

Role-Playing Creates a Valuable Interactive Learning Environment for Biomedical Engineers and Engineering Technologists

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Abstract

There is an ever increasing need for biomedical engineers (BE) and biomedical engineering technologist (BMET) to be able to have greater communication skills and strong technical skills in both industrial and clinical environments. This is exemplified by the increased demand for customer service skills in medical device manufacture's field engineers and service engineers. To meet these demands in an already crowded set of teaching objectives within a BMET bachelors program, an interactive role-playing approach was taken to maximize the group learning process. Scenarios are created for the students to confront real life difficult situations from varied vantage points. Within this safe environment, difficult questions are answered, conflict resolution is addressed and resolutions through compromise are made. The culminating response by the students was an increased understanding of competing motivations and appreciation of the clinical institutional roles that can affect the decision making process.

Introduction

In all engineering disciplines there is a balance between the academic requirements of a selected discipline and the business aspects of the discipline. Often the later is looked over in the academic setting in favor of preserving most of the traditional technical aspects, while the business aspects are, in greater part, left to on the job training (OJT).

Much of this is due to an industry expectation of baseline knowledge in skill sets that are "understood" for a new hire candidate. For example, a bachelors of science in mechanical engineering should have skills in basic statics, dynamics, heat transfer, thermodynamics, fluid mechanics, machine design, measurements, signals and systems, etc. Similar, minimum criterion are set for various engineering and engineering technology programs according to their associated accreditation boards with each institution vying for a leg up over the competition by creating "information rich" (a.k.a. information cramming) courses to meet certain teaching objectives.

With ever increasing demands on the amount of content in a curriculum vs. balancing the credit load, it becomes a challenge of the faculty to include the fundamentals to a substantial level with minimal dilution, while simultaneously injecting new content to keep up with the increasing knowledgebase.

Background

There is an increasing demand in the engineering and technological world for the ability to successfully navigate the industries customer support environment. This is particularly true in the healthcare environment. Unlike many high tech industries, clinical facilities use a wide variety of professionals from extremely diverse backgrounds to come together and service patients in often times life and death situations¹. This particular environment requires engineers and engineering technologists to develop a high level of sensitivity to the players (doctors, nurses, managers, patients, etc.) Conflicts that develop around an issue at times require a collective solution not unlike design resolution. Evidence also suggests that these “soft skills” lead to not only a greater likelihood of initial job placement, but also have a significant effect on an individual’s ability to successfully rise through the corporate ladder²⁻⁴. In addition, the use of Role Playing as a teaching technique has been utilized in the clinical environment⁵.

From our experience, top employers who recruit graduates from the DeVry University, Phoenix BMET bachelors program, such as Phillips Medical, GE Healthcare, and Mayo Clinic, have all expressed a need for more customer service training. This feedback came as a surprise to us, since in getting the 1st ever accredited bachelors BMET program approved, this topic was never discussed. After inquiring deeper into the subject of what is customer service in engineering and engineering technology settings, it becomes very evident that for most customers utilizing sophisticated technology, the most interaction that the customer has is with the field engineers, support engineers and technical support staff. In general, the higher the degree of complexity and usually price, the more likely there is a maintenance and support contract with the customer that is ongoing. Therefore, the field engineers become the first line of contact and in effect represent the face of their respected vendors. Furthermore, this makes the topic of how to interact with and service the customer becomes of the utmost importance for the image of the entire company. If a customer has an unfavorable experience with the engineers or engineering technicians, chances are they are less likely to continue with the vendor when it comes time for their next choice of equipment to procure.

Since our BMET program has instituted a mandatory internship program as a pre-requisite for graduation, much of this industry requirement is fulfilled; however, mission critical items are rarely, if ever, given to the new intern. This translates to the interns being given a protective environment from the accountability and responsibility seen by their mentors and managers. Furthermore, little to no conflict resolution skills in the context of the students selected career has been developed. Finally, the sources, motivations and relationships to a conflict cannot be safely investigated without potential hazardous repercussions to the student’s ability to land a job offer or risk “stepping on proverbial toes”.

In order to address the contextual conflict resolution and preserve a relative balance of adding new material with an already information rich curriculum, a short role playing module was designed that can be put in virtually any engineering course at any level. The entire module takes between 1-2 hours total and can be adapted for small or large groups as needed. The idea is to engage the students, provide a safe environment in which to role play a difficult scenario, come to some resolution, develop a plan of action and most importantly have fun! (A side note: Techniques such as this are commonly used in drama and theater courses as a way for someone to break out of their normal inhibitions and allow the creative process to flow).

Methodology

Cast of Characters

Since the module is tailored to fit a situation in the biomedical engineering and engineering technology context, the fictional persona involved are a set of most likely stakeholders surrounding a problem that needs to be solved (See Table 1 below). Note: A little time taken to making the names humorous goes a long way to disarming students who may be ambivalent to get up in front of others. Also, getting to play a personality other than themselves takes some of the pressure off by limiting their fear of humiliation.

Table 1: Cast of Characters for a healthcare/biomedical instrumentation conflict resolution module

Characters	Job Description	Personality Type	Motivation
Surgeon (Dr. Maximus K.)	Cardiac surgeon for the institution Holy Toledo Hospital	Arrogant, confident, highly educated, assumes he knows how most things work, likes to buy the latest and greatest gadgets.	Since moving to a new ESU system, second time with burn, thinks the new systems are flawed or someone else's fault, has not been to staff training on new equipment
Bioengineering Manager (Cheeping Z. Peace)	Oversight, budgeting and ordering for biomedical engineering department	Bossy, "been doing it the same way for years" mentality, not broken don't fix it, likes a nice paper trail, over documents to cover his own assets.	Thinks "if it ain't broke, don't fix it!", feels pressure from CFO to trim budget, concerned lack of implementation of controls for new equipment
CFO (Influancee. C. Money)	Institutional monetary budgeting, allocation, accounting and reporting (Bottom Line)	Does not care about details except with regards to \$\$, wants all large purchases to be approved by her, neat freak, opinionated, a bit of a technophobic,	New CFO with organization and wants to make a statement, incentivized with stock options, only wants to know how a decision effects the institutions \$\$\$
Nurse (Scrat Chalott)	In charge of patient care and monitoring, support Doctors, report issues with equipment to Biomed.	Feels undervalued by doctors, wants to know what is going on, cantankerous with others when threatened, nice when appreciated	Deep sense of professionalism, genuinely cares about patients, a bit intimidated by new technologies that she does not understand
BMET II (Ms. Nosess Heirschtuff)	Troubleshoot, repair and maintain medical equipment, service items in patient care and train staff on use of new equipment.	Use your own personality! Desire to learn and impress your boss, greater desire for making a difference in people's lives with the patient's <u>best</u> interest!	New to the organization, wants to make great impression for advancement, wants all equipment to work as long as possible

Scenarios

A group of students, equal to the number of characters, are given personalities and motivations that drive their character that are only known to the student playing that character for the duration of a scenario. These guidelines help the students get “into character” so that they have a basis for understanding the perspective of the individual they represent. The characters are not intended to be stereotypical but should represent a good cross-section of likely personality types that the students will most likely encounter in professional life. In large classes, multiple groups can be running concurrently, while any remaining students can be observers of the scenarios. It is important to engage all students; therefore, any student that is not actively playing a character in the 1st Scenario should be a character in the 2nd Scenario. Two scenarios were sufficient to allow the student’s time to role play the scenarios, come up with a plan to solve the scenarios and allow for classroom discussion, feedback and reflection on each scenario. The most interesting comments came during the reflection time after the role playing was completed and should not be under-emphasized (See Survey Section below). The BMET scenarios used in our module were the following:

1. Scenario: An ESU has burned a patient in the OR at Holy Toledo Hospital (again). There is a replacement unit for the surgery. During the last PM the unit tested fine, but now that the patient has been burned during surgery there may be a threat of a law suit by the patient’s family.
2. Scenario: A newly installed, very expensive, fMRI machine has been installed by your crew to a client hospital. Within the third week of operation, the system is down and the clients are livid, since the downtime is costing \$16,000K in revenues each day it is down. Apparently, there was a faulty seal on the liquid nitrogen coolant system causing undue leakage which needs to be replaced. The part will take a week to order and install.

The scenarios all have an element of conflict, consequence, and accountability to perform an action plan within a particular industry context. This creates the backdrop for which the students have to solve a problem that, usually no individual wishes to take the blame for, but never the less has to be addressed and acted upon. In the field of Biomedical Engineering and Biomedical Engineering Technology, a faulty instrument or system can have severe costs, including but not limited to, mortality, morbidity, and monetary costs.

Reflection and Comments

The goal of the role playing session is to not only simulate “real world” conflict situations, but to reflect, share and comment on the experience with one’s peers. The great feature of this exercise was for students to be able to explore a precarious situation and return to a safe haven in which the choices, feelings and understanding of the different perspectives surrounding the particular scenario can be explored and expanded on. This was facilitated by the faculty member ensuring each individual had a chance to speak and all points were heard.

Most of the students showed a desire to participate in what they experience or observed and how it related to them. Interestingly, actual feelings of pressure, blame and resolution were among the most common effects, despite the situations being fictional in nature and no real repercussions were at stake. These comments suggest that simulated conflict can help aid an individual in difficult situation that may occur in the professional environment by better preparing them for these emotions that may occur. Thus the student can be empowered to focus on solving confrontational situation at

hand and not focusing on the emotion itself, which can be debilitating. This is the same rationale that the NASA astronaut program understands and it is a principle reason why astronauts undergo 18-20 months of simulation training prior to becoming official astronauts in the astronaut pool⁶.

After deliberations were complete for both scenarios, a survey (See Table 2 below) was given to all participants. The rating system was used to develop an index for the feedback that could be used to determine some statistical analysis on the data. The index went from 1-5 in the order of strongly disagree, disagree, indifferent, agree or strongly agree. Furthermore, a free form comments section was also encouraged along with a differentiation question on the sex of the individual. This category was of interest to see if males and females answered similarly or differently for the various criterion.

Table 2: Survey handed out after both scenarios were completed

	Ratings Metric	1	2	3	4	5	
Question	Survey	Strongly Disagree	Disagree	Indifferent	Agree	Strongly Agree	Additional Comments (Answer how or why you chose your answer)
A	The exercise opened my eyes to thinking differently about customer service.						
B	I enjoyed the Role Playing aspect of the lesson						
C	I will be better prepared for resolving customer issues as a result of this lesson.						
D	I would have rather learned in a traditional classroom lecture setting						
E	I would have rather learned in an online virtual setting						
F	I feel the exercise was a good use of my time to learn key elements of customer service						
G	Prior to the lesson, I had little idea of what customer service meant in a healthcare setting.						
H	I think customer service is an important component of my future career						
I	I have had little conflict resolution training in a professional setting before						
J	I clearly knew what the different roles and responsibilities of the staff of a healthcare organization were prior to this lesson						
K	I clearly know what the different roles and responsibilities of the staff of a healthcare organization were after this lesson						
L	I think customer service training is important to prospective employers						
M	I see good utility of this training in the medical device industry setting						
N	I see good utility of this training in the clinical environment setting						
O	I can see this collective learning approach used for other topics						

Survey Analysis and Results

The answers to the survey were tallied and statistical testing was performed to determine the mean and standard deviations of the answers using Excel statistical data tools. Also, assuming randomization, a normal distribution and unequal variances for the male (n = 3) and female (n = 5) data sets, a statistical t-test of the means was performed for each of the questions in the survey. The null assumption was assumed that there was no difference with a 95% confidence interval. The results of the data are shown in Figure 1.

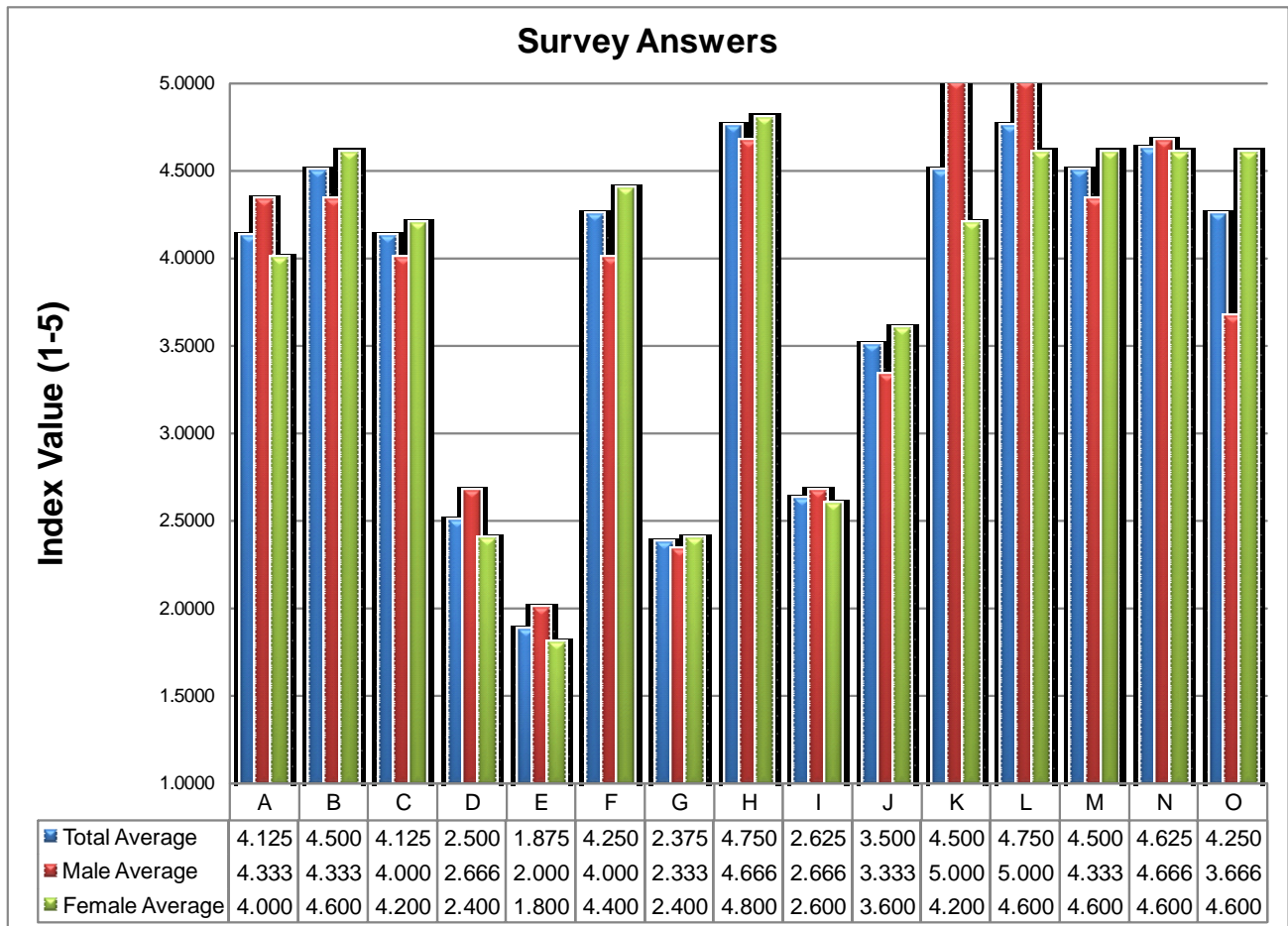


Figure 1: Average survey answers for females (n = 5), males (n = 3) and combined answers (n = 8). Note: 1-Strongly Disagree, 2-Disagree, 3-Indifferent, 4-Agree and 5-Strongly Agree.

The average values are shown for each of the questions in order from A-O. It is readily observable from the data that in most cases there was agreement on the answers to the questions by both males and females; therefore the total population answers reflect the overall answers well, albeit a limited sample size.

Discussion

A more thorough analysis of the data shows that the majority of students enjoyed the using the Role Playing method for learning this material versus other pedagogies (See Table 3 below). Interestingly, scores on Question D, “I would have rather learned in a traditional classroom lecture setting”, was leaned to Disagree where as offering an online option of this lesson in Question E, “I would have rather learned in an online virtual setting” had a pronounced Strongly Disagree answer for both males and females. This should be noted in the context of more and more institutions that are pushing the online format, which may not always service our customers, the students, best interests.

Table 3: Average and Standard Deviation Values for the Questions

Questions		Total Average +/- SD	Male Average +/- SD	Female Average +/- SD
The exercise opened my eyes to thinking differently about customer service.	A	4.125 +/- 0.641	4.333 +/-0.577	4.000 +/-0.707
I enjoyed the Role Playing aspect of the lesson	B	4.500 +/-0.535	4.333 +/-0.577	4.600 +/-0.548
I will be better prepared for resolving customer issues as a result of this lesson.	C	4.125 +/- 0.354	4.000 +/-0.000	4.200 +/-0.447
I would have rather learned in a traditional classroom lecture setting	D	2.500 +/-1.195	2.667 +/-0.577	2.400 +/-1.517
I would have rather learned in an online virtual setting	E	1.875 +/- 0.641	2.000 +/-1.000	1.800 +/-0.447
I feel the exercise was a good use of my time to learn key elements of customer service	F	4.250 +/-0.463	4.000 +/-0.000	4.400 +/-0.548
Prior to the lesson, I had little idea of what customer service meant in a healthcare setting.	G	2.375 +/-0.916	2.333 +/-0.577	2.400 +/-1.140
I think customer service is an important component of my future career	H	4.750 +/-0.463	4.667 +/-0.577	4.800 +/-0.447
I have had little conflict resolution training in a professional setting before	I	2.625 +/-1.598	2.667 +/-2.082	2.600 +/-1.517
I clearly knew what the different roles and responsibilities of the staff of a healthcare organization were prior to this lesson	J	3.500 +/-0.926	3.333 +/-1.155	3.600 +/-0.894
I clearly know what the different roles and responsibilities of the staff of a healthcare organization were after this lesson	K	4.500 +/-0.756	5.000 +/-0.000	4.200 +/-0.837
I think customer service training is important to prospective employers	L	4.750 +/-0.463	5.000 +/-0.000	4.600 +/-0.548
I see good utility of this training in the medical device industry setting	M	4.500 +/-0.535	4.333 +/-0.577	4.600 +/-0.548
I see good utility of this training in the clinical environment setting	N	4.625 +/-0.518	4.667 +/-0.577	4.600 +/-0.548
I can see this collective learning approach used for other topics	O	4.250 +/-0.707	3.667 +/-0.577	4.600 +/-0.548

Questions G and I, which related to previous customer service and conflict resolution training suggests that students have some concept of what it means and upon reading their comments is typically in the context of their current or past jobs. This result is tempered by the fact that the variance and hence standard deviation on these questions were extremely high; therefore, a larger data set would be warranted to properly answer this question with any degree of confidence. Since DeVry's student body predominantly has students that both go to work and school full time, this may be unique to our type of institution, where as a typical 4 year university may yield different results⁷. In general, the older students that were coming into their education for retraining had a better understanding than the younger students that were expecting to start their first career.

Strong agreement correlated to the rest of the Questions except for Question J, "I clearly knew what the different roles and responsibilities of the staff of a healthcare organization were prior to this lesson", which was a slight agreement to indifferent rating. Being that these students are in their senior year of the BMET program, they still had limited understanding of the culture of the work place that they were going to embark on as a career. When coupling that result to the enthusiastic answers to using this technique as a good use of time and the utility of this training in both the clinical and medical device industry environments, it strongly suggests that this approach filled in an important gap in the professional training for the undergraduate student heading toward graduation. Finally almost all students felt that this training was of great importance to both prospective employers and their future careers covered in Questions H & L.

Overall the students seemed to agree that this learning approach could be used for other topics (See Table 3: Question O). Although this limited study could not distinguish statistical differences between the answers by males or females, this is in part due to the limited number of samples. Therefore, an expansion of the numbers of participants will be necessary to achieve any statistical certainty. Due to a strong positive response from students, industry and faculty, a continuation of this survey is planned to continue adding data with future classes. Once there are ample numbers, a revisited statistical analysis will be performed and if there are any deviations from what is presented in this paper, the new results will become available.

Summary and Conclusions

In summary, there was a strong positive feedback rating from students that both enjoyed and felt the customer/ conflict resolution role playing was a worthwhile use of their class time. Combine that with an increase in biomedical, bioimaging and biotechnology instrumentation industry demands for graduates that have some customer service skills and abilities to handle difficult situations as they arrive. There was a strong negative feedback rating on the use of an online or virtual setting to teach customer service skills. This is in part due to the fact that the real world situations will involve live scenarios with various personalities, perspectives and motivations that can complicate creating a resolution.

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