met the programmatic learning objectives, though, again, not as well as the LAES core courses. In particular, students felt that their Liberal Arts concentration courses met learning objectives 1 (creative/critical thinking, 74.1%), 2 (communication, 81.5%), and 5 (ethical and professional responsibilities, 63%) “very well”. Understandably, students were more evenly divided in terms of learning objective 3 (use mathematics, science and engineering principles); only about 52% of respondents rated their Liberal Arts courses as being in the “reasonably well” or “very well” categories. A majority of student respondents (88.8%) felt that their Liberal Arts courses prepared them “reasonably” or “very well” to serve as informed citizens (learning objective 6).

Overall, the general impression of the program’s ability to meet the programmatic learning objectives is very strong. This is particularly true for the LAES core courses, which bring

together the learning that's developed in the concentrations. Only a few students indicated that their individual concentration courses did not meet the programmatic learning objectives either reasonably or very well. However, taken together, there is evidence that skills not met with one concentration or in the core are met elsewhere in the major curriculum. The Liberal Arts concentration and the core were seen as contributing more than the Engineering concentration to effective communication; likewise the Engineering concentration was key in providing students with strong science, engineering, and math skills—exactly the mix the program was designed to see.

In terms of personal learning objectives, 63% of students feel that the program has helped them achieve their personal learning objectives very well. The remaining 37% felt that the program has helped them reasonably well. No student responded in the neutral or lower categories regarding the program's ability to help him or her meet their personal learning objectives. Substantively, student descriptions of their personal learning objectives centered around four main themes: integration, collaboration/teamwork, work skills/experience, and subject specific knowledge. Fifty percent of the students who provided comments discussed the idea that LAES program allowed them to focus on a breadth of areas and the interconnections among those areas. A good number of students (32%) also commented on how the program helped them learn the skills of teamwork and collaboration with diverse individuals.

Students also focused on the program's ability to offer both knowledge/depth and on the ability to provide practical, hands-on work experience and skills. There were far fewer comments regarding what personal learning objectives the respondents wish LAES would develop more in depth. Thirty-one percent of the 16 comments received focused on the desire for a more concrete set of career skills, largely networking and self-marketing/promotion.

Some students (25%) also sought more experience with industry specific technology and software. Finally, there were two students who commented on the fact that they would like to see a more diverse set of projects within the core LAES courses. While there were only a small number of students who made similar comments, it was a theme throughout several of the more qualitative questions.

From a professional goals perspective, most respondents (59%) felt that the program helped them meet their goals as an emerging professional. Students felt that the program helped them develop a unique set of skills/knowledge about a subject matter, provided them the ability to communicate through a variety of mediums, and allowed them to learn to quickly adapt to a variety of challenges. Of the 19 comments received, the most frequently mentioned professional benefit was the fact that the LAES program provides them the opportunity to work with and present to industry professionals extremely early in their educational career. Students appreciate the opportunity to professionalize their education early as well as the depth of industry connections the program offers.

Perhaps notably, 7% of respondents felt neutral about the program's ability to meet their professional goals. While these numbers are still strong, particularly for a young program, given the focus of the program, it may be worth noting that students were slightly less favorable in their perceptions of the program's ability to meet their professional goals than they were in their

perceptions of the program's ability to meet their learning goals. Of the 16 comments received in terms of how to improve the professional aspects of the program, some students (25%) would like to see the program extend the scope of connections and projects connecting the liberal arts and engineering fields. Some students (25%) would also like to see the program develop additional networking/marketing skills, including the development of a portfolio. Finally, a small number of students would like to see the program provide more depth on specific industry software/technology.

### 3. Employer Feedback

In response to an employer survey sent to 13 current employers of LAES graduates, surveyed during Fall 2011, 7 employers responded.

Of the seven respondents, four were very involved with the hiring process and the same number were directly connected to the hiring and/or interviewing of the LAES student employee. In response to the questions, five felt the employed LAES students were able to think critically and creatively in the process of solving techno-social problems, considering philosophical, aesthetic and expressive concerns. Six of the seven respondents agreed or somewhat agreed that their employed LAES students were able to demonstrate ethical and professional responsibilities associated with the creation, use and integration of technology. Seven of the respondents agreed that the employed LAES students were able to serve as informed and responsible citizens in a global culture and seemed to remain involved with learning and helping society improve.

Many of the respondents commented on the students' ability to work efficiently, noting that the students seemed to be well prepared for work. One employer stated that s/he found the LAES students to be "very bright individuals and excellent at creating new ways to make our office and production and distribution more cost effective. Great insight and skills come from their courses from which they have taken at Cal Poly. I think all of the students that I have hired from Cal Poly in other majors have all contributed their own style and knowledge to the company." Another employer noted that the LAES student hires, "...impressed us dearly with the work ethic, creativity, and ability to work seamlessly with us," and that the students' "traits of creativity and mindfulness stand out, not to mention their excitement, energy, communication skills and curiosity."

One of the most important aspects about the professional training that we're helping to provide in our program is the fact that we have been doing this during a period in the American economy that has hit one of its lowest points in the last 60-80 years. During years when so many people have been thrown out of work, and so many college graduates are unemployed months, sometimes years after graduation, many of our program's graduates stepped directly into employment in their intended fields, with jobs that were either waiting for them before they graduated, or with positions they received within weeks of leaving Cal Poly. We have tried to track our students' employment both in areas that are related to their eventual careers, and also in basic employment that helps them pay the bills. Many of our students are funding their college study completely on their own, and many of our students are working two or three jobs while studying, just to get by. Therefore, when reviewing the employment opportunities for our students, it is important to keep in mind that our students need to supplement unpaid or low-pay

internship positions in their career fields with employment in service jobs that are often well outside their fields of study.

During the graduation process and in letters from recent graduates, our students commented on the fact that the diversity of their interests and experiences from Cal Poly were key factors in securing their new jobs. Additionally, the overseas work/study experience that is required for completion of our program directly led to employment for a few of our students, and was mentioned as an important factor that allowed all the students to find a job in one of the most competitive and desperate markets for graduating college students in recent memory.

None of our recent graduates are heading toward making their first million dollars right out of the gate, and all their current jobs are indeed at an entry level, but they all are in the fields for which our students prepared themselves during their last few years in the LAES program, and these students are all excited to be able to start with their chosen careers especially in tough economic times.

#### 4. Moving Forward

Because the BA LAES utilizes course credits accumulated during the normal progression within the initial engineering major, coupled with required lower division general education courses taken in the first few quarters, the transition to the new BA LAES should be a much more efficient pathway to entrance (and graduation) for these internal transfers, thereby allowing for faster replacement of student positions in the participating engineering programs, while also increasing the graduation and retention rates for those same programs (as calculated by some, but not all indices).

The larger number of students transferring out of Engineering into LAES is expected and meets with our initial mission of the program to help engineering students at Cal Poly change into a new, better-fitting major, while allowing them to more efficiently move toward graduation. By also providing a major that allows engineering students and technical students to more easily make effective use of their prior coursework in constructing a new major, we are helping to fulfill our university's retention goals.

We continue to receive numerous requests for information on how to get into the LAES program from freshmen and parents of potential students. In fact, since Spring 2010, the majority of initial outside requests for information about our program were coming from entering freshmen. However, we are reluctant to modify the program to accept freshman applicants for two important reasons.

1) The name "Liberal Arts and Engineering Studies" may be confusing to students, creating the impression that students are applying to a more general program where they will later select a degree in either Liberal Arts or Engineering (cf., the Liberal Studies degree, which although heavily advertised as providing preparation for entering the field of elementary education, must deal with students who indicate that they were unaware of the type of program it is and want to change majors even before taking their first class).



2) As mentioned prior, it is probable that incoming freshman students would not be ready for the flexible nature of the program, which requires significant independence and initiative on the part of students. It would be a poor use of resources to end up having students decide that once admitted, they needed to find another program.

The students in this program are preparing themselves for careers that will shift in focus and orientation many times during their working lives. The modern student knows that to survive in shifting marketplace, interdisciplinary interests and knowledge are essential for success. From their contacts with industry, government, the arts and the humanities, students know they need to understand technology from the point of view of the engineer who designed it, while also understanding how that technology influences the people and cultures that put it to use.

This program serves industries and commercial fields that need self-directed, motivated people, who can think quickly to solve complex technological and social problems, can work in team environments, and who can easily communicate those solutions to a wide range of specialists ranging from in-house engineers to marketing managers to distant technology support staff, to non-technical users and the general public.

This program creates employees, who are conversant with the forms of communication and development present in a modern company, employees who are as equally adept at creating online information systems as they are at writing clear and effective internal technical specifications. This program also creates innovators who can help entertainment and information organizations find new ways to talk with people from many different cultural and linguistic backgrounds.

For the government, this program creates employees, who fully understand how technology can be both a solution and a problem when dealing with a wide range of social policy issues, and employees who can revise and adapt complex information for public distribution through a wide range of textual, visual and interactive media.

As modern culture becomes truly global and our use of complex technology becomes an integral part of everything we do, a solid understanding of engineering and the humanities will be essential in solving nearly any problem, as a result many more programs like LAES will inevitably develop at many technical universities in the USA and abroad. Setting up these programs can initially be difficult, but if constructed carefully, following some of the methods recommended by Traver and Klein in their discussion about the academic synthesis of Engineering with the Liberal Arts (*Integration of Engineering and the Liberal Arts: A Two Way Street*), these programs should be successful.

One important area that does provide some dispute when bringing engineering and liberal arts together is how students will be “classified” upon graduation. Where do these type of hybrid students find jobs? What line will they follow for a career? The largest area of misunderstanding about the availability of jobs for interdisciplinary students is that the places where our kind of students want to work often do not have specific “tracks” or areas of specific training or certification that they require of all their employees.

Students enter LAES because they are interested in nonspecific, nontraditional careers after they leave the university. Our students seek work in interdisciplinary, often ill-defined fields of employment, and therefore the paths that people chart to get into these kind of careers varies so widely it is commonly understood by professionals in these fields that there is indeed no “path” at all—each person makes his or her own way in, usually with a completely unique approach and with wildly different entrance-level experiences.

From a traditional, technology training perspective, it appears there are no jobs at all. From the LAES perspective, and from our students’ perspective, we see many different jobs. Our students see freedom of choice, and they see continual change, challenge, and the need to provide their own “paths” toward careers that have meaning and relevance for them. During a time of economic unrest, it’s common for people to return to fundamentals and to avoid risk taking or jumping into unproven endeavors. Therefore, we assumed that due to the economic problems hitting our state and its colleges in the last few years, LAES as a new, unproven and experimental program would see a drop in enrollment. This didn’t happen; in fact the LAES program continues to grow at a steady pace.

The important lesson we have taken away from this experience is that fully supporting and encouraging academic diversity of interest, and ensuring a solid connection of liberal arts study with engineering training, creates students who are in high demand in many industries, especially when times are hard and new positions are scarce.

## 5. References

1. National Academy of Engineering. *The Engineer of 2020: Visions of Engineering in the New Century*. Washington, DC: National Academies Press, 2004.
2. Cherrice Traver, J. Douglas Klein. “Integration of Engineering and the Liberal Arts: A Two-Way Street.” Presented at the 2010 Annual Conference & Exposition for the American Society for Engineering Education, Vancouver, B.C., Canada, 2010.