

# A Ten-Year Assessment of a Biomedical Engineering Summer Research Internship Within A Comprehensive Cancer Center

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## I. INTRODUCTION

The University of Texas M.D. Anderson Cancer Center (UTMDACC) is a component of the University of Texas System. It is one of the nation's original three Comprehensive Cancer Centers designated by the National Cancer Act of 1971 [1] and is one of 39 Comprehensive Cancer Centers today [2]. In 1996, the Laboratory of Reparative Biology & Bioengineering (LRBB) was established at UTMDACC to develop translatable solutions for clinical problems and limitations and train the next generation of scientists in a multidisciplinary, discovery-centered environment. As part of LRBB's educational mission, a formal Biomedical Engineering Summer Internship Program was initiated for undergraduate, medical, and senior high school students focused in STEM programs. Trainees are competitively selected from local, interstate, and international universities and medical schools through collaborative links established by UTMDACC and/or LRBB. The internship is administered by engineering faculty within the cancer center and trainees are co-mentored by engineering and clinical faculty.

It is clear that successful performance of future engineers requires skills in technical expertise, innovation, and effective fusion of disparate disciplines [3, 4]. The internship within the LRBB serves a critical purpose for trainees participating in or interested in biomedical engineering or quantitative-based careers by providing an opportunity to learn and integrate medical principles with STEM fundamentals. A database of trainee demographics and tangible learning outcomes has been maintained. A decade has passed since the internship program began. In this 10-year study (1996-2006), we make a systemic and in depth effort to assess and evaluate the STEM education program to measure the impact of the experiences on trainee learning.

## II. DESCRIPTION OF CURRICULUM

The ultimate goal of the internship is to improve student learning. The intensive 10-week

curriculum is designed to immerse trainees in a hands-on, practical environment that enhances the skill sets required to develop STEM solutions for clinically relevant problems. In addition, the internship aids trainees in career path decisions by highlighting their strengths, weaknesses, likes, and dislikes. Further, the internship provides trainees the opportunity to learn, practice, and demonstrate elements of ABET Criterion 3 [5]. Although the LRBB is not within an engineering degree granting institution, it is of critical importance to engineering departments who send trainees that the internship possess aspects of ABET Criterion 3. There are numerous classification strategies employed to describe educational internships. The curriculum described and assessed herein concentrates on six content categories, each of which is briefly presented.

### A. Didactic Classes

At the beginning of the internship, trainees participate in several laboratory and institutional didactic classes aimed at enhancing awareness of critical issues relevant to the conduct of research. Trainees participate in a 1-day laboratory orientation that covers laboratory safety and proper laboratory etiquette (i.e., how to properly handle equipment, clean up, etc.). During orientation each trainee is also given their research expectations and how to properly record data and findings in their laboratory notebook.

In addition to lab-based classes, trainees matriculate through two institution-based classes: Laboratory Safety Training and Animal Care and Use Training. The Laboratory Safety Training covers health, safety, and environmental issues related to research processes and activities. Animal Care and Use Training entails the proper techniques for working with research animals. The class uses both multi-media materials as well as hands-on training so that the trainees are well prepared while working in Veterinary Medicine facilities. Further training on clinic and operating room etiquette are administered by individual faculty.

Cell culture training presents sterile tech-

## ABSTRACT

A Biomedical Engineering Internship Program conducted within a Comprehensive Cancer Center over a 10 year period was assessed and evaluated. Although this is a non-traditional location for an internship, it is an ideal site for a multidisciplinary training program for science, technology, engineering, and mathematics (STEM) students. We made a systematic and comprehensive effort to assess and evaluate the impact of the internship experiences on trainees' learning. The curriculum centered around six content categories: didactic classes, research skills, clinical experience, communication, tours and demonstrations, and social activities. The students were assessed for this study via three methods: demographics, selected response surveys, and academic outcomes. The assessment data indicate that the Biomedical Engineering Internship Program has been successful in creating a learning environment that integrates medical principles and STEM fundamentals.

Keywords: assessment, evaluation, engineering education, internship

niques as well as the necessary tools for cell culture. If the trainee will be working with cell culture in the research project they have been assigned, they must demonstrate proficiency with the cells by growing a cell line and constructing a cell growth curve. Individualized training sessions are administered by laboratory staff and/or faculty for use of specialized equipment or protocols. This training includes the principles and practical applications of fluorescence microscopy, atomic force microscopy; total internal reflection fluorescence microscopy; digital image acquisition and analysis; and biomaterial manipulation, scaffold fabrication and characterization.

## B. Research Skills

The trainees are assigned a research project at the beginning of the internship in one of three broad areas: regenerative medicine, nanomedicine, and core research support. Projects are carefully designed and matched according to the trainee's interest as well as their relevant background. The majority of individual assignments are part of larger projects that require teamwork among the trainees. Research projects serve the dual purpose of enhancing trainees' research skill sets and assisting the LRBB with the ultimate goal of developing clinically translatable products and enhancing patient quality of life. Skills sets enhanced by conducting research projects include analytical skills, problem solving and decision-making, project management, teamwork, and technical aspects of the research process [6]. Table 1 defines each of these skills within the context of the 10-week internship. A strong work ethic is practiced, requiring trainees to work efficiently and effectively on their projects daily.

## C. Clinical Experience

One of the advantages of conducting a biomedical engineering internship within a Comprehensive Cancer Center is the direct access to and integration with clinical and operative facilities. Many trainees enroll in the internship with future aspirations of medical school. Hence, clinical experiences are invaluable for crystallizing medical career interests as well as linking trainee research projects to realized clinical limitations. Trainees are constantly exposed to patients and realize the need to improve surgical outcomes and patient quality of life.

The majority of trainees are co-mentored with both a biomedical engineer and a physician scientist. This allows trainees to maintain clinical relevance and learn how to communi-

cate across disparate fields [7]. Trainees are permitted to shadow clinical faculty during their clinic hours to observe patient-physician interactions, surgical planning, and postoperative outcomes, as well as learn about HIPPA, IRB, and other regulations physicians must abide. In addition, trainees are permitted to observe invasive operative cases. This allows trainees to observe hands-on operative limitations and ergonomics, two engineering aspects critical to consider when designing clinically translatable strategies.

Trainees are classified as "observers", preventing direct contact with patients in the operating room. However, they are permitted to learn and practice surgical skills in the animal surgery facility. Faculty routinely have trainees

Skill Set (ABET Criterion 3 [2])	Learning Outcomes
<i>Analytical skills</i> (a, e, k)	<ul style="list-style-type: none"> <li>• Critical think through multiple variables, alternative solutions, and feasibility</li> <li>• Translation of theory to practical application</li> <li>• Analyze, interpret, and statistically evaluate data</li> <li>• Order of magnitude judgments and use of measurement units and conversions</li> <li>• Integration of past knowledge with new information</li> </ul>
<i>Problem solving and decision making</i> (e)	<ul style="list-style-type: none"> <li>• Develop solutions without making premature conclusions</li> <li>• Creativity</li> <li>• Learn from failure</li> </ul>
<i>Project management</i> (d, g)	<ul style="list-style-type: none"> <li>• Prioritization of tasks to meet project milestones</li> <li>• Real-time corrective action</li> <li>• Effective multi-tasking</li> <li>• Clarification of requirements and milestones</li> <li>• Balance team vs. individual tasks</li> </ul>
<i>Teamwork</i> (d, g)	<ul style="list-style-type: none"> <li>• Contribute actively to complete a project</li> <li>• Joint and individual accountability</li> <li>• Cooperation and communication</li> <li>• Reconcile differences among team members</li> <li>• Sharing of information and laboratory resources</li> </ul>
<i>Research process</i> (a, b, c, f, h, j, k)	<ul style="list-style-type: none"> <li>• Effective use of computer resources</li> <li>• Effective use of databases (e.g., PubMed)</li> <li>• Proper experimental design</li> <li>• Develop and test hypotheses</li> <li>• Specify and obtain required laboratory supply and equipment resources</li> <li>• Write and follow protocols</li> <li>• Properly collect, measure, and document data from the lab, clinic, and/or animal facilities</li> </ul>

**Table 1: Skill sets and learning outcomes for the research component of the internship curriculum.**

assist with animal surgeries where they learn how to suture, move and work in a sterile field, correctly name and handle surgical instruments, conduct simple dissections, and retract in more complicated surgical and microsurgical procedures. Participation in animal studies also permits trainees to gain the ability to make measurements on and interpret data from living systems as well as address the problems associated with the interaction between living and non-living materials.

#### **D. Communication**

At LRBB, oral and written communication occurs via various modalities since biomedical engineering as a practicing profession requires effective interdisciplinary communication. Trainees are required to write effectively in levels ranging from weekly summaries to formal technical reports and be able to present their work orally in diverse meeting formats.

Laboratory notebooks are issued at the beginning of the internship and each trainee is responsible for journaling their work daily. Trainees are required to document meeting notes, literature reviews, experimental designs, data, and articulated conclusions in a clear and complete manner. An umbrella confidentiality agreement is signed at the beginning of the internship to protect the laboratory's intellectual property. This permits trainees to make copies of their laboratory notebooks for future class work and reports. Laboratory notebooks are reviewed and critiqued weekly by laboratory staff.

In addition to laboratory notebooks, trainees are required to utilize correct e-mail etiquette. Specifically, they are instructed to use e-mail for concise information dissemination, file transfers, and meeting scheduling rather than use e-mail for open-ended discussion or "e-talking" [8]. Correct grammar as opposed to text message language is required. The written communication component of the curriculum also stresses appropriate methods for presenting data at team meetings so that data can be properly interpreted and conclusions expressed. Methods typically include various forms of graphical and statistical presentation. Trainees are also required to present a final written report of their research project using a peer-reviewed journal format. In some cases, research progresses to the point that trainees have the opportunity to participate in writing a conference abstract and/or a manuscript.

Numerous opportunities exist for trainees to enhance oral communication skills. Regular meetings with research advisors permits

trainees to practice articulating ideas in a clear and concise fashion, using facts to reinforce points, and asking questions to obtain feedback. Trainees are required to communicate effectively across various scales: peers, advisors, small teams, and large audiences. In addition, trainees learn about the challenges realized and skills required to communicate with multidisciplinary teams consisting of engineers, physicians, and life scientists. At the end of the internship, trainees participate in a formal 1-day symposium where they present their research to peers and faculty using PowerPoint and other media formats. Trainees are given constructive criticism on their presentation skills, including effectiveness of media utility, presentation speed and volume, proper use of laser pointer, and ability to handle questions.

#### **E. Tours and Demonstrations**

As a Comprehensive Cancer Center, the UTMDACC possesses many facilities for trainees to tour to enhance their knowledge base and research awareness. A tour of the Veterinary Surgery facility educates trainees on the wealth of small and large animal models employed, the ethical care and procedures required for a AAALAC accredited facility, and the imaging and surgical resources available for animal model-based research. In addition, a tour of UTMDACC's Medical Library demonstrates the most efficient search methods for locating materials within all of the Texas Medical Center's libraries.

#### **F. Networking Activities**

The trainees are given multiple opportunities to interact not only within the laboratory settings, but on much broader scopes as well. Each trainee attends UTMDACC's New Hire Orientation at the beginning of the internship. During the orientation, there is potential for the trainees to meet and interact with employees from different departments as well as different job classifications. The trainees also participate in regularly scheduled formal lab meetings in which data are presented and disseminated to the laboratory staff, trainees, and faculty. There are also informal group meetings ("coffee meetings") in which diverse scientific and administrative topics are discussed in the absence of faculty.

Throughout the internship several functions are planned to ensure that the trainees are also enjoying their time and to provide informal venues to foster faculty-trainee interactions. Breakfasts, lunches, "munchie" days and/or movie

nights are planned throughout the course of the summer. At the end of the internship, a laboratory BBQ is hosted by faculty to celebrate the trainees' internship experience.

### III. METHODS OF ASSESSMENT

In order to obtain a better understanding of the Biomedical Engineering Internship Program, three methods of analysis are employed to assess and evaluate the internship: trainee demographics, selected-response surveys, and academic outcomes. Archiving of laboratory notebooks and oral presentations permits generation of trainee portfolios as a direct assessment tool. However, portfolios are not included herein as they do not lend themselves to presentation in manuscript format. In this study, assessment is defined as the act of collecting data or evidence, and evaluation is defined as interpretations made of the collected assessment evidence [9].

#### A. Demographics

A database has been maintained of all internship trainees since 1996. The database records a myriad of trainee descriptors. UTM-DACC is an academic hospital and does not possess an engineering or medical school program of its own. Hence, all trainees enroll from external, collaborative academic entities. Trainee demographics are stratified according to gender, race/ethnicity, academic level (medical, undergraduate, or high school student), and location of academic residence. In addition, the cumulative number of trainees is plotted against time. Trainees are further stratified according to one of the three aforementioned project areas.

#### B. Selected-response surveys

A selected-response survey is a survey in which subjects respond by selecting their answers from a list of predetermined responses [9]. A selected-response survey was chosen rather than an open-ended survey because the open-ended surveys (i.e., unstructured, short answer responses) would vary too much given the broad background and experiences of the trainees [9]. The survey assesses trainee perceptions of the impact of the internship on several skill sets and its perceived importance on learning outcomes. An example post-internship survey is found in Appendix I. A Likert ordinal scale is employed for question responses (e.g., very little=1,..., very much=5). The Likert technique presents a set of attitude statements. Subjects are asked to express agreement or

disagreement on a five-point scale. Each degree of agreement is given a numerical value from one to five. Thus, a total numerical value can be calculated from all the responses. A pilot survey was conducted to eliminate any ambiguous statements, negative statements, or statements which might seem unduly "leading".

Since surveys are a self-report instrument, the quality of the information acquired depends on the extent to which subjects choose to respond honestly. To assist in data integrity, surveys are administered in paper/pencil format in the absence of faculty and a non-faculty administrative assistant collects the surveys and enters responses in a database. Low response rates obviously threaten the validity of a study. Controls were established to encourage participants to respond, including the non-faculty administrative assistant sending follow-up reminders and, more recently, instituting survey completion as part of the trainee's formal check-out procedure.

#### C. Academic outcomes

Despite the internship lasting only 10-weeks, trainees tend to be quite productive in acquiring and analyzing data. As a matter of laboratory policy, trainees who substantially participate in (a) conception and design, or analysis and interpretation of data, and (b) drafting the article or revising it critically for important intellectual content are listed as co-authors on manuscripts and conference abstracts. The number of manuscripts and oral/poster presentations with trainees listed as co-author are assessed for the past ten years.

## IV. RESULTS & DISCUSSION

LRBB'S Summer Biomedical Engineering Internship has enrolled 51 STEM trainees over the past 10 years. Figure 1 illustrates the cumulative number of trainees over the decade. Increases in trainee number followed an increase in laboratory space assigned to the LRBB. A total of 30 trainees responded to the post-internship survey, yielding a response rate of 59%. In the past, surveys were mailed after the trainees returned home. An 88% response rate has been realized the past 2 years once survey completion was instituted as a part of the trainees' formal check-out procedure. Demographic assessment for all trainees is 100% complete.

#### A. Demographics

Trainee gender was 61% male and 39%

female. The ethnic distribution of trainees was 58% White, 22% Asian, 16% Hispanic, and 4% African American. The gender and ethnicity statistics track with the undergraduate demographics of local universities (Rice University and University of Texas at Austin, university web-based data not shown). Trainees were predominantly undergraduate students (53%), and the remainder medical (27%) and high school students (20%). The largest segment of trainees enrolled from Texas institutions (78%) and 8% from international institutions (Table 2). Of the Texas institutions, Rice University and University of Texas at Austin provided the majority of trainees (45%).

Research projects were assigned in three broad areas. Trainees largely selected regenerative medicine projects (65%), followed by core support (23%) and nanomedicine (12%). Nanomedicine has only been an option for trainees the past two years and it is anticipated that this project area will increase in popularity over the next 5 years. Table 3 list representative trainee research projects that fall under each project area.

### B. Selected-response surveys

The aspect of the internship program most difficult to measure is the quality of the trainees' individual experience and research project. Trainees necessarily enter the internship with a variety of personal and academic backgrounds, receive guidance from faculty mentors with different styles and goals, and conduct research at different levels of sophistication. Hence, there are numerous variables that make it difficult to generate a standard measure. A selected-response survey was employed to capture a measure of the trainees' perceived experience. It is recognized in interpreting the data that trainees do not typically possess the long-term, objective, calibrated perspective on their performance level that faculty do.

Trainees were asked to participate in a 25 question selected-response survey at the completion of the internship. A copy of the survey is found in Appendix 1. Figure 2 illustrates the trainees' perception on how the internship enhanced six critical skill areas. The average Likert scores for all skills were between 4 (Much) and 5 (Very Much). The lowest skill area was Creative Problem Solving (score=4.04) and is perhaps an area that needs to be addressed more effectively during future internships.

Trainees were queried to determine if they perceived 12 internship activities beneficial to their experience (Figure 3). With the exception

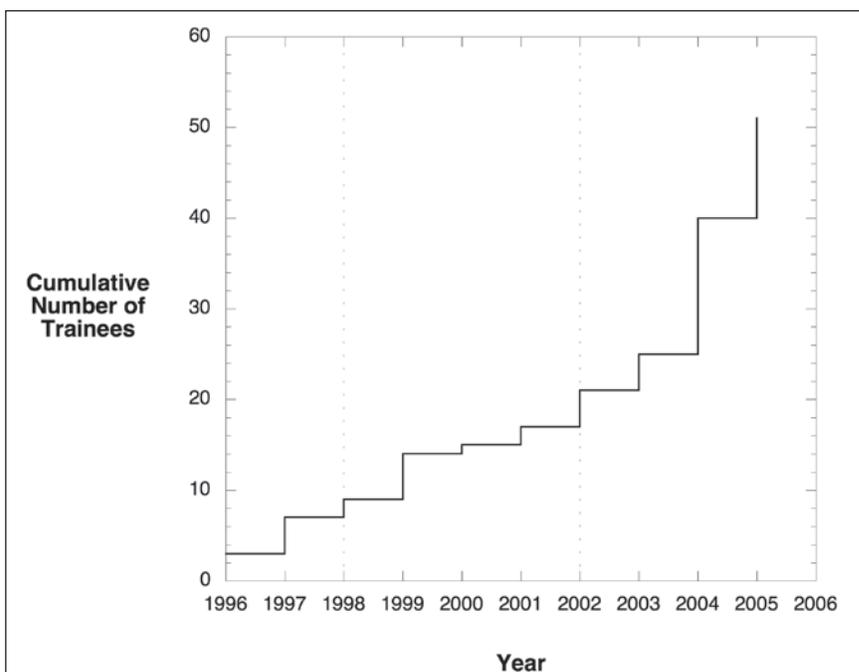


Figure 1

<i>United States</i>		<i>International</i>	
Texas	40	Puerto Rico	3
Pennsylvania	2	Germany	1
Connecticut	1		
Maryland	1		
Michigan	1		
Missouri	1		
Oklahoma	1		
<i>Total</i>	<i>47</i>		<i>4</i>

Table 2. Origin of Country and State of trainees.

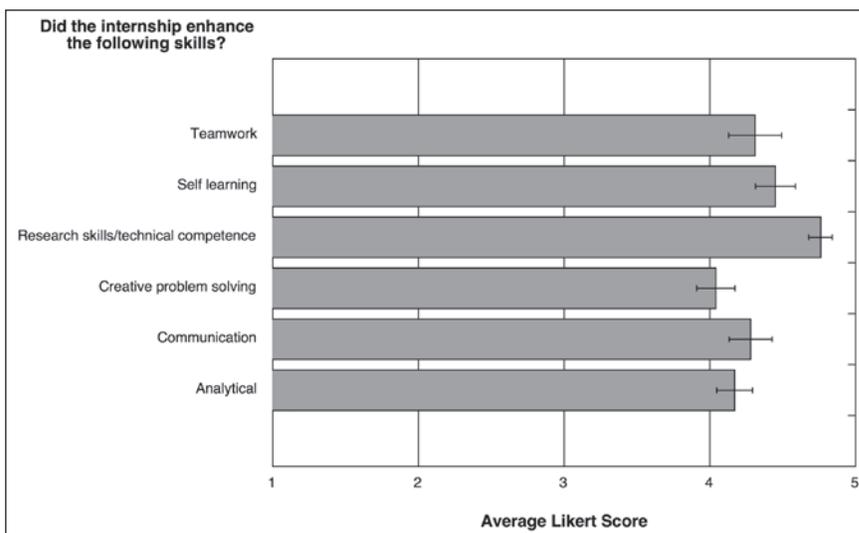


Figure 2

of two activities, all possessed average Likert scores between 4 and 5. On-line Library Skills and Laboratory Safety Training yielded Likert scores between 3 (Neutral) and 4 (Much). Interestingly, these are the only two activities not directly taught by LRBB staff or faculty. Rather, they are general institutional courses. Upon arrival, the majority of trainees tend to be quite facile with on-line search skills and most have taken a laboratory safety class within their home academic institution. It is advantageous to ensure that all trainees possess the same foundation, so deletion of these two activities is not advisable. Laboratory Safety Training is an institutional requirement and can not be removed from the curriculum. The lower scores suggest that augmentation of the institution-based activities may be necessary to challenge the trainees.

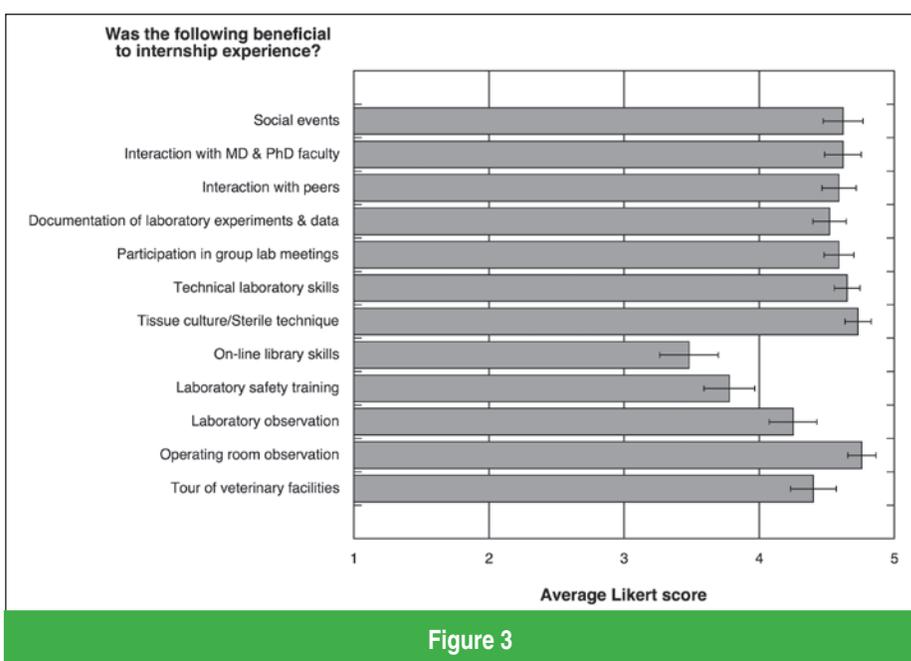
Four additional questions were asked of trainees and response results are presented in Figure 4. Trainees perceived that they were effectively mentored by LRBB staff and participating faculty, attested with Likert scores ranging between 4 and 5. The scores for faculty mentoring bodes well, suggesting that despite the fact they possess disparate disciplines and goals, the faculty are well calibrated and committed to the internship program. Student “word of mouth” is often employed as a qualitative measure of course success and/or trainee interest. The Likert score for trainee internship recommendation suggests that the biomedical engineering internship is successful. This tracks with anecdotal evidence of trainees requesting an internship application based on a classmates suggestion. Finally, the internship proved useful to the trainees in crystallizing their career path and goals. Verbal statements of trainees have been clear on this point. Example statements include: (a) “I know now that I don’t want to do research”, (b) “I definitely want to go to medical school”, and (c) “I am very interested and prefer to go to graduate school in biomedical engineering versus other disciplines”.

### C. Academic outcomes

Academic outcomes were measured based on significant contribution of the student’s work towards national and international publications in journals and presentations at meetings/ conferences. Table 4 highlights the quality of the journals and conferences that the students participated in terms of authorship on manuscripts and abstracts. There were 29 publications and 37 presentations that resulted from the work conducted by students in the LRBB over the

<i>Regenerative Medicine</i>	<ul style="list-style-type: none"> <li>• 3D morphometric analysis of revascularization</li> <li>• Adipose tissue engineering within perfused bioreactors</li> <li>• Characterization of an ovine model for bone tissue engineering</li> <li>• Fabrication and implantation of biodegradable nerve conduits for peripheral nerve regeneration</li> <li>• Fabrication of collagen/chitosan scaffolds for adipose tissue engineering</li> <li>• Structural and mechanical characteristics of silk fibroin and chitosan blend scaffolds for tissue regeneration</li> <li>• Abdominal wall reconstruction with silk fibroin-chitosan blend biomaterials</li> </ul>
<i>Nanomedicine</i>	<ul style="list-style-type: none"> <li>• Dielectrophoretic nano-fibrillar alignment in silk fibroin-chitosan blend scaffolds for blood vessel guidance and assembly.</li> <li>• Characterization of nano-mechanical properties of silk fibroin/chitosan scaffolds to regulate endothelial cell focal adhesion behavior.</li> <li>• Modulation of endothelial cell adhesion on silk fibroin and chitosan surfaces.</li> <li>• Liposomal nano-coatings for long term and targeted therapeutic local delivery</li> <li>• Promotion of stable vasculature via siRNA technology</li> </ul>
<i>Core Support</i>	<ul style="list-style-type: none"> <li>• Development and validation of glyceraldehyde 3-phosphate dehydrogenase (GPDH) assay</li> <li>• Development and validation of human leptin assay</li> <li>• Development of software image analysis scripts for quantitative histomorphometry.</li> <li>• Equipment setup and calibration of total internal reflection microscopy (TIRFM) system</li> <li>• Equipment setup and development of Western assays</li> </ul>

**Table 3. Representative research titles for each project area.**



**Figure 3**

last 10 years. The raw data does not directly reflect the contribution of more than one summer intern that co-authored the presentation or publication with another summer intern. Trainees also presented seminars and papers at the end of the summer program; these are not included in the academic outcome data.

## U. SUMMARY

Cooperative education and internships have traditionally demonstrated a positive impact on trainee academic performance and experience. This article assessed and evaluated a biomedical engineering internship conducted within a comprehensive cancer center over a 10 year period. This is a non-traditional location for an internship, but submits that it is an ideal site for a biomedical engineering summer internship. Based on the assessment data and evaluation presented, the internship has been quite successful, providing a discovery-centered creative environment where medical principles are integrated with STEM fundamentals.

Although the program's initial decade has proven successful, several program extensions can be implemented. First, assessment herein largely focused on one constituency of the internship, namely the trainees. The mentoring faculty represents the second constituency and need to participate in assessment as well. In addition, the assessment methods employed are descriptive and, although useful, more outcome-driven and direct methods must be employed to enhance evaluation and meet ABET requirements. Further, future curriculum modifications should take advantage of new learning sciences, such as implementing adaptive expertise from the How People Learn (HPL) model [10].

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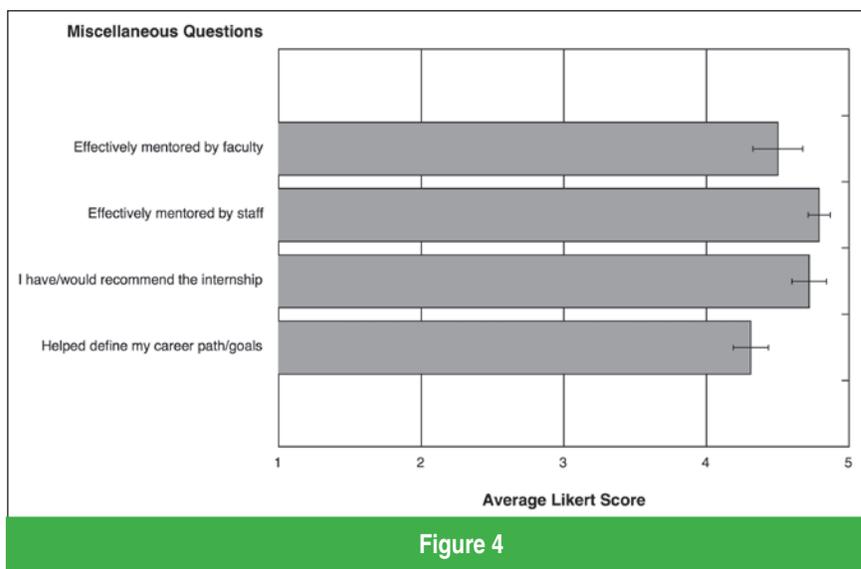


Figure 4

Mr. Charles Butt, the B. & Florence E. King Foundation, the National Institutes of Health, the University of Texas Center for Biomedical Engineering, and the University of Texas M.D. Anderson Cancer Center.

Journals	<ul style="list-style-type: none"> <li>Annals of Biomedical Engineering</li> <li>Journal of Biomedical Materials Research</li> <li>Microvascular Research</li> <li>Tissue Engineering</li> <li>Wound Repair and Regeneration</li> </ul>
Conferences-Local	<ul style="list-style-type: none"> <li>Houston Society of Engineering in Medicine and Biology</li> <li>University of Texas Biomedical Engineering Retreat</li> </ul>
Conferences-National	<ul style="list-style-type: none"> <li>American College of Surgeons</li> <li>American Society for Reconstructive Microsurgery</li> <li>American Society of Mechanical Engineers Summer Bioengineering Conference</li> <li>Biomedical Engineering Society</li> <li>National Society for Histotechnology</li> <li>Plastic Surgery Research Council</li> <li>Society for Biomaterials</li> <li>Society for Physical Regulation in Biology and Medicine</li> </ul>
Conferences-International	<ul style="list-style-type: none"> <li>Advances in Tissue Engineering and Biomaterials</li> <li>British Association of Plastic Surgeons</li> <li>European Tissue Repair Society</li> <li>International Symposium for Minorities in Science</li> <li>Tissue Engineering and Regenerative Medicine International Society</li> </ul>

Table 4: Journals and conferences that students participated in. Students were included in manuscript or abstract authorship.

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During the 10-year study, **Anshu B. Mathur**, Ph.D. was Assistant Professor at the Laboratory of Reparative Biology & Bioengineering, Department of Plastic Surgery, the University of Texas M.D. Anderson Cancer Center and served as Associate Director of the Laboratory of Reparative Biology & Bioengineering. She currently is Assistant Professor at the Biomedical Engineering the University of Texas M.D. Anderson Cancer Center and possesses a joint appointment with the Plastic Surgery Department. Moreover, she is Director of the Tissue Regeneration and Molecular Cell Engineering Laboratory, the successor entity of the Laboratory of Reparative Biology & Bioengineering and joint laboratory between the Biomedical Engineering and Plastic Surgery departments. In addition, she possesses active adjunct positions at Department of Biomedical Engineering, University of Texas at Austin and Department of Bioengineering, Rice University where she teaches classes and advises undergraduate and graduate engineering students. She received a B.S. in Biochemistry, a B.S. in Polymer Chemistry, and a M.S. in Polymer Chemistry from North Carolina State University, and a M.S. in Biomedical Engineering from Duke University. She received a Ph.D. in Biomedical Engineering from Duke University in 2001. After working as a Patent Technology Consultant for Spore LLC, she joined the University of Texas M.D. Anderson Cancer Center in 2003. Her research interests include nanomedicine and regenerative biomaterials. She is a member of the Biomedical Engineering Society and Society for Biomaterials.



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**Amy Wright**, B.B.A. is the Internship Coordinator at the Laboratory of Reparative Biology & Bioengineering, Department of Plastic Surgery, the University of Texas M.D. Anderson Cancer Center. She received her BBA from LeTourneau University. She is responsible for compiling and maintaining the internship database and all administrative aspects of the internship.





**INTEGRATIVE BIOMEDICAL ENGINEERING  
SUMMER INTERNSHIP PROGRAM SURVEY**  
The Laboratory of Reparative Biology & Bioengineering  
University of Texas M.D. Anderson Cancer Center

Name:  Summer Attended:   
(e.g., 6/05-8/05)

**INSTRUCTIONS:** Please answer the following questions about your summer research internship experience to the best of your recollection. Type an X in the box related to your answer according to the provided scale. In select questions, NA may be appropriate for your summer experience.

Very Little 1	Little 2	Neutral 3	Much 4	Very Much 5	N/A

1. The summer internship program helped to define my career path/goals.

2. Participating in the summer internship program enhanced my skills in the following six areas:

**Analytical Skills**

*Apply logic in solving problems and analyze problems from different points of views.*

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**Communication**

*Articulates ideas in a clear and concise fashion and use facts to reinforce points.*

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**Creative Problem Solving**

*Develop many potential solutions while discouraging others from rushing to premature conclusions.*

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**Research Skills/Technical Competence**

*Demonstrate a basic understanding of fundamental biomedical engineering and/or laboratory principles.*

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**Self Learning**

*Learn independently and continuously exceed basic requirements of an assignment.*

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Very Little 1	Little 2	Neutral 3	Much 4	Very Much 5	N/A

Teamwork

*Contribute a fair share to the completion of the project, encourage everyone to participate, cooperate with the team members, share information, and help reconcile differences of opinions among fellow team members.*

3. The program helped to improve my grades the following semester.

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4. I used my summer research as a basis for other projects (e.g., sr. design, papers, posters, etc.)

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5. I have or would recommend our lab to other students.

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6. I found the following beneficial to my summer internship experience:

Tour of Veterinary Facilities

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Operating Room Observation

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Laboratory Orientation

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Laboratory Safety Training

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On-line Library Skills

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Tissue Cultures/ Sterile Technique

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Technical Laboratory Skills

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Participation in Group Lab Meetings

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Documentation of Laboratory Experiments and Data

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	Very Little 1	Little 2	Neutral 3	Much 4	Very Much 5	N/A
Interaction with Peers						
Interactions with Ph.D. and M.D. Faculty						
Social Events						
Other:						

7. I was effectively mentored during my internship by:

Research Staff

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Faculty Mentor

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Please type your current academic or professional appointment.

Please type your institution or employer.

**THANK YOU!** Your participation in this survey will assist in continual improvement of the summer educational program.