# Bringing the great pumpkin to life with technology, art, and engineering

**Mr. Mike Thomas Pitcher, University of Texas, El Paso**

Mike Pitcher is the Director of Academic Technologies at the University of Texas at El Paso. He has had experience in learning in both a traditional university program as well as the new online learning model, which he utilizes in his current position consulting with faculty about the design of new learning experiences. His experience in technology and teaching started in 1993 as a student lab technician and has continued to expand and grow over the years, both technically as well as pedagogically. Currently he works in one of the most technically outstanding buildings in the region where he provides support to students, faculty, and staff in implementing technology inside and outside the classroom, researching new engineering education strategies as well as the technologies to support the 21st century classroom (online and face to face). He also has assisted both the campus as well as the local community in developing technology programs that highlight student skills development in ways that engage and attract individuals towards STEAM and STEM fields by showcasing how those skills impact the current project in real-world ways that people can understand and be involved in. As part of a university that is focused on supporting the 21st century student demographic he continues to innovate and research on how we can design new methods of learning to educate both our students and communities on how STEM and STEAM make up a large part of that vision and our future.

**Mr. Pedro Arturo Espinoza, University of Texas, El Paso**

Pedro worked in the manufacturing industry as a Quality Control Engineer for some years before acquiring his current position as an Instructional Technologist at the University of Texas at El Paso (UTEP). For over eleven years in this role, he has worked with a team of managers that oversee various learning environments and systems in the Academic Technologies Department at UTEP. He leads a group of more than 30 multidisciplinary student employees that help support a wide range of technologies for classrooms and other learning spaces, including videoconferencing rooms. In addition to teaching a Foundations of Engineering course, Pedro also provides technology training on Mac OS X, CISCO networking and various other technology topics. He also enjoys the role of social media coordinator for Academic Technologies to showcase the department's services and the dedicated students and staff members who work there. Pedro received his Bachelor of Science degree in Electrical Engineering and a Master of Science in Engineering with a concentration in Engineering Education from UTEP.

**Dr. Oscar Antonio Perez, University of Texas, El Paso**

Mr. Oscar Perez received his PhD. in Electrical Engineering from the University of Texas at El Paso (UTEP) with a special focus on control systems and data communications. He was Awarded the Woody Everett award from the American Society for engineering education August 2011 for the research on the impact of mobile devices in the classroom. Dr. Perez has been teaching the Basic Engineering (BE) – BE 1301 course for over 9 years. Lead the design for the development of the new Basic Engineering course (now UNIV 1301) for engineering at UTEP for the Engineering, Science and University Colleges. Developed over 5 new courses, including UTEP technology & society core curriculum classes specifically for incoming freshman with a STEM background. Dr. Perez was awarded the 2014 "University of Texas at El Paso award for Outstanding Teaching". Dr. Perez has thirteen years of professional experience working as an Electrical and Computer Engineer. leads a team to provide technical support to faculty and students utilizing UGLC classrooms and auditoriums. Dr. Perez is committed to the highest level of service to provide an exceptional experience to all of the UGLC guests. Dr. Perez strongly believes that by providing exceptional customer service that UGLC patrons will return to make use of the various services the university offers. Mr. Perez enjoys working on the professional development of the students' employees at the UGLC. He shares with his student employees his practical experience in using electrical engineering concepts and computer technologies to help in everyday real-world applications. Dr. Perez has worked with the uTeach and Tech-e camp programs at UTEP since their creation to streamline the transition process for engineering students from local area K-12 schools to college by equipping students and their teachers

with teaching strategies and technologies each summer. Oscar enjoys teamwork, believes in education as a process for achieving life-long learning rather than as a purely academic pursuit. He currently works on maintaining, upgrading and designing the new classroom of the future model at UTEP. Dr. Perez is inspired because he enjoys working with people and technology in the same environment.

**Mr. Hugo Gomez, University of Texas, El Paso**

Mr. Hugo Gomez works as an Instructional Technologist at the University of Texas at El Paso, he is focused on expanding the professional and technical skill sets of our students and faculty community to better prepare them for the world of technology today and tomorrow. He works alongside a wide assortment of students, faculty and staff on campus to make sure their technology toolsets are up to date. Furthermore, Hugo provides workshops to over half of the student population at UTEP and as such, has been instrumental in providing the behind the scenes support to all these courses. Mr. Gomez also collaborates in the Learning Lab team to explore and implement new educational strategies in the classroom. Mr. Gomez has a Masters Degree in Engineering Education from The University of Texas at El Paso. He has participated in the UTEACH summer program as a Technology Instructor in which he provided workshops on website design, movie creation and computer networking. In addition, Mr. Gomez teaches UNIV1301 Foundations of Engineering, were students learn academic, personal and engineering skills, among many other abilities that help them understand their opportunities and responsibilities as engineering students.

**Mr. Randy Hazael Anaya, University of Texas, El Paso**

Randy Anaya, Instructional Technologist at the University of Texas at El Paso. Received a BFA in Graphic Design with a minor in Multimedia design from the Universidad Autónoma de Ciudad Juarez, Mexico. Received a BA in Media Advertising at UTEP and is currently enrolled as a Master of Interdisciplinary Studies with an emphasis on the use of art and technology in teaching and learning. Randy works on research and development of applying the creative process to workshops, trainings and student engagement. Currently doing extensive research and deployment of emerging technologies to redefine the classroom, mentoring and excellence through student interaction.

**Hector Erick Lugo Nevarez, University of Texas, El Paso**

Mr. Hector Lugo works as a Student Technology Success Coordinator at The University of Texas at El Paso. He holds a B.S. in Electrical Engineering. He is currently enrolled as a Master of Science with a Major in Electrical Engineering. His motivation and passion pushes him into research in wireless communication, especially in Bluetooth Low Energy and Near Field Communication as well as building projects and fostering innovation with faculty and staff members. As part of the Learning Environments division, the idea to develop, oversee and assess engaging students to expand their knowledge and creativity by innovating new technologies application for Engineering Education is currently under way to engage the university and the community. Concluding, Mr. Lugo's ambition is to encourage students to focus in science, technology and engineer abilities in order to expand their professional potential.

**Dr. Peter Golding P.E., University of Texas, El Paso**

Professor in the Department of Engineering and Leadership at UTEP.

**Erik Lopez**

Innovation has always played a key role in Erik's life. His passion towards technology led him to pursue a Bachelor's of Science degree in Electrical Engineering at The University of Texas at El Paso. In the process of experimenting with the different electrical components, Erik has applied his creativity to a variety of mediums including 3D Video Mapping, Rear Projection, App User Interface, and Arduino based projects among others. With the contribution of his fellow coworkers, Erik discovered new tools in the media development field in his first year as an employee of Academic Technologies. The cooperative environment in Academic Technologies has improved Erik's ethical, professional and personal involvement during the past years.

**Deena Mustin, UTEP Academic Technologies**

Deena Mustin is a Graphic Design major at the University of Texas at El Paso and was responsible for the overall design of the Halloween display for Fall 2016. Every element of the display from initial sketches to the interactive pumpkins, tombstones, trees and the skull with video projection was hand drawn and hand painted. Deena worked with other design and computer science students, using her skills in production, fine art and art direction to bring the project to life.

**Mr. Robin Munoz, Academic Technologies**

Industrial designer with experience in the field of design development and manufacturing. Additional interdisciplinary education in pedagogy of mathematics and the arts as well as mechatronic engineering.

**Miss Jackeline Munoz**
**Ms. Sarah Huizar, UTEP Academic Technologies Learning Environments**

Sarah Huizar is a Graphic Design student at the University of Texas at El Paso, also minoring in Communication Studies and Creative Writing. While Sarah works at UTEP for AT- Learning Environments as a Graphic Designer and Writer, she is always ready to expand her knowledge in other areas that interest her, such as video editing. Accepting opportunities to grow, she continues to work diligently to complete assigned tasks and meet deadlines. In her spare time she participates in outdoor activities which help her exercise critical thinking skills that are then applied to her work and academic life. Sarah believes that the key to personal success entails pursuing outdoor experiences, seizing opportunities that make one happy, and taking every experience as a learning one.

**Crystal Fernandez**
**Mrs. Celena m arreola, American Society for Engineering Education**
**Tetyana Zhyvotovska, University of Texas at El Paso**

Tetyana Zhyvotovska is a PhD student in Rhetoric and Composition program and assistant instructor at the University of Texas at El Paso. She previously taught at the universities in Ukraine and Languages and Linguistics Department at UTEP. Her research interests include rhetoric of translation and technical communication.

# BRINGING THE GREAT PUMPKIN TO LIFE WITH TECHNOLOGY, ART AND ENGINEERING

## INTRODUCTION

In the world of engineering today we recognize that future engineers must collaborate with an assortment of fields outside of engineering. This is the only way we will be able to meet the grand challenges posed currently. For this reason, we began a journey to explore how a real-world project involving problem based design and focused on community outreach could help. The goal was to help facilitate the process of interdisciplinary collaboration. This project now in the seventh year at The University of Texas at El Paso brings students together to design a community exhibit. Through the process students learn a great deal about technology, networking [computer and people-based], design, art and engineering. The entire project is led and constructed by students. The product is evaluated on design, practicality [setup and breakdown], engagement with the audience, and technical functionality. This paper will focus on a review of the seven years in which the project has existed, skills that students have gained throughout such, and strategies to implement such a problem based project in other programs.

As we review the lessons learned from seven years of work it is important to note that originally the focus on skills growth was more geared towards learning how to solder electronics. The project has since grown in reach and complexity as each new year brings about more dynamism and engagement from students and the community; creating expanded learning goals, and larger outcomes far beyond the original goal set forth.

## MATERIALS AND METHODS

In the first year, we focused on the simple task of presenting students with a problem based challenge of engaging the community with a display. The task involved soldering a circuit board that could be used to control an artificial pumpkin which would engage a community audience. The idea was to promote aspects of STEAM (Science, Technology, Engineering, Art, and Math) in a fun and attention getting way. The first year's goal was to have a collaborative team work together to accomplish this and was heavily led with faculty/staff mentors as the students worked to accomplish this goal. Students were recruited primarily through Facebook postings to the departmental account along with student to student word of mouth and announcements at student meetings. The engagement level the first year was high and twenty students signed up and completed the project. The most notable thing from the results the first year was the community response to such which was enormous in magnitude and truly was not anticipated at such a level. Teams were assigned the first year directly by the overseeing faculty. Students were required to accomplish specific tasks; primarily circuit board design and soldering. Students had limited freedom in the overall design in the initial year.

An enormous flood of requests came pouring in for continuation of the project by both students and community members who had seen it. Jumping ahead we have just completed the seventh year of such a project and it's reach and growth have been substantial. The number of students involved has grown by almost two hundred percent, the management of the project has been completely turned over to being student led and driven, students designate their own team leaders, create their own sub-teams and heavily mentor each other. Teams now actively seek out involvement from

faculty/staff within needed expertise on their own and participation has spread almost equally across colleges: science (23%), engineering (22%), liberal arts (21%), with slightly smaller participation from education (19%) and business (15%). The demographics are now nearing equal participation from males and females with an actual participation of 56% male, 44% female. The project while still not part of any degree program or credit granting course has been recognized by students as being a key part of taking their learning experience outside the classroom and we will take a more detailed look at those results further on within the paper specifically.

Team formation has transitioned from initially being set by faculty to be completely student driven. Students take full responsibility for tasks and create and dissolve teams as needed. Throughout the process, we have found that allowing huge flexibility within team selection and the ability for teams to dissolve and realign themselves not only provides students much better experiences but resembles working teams in industry much more closely. The ability to join a team as a mentee who wants to learn about a skill without having to be permanently part of it has created an environment of flexible and personalized learning.

Scheduling has also transitioned from originally having weekly meetings to a much more flexible schedule in which students select team leaders that report directly to overseeing faculty on a as needed basis. Student team leaders must report at least once every two weeks but we have found that they will gravitate after the initial design phase to wanting to meet several times a week by their own choice. Teams themselves set their own meeting times organized through their student team leader. Attendance is not mandatory at any meeting however active participation is required in some form to maintain consistent communication. Teams have the authority through their team leader to remove non-participating members after speaking with faculty in regards. This has only occurred once within the seven years of the project. The hugely dynamic structuring of team member movement based on personal learning is a key reason for this. Team members will on average be a part of at least three substantially different skill focused teams throughout the entire project process. Students can be a member of as many or as few teams as they would like. Student team leaders can only be a member of the team they are leading. Team leaders are encouraged to consult with other team leaders on a constant basis rather than be members of those teams.

The methodology towards assessing this project has been adapted over the course of seven years. The original methodology was based on the learning outcome of whether students could complete the soldering of a circuit board. Upon reflection, the first year's methodology while adequate limited the focus and didn't capture the full range of skills development of the students. The original methodology was focused around the deliverable itself to assess the success of the project and learning objectives. In the second and subsequent years, additional assessments have been added to try to capture the full magnitude of the process. These assessments focus on specific skills obtained, level of collaboration and transfer of skills between majors, soft skills learned, relation to coursework, etc. The third year, a pre-post assessment was added to determine specifically which skills students obtained during the process. From this assessment, we could define seventeen skills that students collectively felt that they learned throughout the process. These skills were not a part of our original key deliverables but were deemed important by the students. These seventeen skills students directly correlated as an essential benefit from the experience which they were not obtaining from their degree program. In the fourth and fifth years of the project we added surveys to better understand the perception of students. These focused around how they felt this project related to both their classwork and long term learning. The last

two years have focused on a better understanding of the importance of such a learning experience. The focus is currently on what is the impact of this project within the scope of the entire student's coursework/academic experience. Rubrics to "grade" the final product have been implemented but still need refinement. Due to the sheer enormity of the community involvement, now averaging over three thousand visitors within a five-hour time span, we have had to scale back community assessment to make it feasible.

One major struggle we have faced in the assessment area over the years is that assessment for community project based programs is limited or non-existent. This is specifically true of projects that non-required or non-credit granting projects. We have struggled between finding a model that is focused around PBL and its dynamic instructional environment. "While each PBL instructional environment is unique, and therefore merits its own unique assessment strategy, several alternative assessment techniques seem particularly appropriate for the PBL learning environment." [1] Therefore, we have utilized some of the common pieces of personal reflection, content analysis, and outside evaluation instead of more traditional classroom based pieces such as journals and activity logs. We did look at the Engineering Projects in Community Service (EPICS) program at Purdue. [2] While there were many similarities in regards such we found just as many differences specifically the way journals seemed to be heavily integrated into the classroom piece which would be not be replicable in our project as we had no classroom piece to use to grade such. "In engineering, there are many examples of service-learning programs ranging from freshman introductory courses to senior capstone courses. Despite their successes, an area that the engineering education community has yet to fully develop is the reflection component of service-learning." [3] We have made a conscious choice to keep the project housed outside the bounds of a for credit course due to student feedback which will be specifically discussed in the results section.

## RESULTS

The exhibits that have been created over the years have varied greatly in design and have grown in depth and complexity over that same span of time. Much of the interdisciplinary collaboration between majors has had a significant impact on such. Majors that wouldn't normal collaborate such as graphic design and electrical/computer engineering have shown to have had some of the most impressive outcomes in terms of end design and function. Below are a few photos of the exhibits as they have progressed from year to year to get a conceptual idea of the final product(s), so the reader will have context in which to understand the assessment pieces.

Figure 1. Photo of the project in 2011

Figure 2. Photo of the project in 2013

Figure 3. Photo of the project in 2014

Figure 4. Photo of the project in 2016

Figure 5. Photo of audience iPad control system (early design phases in Xcode)

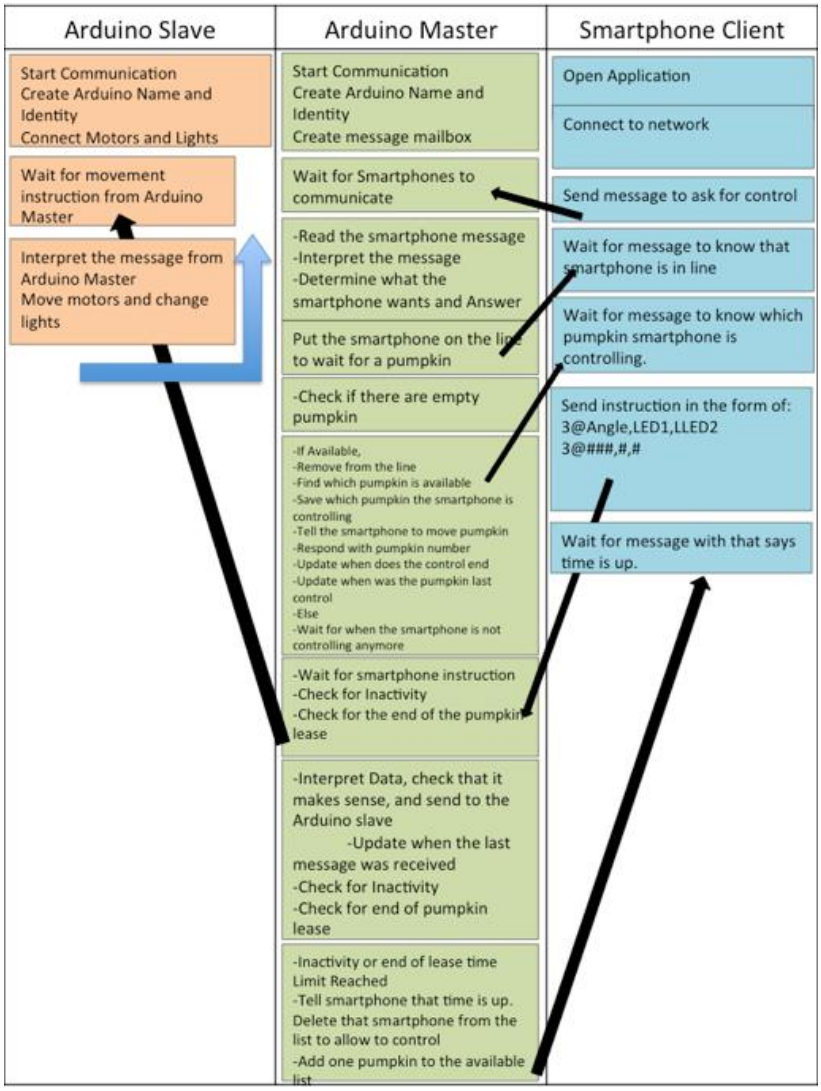


Figure 6. Example of student created design schematics for project

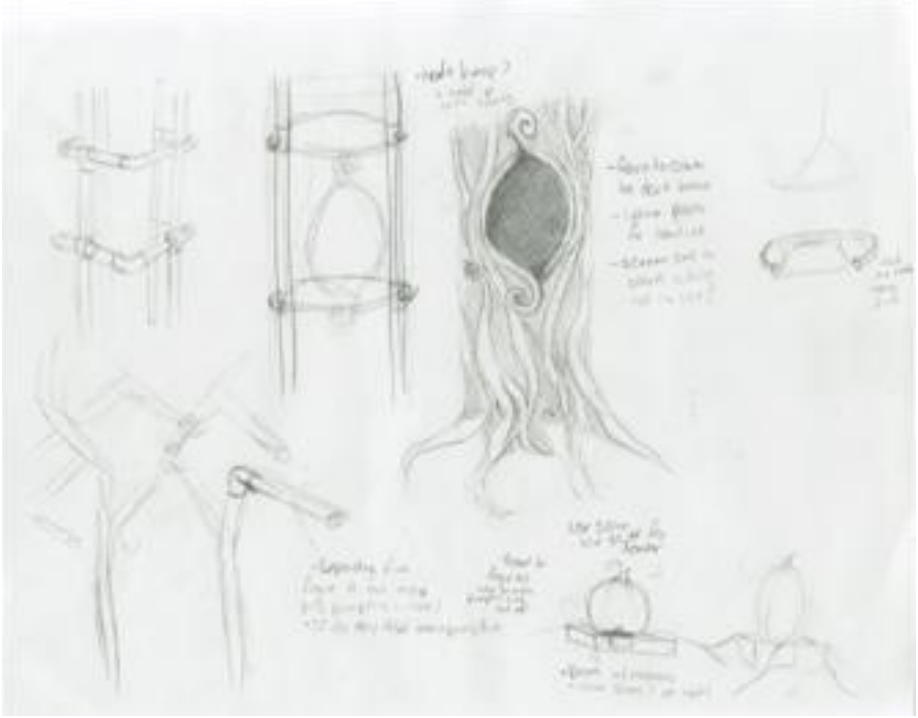

Figure 7. Example of student created sketch of a tree element


Figure 8. Example of student created wire maps

Having the above photos as a contextual basis for some of the final products designed, we will focus on a brief sampling of the assessments and results over the seven years of this project. One

of the most notable is the choice that has been made to keep this project outside the scope of a credit granting course. This project is housed completely as an extracurricular activity based on student assessment. A significant number (87%) of students completing the assessment about the importance of this project to their field of study and major wrote in comments that they felt "more free to take bigger risks" and "could experiment with design choices". The reason stated for such revolved around comments such as "this was a free and open learning experience and a final grade didn't depend on my success of trying something above my knowledge level". It is for this reason that we have made a conscious choice to not integrate this project into a credit granting course. Our focus is to maintain an environment where students feel comfortable exploring concepts and are encouraged to take risks with implementing higher level concepts.

Student managers along with faculty/staff were assessed to find out how many times either their specific team or the team(s) they were mentoring were utilizing a specific skill or process. These assessments occurred at several junctures during the project which roughly translates to about every two weeks. The graph below lists an average of frequency of occurrence of each answer across all teams within a given project year. As we can see construction, planning processes, time management, learning new skills, and expanding existing skills are some of the most notable. A bit of a surprising result is that circuit boards which was the primary skill that launched this process has now substantially been reduced in focus. A greater focus has been placed on gaining knowledge in another discipline, computer programming, independent research, task delegation and many others.

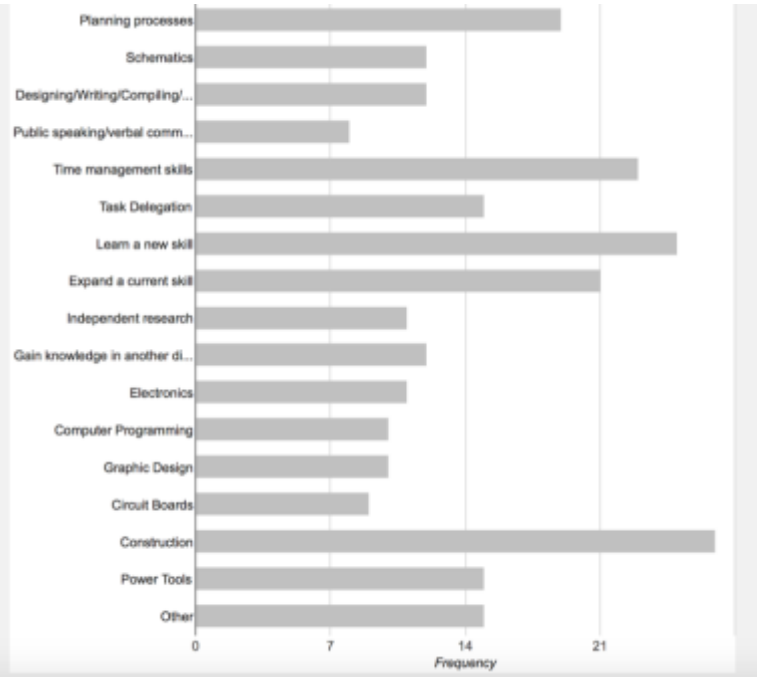


Figure 9. Number of time skill/process was utilized within the project

Students were assessed to find out if they felt that they were being able to apply classroom knowledge. It was also asked if students felt the experience was important. Students believe for the most part that this project utilizes classroom knowledge and has value and importance to their major. This can be seen from the results below in Figures 10, 11, and 12. Most students stated that they would choose to participate again. Those that stated they would not participate said the main reason was lack of time.

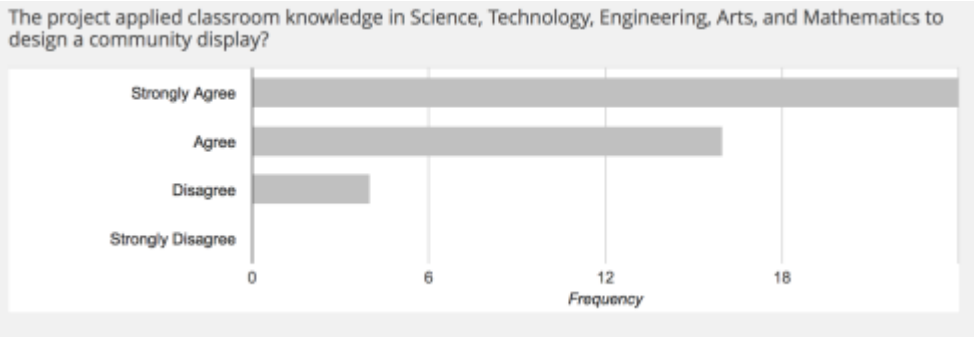


Figure 10. Applied classroom knowledge

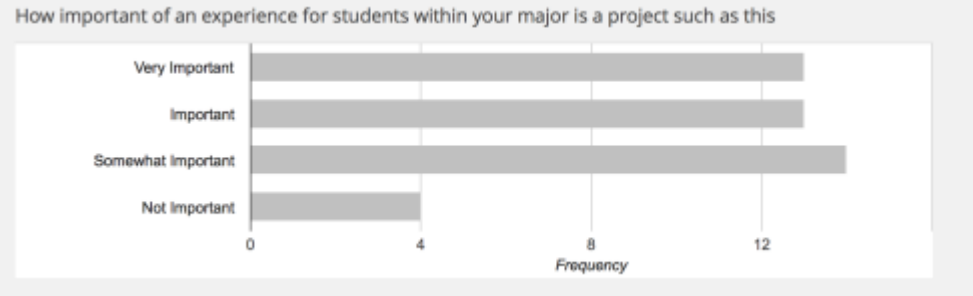


Figure 11. Importance of project within student's major

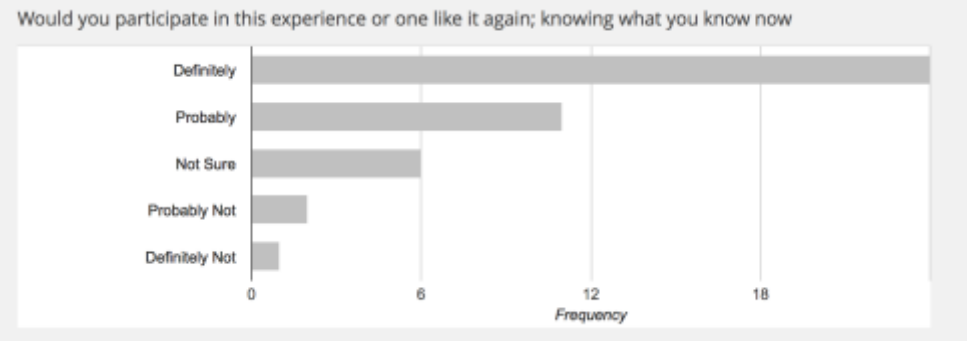


Figure 12. Would students choose to participate again

The results over the seven years collectively show that students are very positive towards this type of experience. Summarizing questions in regards to whether students would participate in such an activity again and their perception towards the application of classroom knowledge in this project over the seven years has been consistent. The results show 82.5% of students saying that they would participate in an experience like this again. Slight over 90% saying it was an important experience for their major/degree program. These results held across all majors, engineering majors vs. non-engineering majors.

Looking at results over the seven-year time span 89% of students believed that community involvement with this project was better than what they would experience in their traditional major courses. Based on assessments over the seven-year period, it can easily be argued that directly connecting skills learning to real world experiences has a substantial impact on students. Moreover, there is a need for addition research on how to design, development, and evaluate such experiences especially those not based within credit granting course.

## DISCUSSION

The results over seven years of this project have yielded insight into why extracurricular or external projects that are not for-credit based yield student outcomes. The first is that students are willing to take more risks. Students don't fear failure in the form of a grade and so focus on personal learning outcomes more. A project once focused on just soldering circuit boards has resulted in students now creating entirely new network protocols, schematics, and electrical components to meet the design challenges they face. More importantly they feel this project is geared towards solving a challenge which they deem is important to their learning outcomes.

While not directly assessed in the first seven years of this project we are looking to see if this ability to expand their skill sets and take on new and growing challenges yields over time more self-confidence. This is both focused on their professional and academic careers and whether this self-confidence leads to better performance in coursework overall. These types of studies have been done in for credit courses but we have found a lack of literature tied to projects that are clearly housed outside the normal degree program. "We see that students who come into a course with more favorable beliefs are more likely to achieve high learning gains." [4] This would seem to infer that building confidence outside of coursework towards a student's skills might truly yield benefits inside the classroom as well. However, such a study has not been directly done in regards this project.

The new thinking in today's circles is discussion around grit and long term success. We feel that this model of perseverance might could be taught or inherently encouraged in projects like this. Student projects that have a low point of entry and risk and yet where the community based expectations for delivery are high might encourage the development of grit. We want to further explore the development of grit in a relatively low stakes environment for participants.

Aside from the student gains, the learning outcomes, and the research around such; the interaction with the community is a huge win. Many visitors to this project are below the age of fifteen. This is a great way to expose kids to the power of STEAM (Science, Technology, Engineering, Art and Math) in an exceptionally informal way but one that has a lasting impression. Bringing context and showing the behind the scenes of such projects also allows understanding of truly how much "thinking and work" goes into the use of servos and animated characters. Further discussion of creating entirely new network control protocols, iPad applications, etc. bring

STEAM fields to life in a way hard to replicate with this age group. It allows kids to see that the fun and cool stuff has a lot of hardcore concepts making it work behind the scenes.

## CONCLUSION

Over the seven years that this project has existed it has continued to grow and expand. The learning outcomes from such is that non-credit projects housed outside traditional coursework can encourage and instill confidence in the students that participate in them. The skills development during such are greatly varied and provide grow in ways that are not traditionally looked at.

The need for additional assessment methodologies that are not purely focused on journals and the associated class grading of them will be critical as we look at more project based learning experiences. There needs to be a focus on defining grit experiences outside the classroom with experiences such as this. Specifically, those which have a low-entry point in terms of risk and yet have a high yield in terms of confidence gain.

The future of engineers who work in the multi-disciplinary world of today face many challenges and projects. Many of these will require completely unique and unscripted solutions. Projects such as this one begin to lay those expectations and foundations for students. Projects where the end goal may not be clearly or fully defined beyond just an it needs a solution makes students learn in real-world terms.

## FUTURE WORK

Based on the findings up to this point, we want to now focus on how this experience or better phrased if this experience instills grit amongst students. How does such impact their longer-term outcomes; professionally, in the classroom, and throughout their degree path. There are many additional items that need to be refined within this area. More research and development of assessment criteria and mechanisms are needed. Specifically, those that reach outside the traditional bounds of classroom based learning experiences and grade based coursework. The solution currently is based on journals embedded into a course but what happens when you don't have a course to embed that process in? Our findings so far show we can create larger impacts with non-course based project based learning experiences. However due to the very fact they present opportunities to explore concepts free from grading makes direct correlation with course based models a bit more challenging and difficult. The assessment strategies must differ to capture skills learning not directly focused on final grade and thus as well only creates more challenges to correlation with course based work.

## REFERENCES

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[3] L. Slivovsky, F. DeRego, C. Zoltowski, L. Jamieson and W. Oakes, "An Analysis of the Reflection Component in the EPICS Model of Service Learning," in *Proceedings of the 2004 American Society for Engineering Education Annual Conference & Exposition*, 2004.

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