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Using an Entrepreneurial Mindset and Biomimicry-Based Design to Better Engage First-Year Engineering Students

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Howdy,

After 23 years in Telecom building LD, internet, and email platforms and networks, I observed that the front line personnel that I was hiring didn't have what I considered to be skills that they should be bringing to the table.

I began investigating why, and that led me to high school. Alas, I began my journey in Education in 2010 inhabiting the classrooms of Lovejoy High School, where my two daughters attended. I redubbed my PreCalculus course as Problem-Solving with Brooks and was also afforded the opportunity to lead an impactul Project Lead the Way (PLTW) Principles of Engineering (PoE) course, a project-based learning survey of the engineering discipline.

Since the Summer of 2015 I have been privileged to work with the Texas A and M Sketch Recognition Lab (TAMU SRL) to evaluate a couple of online tutorial tools (Intelligent Tutoring Systems (ITS)) currently under development, Mechanix and Sketchtivity, that provide immediate constructive feedback to the students and student-level metrics to the instructors. I presented on this work at the state and national PLTW Conventions and at CPTTE in 2016.

I also spent 5 semesters beginning the Fall of 2015 taking online courses learning how to construct and deliver online courses. This resulted in a MSEd from Purdue University in Learning Design and Technology (LDT).

This widely varied background prepared me well for my next big adventure. Beginning in August 2018 I became the Texas A and M Professor of Practice for the Texas A and M Engineering Academy at Blinn College in Brenham. Texas A and M Engineering Academies are an innovative approach to providing the planet with more Aggie Engineers.

I am focused on enhancing the high school through first-year college experience and am an engaged member of the Texas A and M IEEI (Institute for Engineering Education and Innovation).

My foundations were set by an upbringing on the family ranch near Joshua, Texas and 4 memorable years at Texas A and M where I met my wife, I led Bugle Rank #7 in the Fightin' Texas Aggie Band (Class of '86 Whoop!), and dove into Telecom Engineering. Once in Telecom, my learning continued at MCI, Vartec, and Charter.

Using an Entrepreneurial Mindset and Biomimicry-Based Design to Better Engage First-Year Engineering Students

Abstract

This is an evidence-based practice paper that examines the curriculum deployment that occurred in the second semester of the first-year engineering program. The curriculum introduced Entrepreneurial Mindset (EM) and biomimicry using the Engineering Design Process (EDP) within the context of the accomplishments and mindset of Da Vinci. The course explored engineering mechanics and design topics concurrent with applying physics topics in an engineering laboratory. A qualitative analysis was performed using a new reflective tool, PhotoVoice. The purpose of the assessment was to better understand the impact of the course on the student vision, the operation of the course relative to what they have encountered in their educational careers, and student-perceived learning outcomes. Analysis of student reflections revealed themes of "Changed Perspectives," "Engagement in the Classroom," and "Brainstorming Benefits" when describing the impact of the course on their career visions. This paper concludes with intervention details, lessons learned, and "next step" actions driving course enhancements and extensions such that the lessons may be effectively recreated in other engineering classrooms.

Introduction

As there is a lack of interdisciplinary opportunities within the first-year experience, students may disengage and potentially drop out of engineering. Most students have had little exposure to cross-curricular activities prior to college with a secondary school system optimally designed with a silo structure. The students are often intrigued by the opportunity to use skills or knowledge from one of their courses (Math/Science) in another (Engineering).

Some states' high schools are beginning to address this lack of interdisciplinary activity exposure challenge through the implementation of new educational science procedural standards that incorporate engineering thinking such as SEPS (Scientific and Engineering Practices Standards). The challenge is that K-12 (high school focus) is still very siloed, so a difficult roll-out [1], [2].

Some colleges are implementing pre-course trainings to help incoming students better prepare for college, such as summer bridge courses and pre-course preparation sessions [3], [4], [5], [6]. These tend to focus on a particular topic and typically do not explore interdisciplinary elements [7], [8].

Extracurricular student organizations and clubs are assembled to foster student engagement of specific topics. These are often student run with limited faculty oversight (limited instructional guidance) and not all students are involved, only those that make the time. Some of the activities do engage faculty to address topics from an interdisciplinary perspective, yet this is a reactive

response from the faculty perspective (only addressing the student leadership request and not reviewing and advising the full program), and often a small population [9], [10].

This study introduces a new approach to teaching first-year engineering students through an interdisciplinary project incorporating EM, bio-inspired design, and STEAM practices with a foundation of the thoughts and products of Da Vinci.

The research question being pursued is: "How do engineering student perceptions of the engineering discipline change as a result of participating in this first-year engineering interdisciplinary lesson?"

Challenges

First-year college students are, generally, exiting a secondary school program where siloing of academic disciplines is prevalent. There is limited collaboration of lesson across disciplines in the secondary curricular structure. When science is introduced in math, or vice versa, students often note that it is not part of that class. Even more so when English, History, or Art are involved. One of the many elements of the collegiate foundation is to help students understand how all the disciplines interrelate, to include engineering.

The challenge during an undergraduate engineering student's first-year experience is to weave the elements (the physics, chemistry, and math involved in an engineering course) together in such a way that student thinking is changed. Referencing Gagne's design guidance [11], it is critical to get their attention with an engaging opening and then pair that with a connection to their past learning.

Engineering students are often directed to the major because they are proficient in math and science, yet they may or may not also possess impactful professional skills (writing, speaking, audio/visual production) that are not typically applied in engineering course work. The use of these skills needs to be encouraged as preparation for their engineering career. Recent feedback from industry partners has yielded that many interns and recent graduates are technically competent yet lack the professional skills needed to work in an office environment or within teams.

The drive into the interdisciplinary space builds an important foundation during the first-year engineering student experience. Interdisciplinary lessons guide students to develop as a team member and explore ideas with team members of differing perspectives [12]. College is the lab to learn how to operate in this environment in preparation for integration into the work force where team activity and diverse peer perspectives are encountered.

High schools have an overarching goal of graduating students, and the pathway can be complicated by deploying cross-discipline activities ineffectively. The risk of creating greater confusion through the introduction of interdisciplinary work often dissuades administration from allowing instructors to pursue this route. In addition, high schools must also prioritize and optimize instructor and student lesson time efficiency while meeting the state standards with a focus on standardized test scores.

Another college preparation tool, pre-course college sessions [6], are often delivered by a particular discipline, and not considering the student needs as a whole. They are designed to address common deficiencies in order to get the students to a base of understanding and choose not to delve into related areas of thought concurrently. For example, preparing a student for a programming course by focusing on the language syntax and structure without delving into expected applications.

The student organizations and clubs often focus more on the overall well-being of the members as opposed to progressing them academically from the cross-discipline perspective. Student leadership typically does not have the pedagogical wherewithal or support to drive cross-disciplinary efforts.

The scope of the engineering workplace and activity requirements are expanding to include more engagement in the "Why? Impact? Resources? Concept Sales" arena which requires engineers' inclusion of EM in their toolkit. EM encourages students to consider impacts outside of their snapshot view of a full product process, such as how source material is obtained and what does the "end of life" disposal for a product entail.

The arts element is pursued relative to the engineer's need to grow their professional skills in order to remain competitive in their field. A great idea that they cannot communicate effectively will not be a great idea moving forward with them. A competitive ideas landscape heightens the need to effectively communicate ideas to achieve success.

Viewing the world with a Da Vinci lens guides the students to realize that nature may have already solved a challenge that we are addressing, and we need to look there for inspiration. This proved to be a new perspective for many students during the study.

A study of the life and times of Da Vinci give us a solid visual on the entrepreneurial mindset (EM) and biomimicry. These terms are generally foreign to first-year engineering college students. Although these topics are not a foundation of most first-year engineering college programs, their inclusion in the curriculum can drastically adjust the lens through which students view the world and their future careers.

This paper explores the development and deployment of a new multiple touchpoint lesson plan for an Engineering Mechanics class to ignite creative thinking and communication skills in engineering students while establishing biomimicry and the EM as essential components of their engineering knowledge base.

The EM and bio-inspired design supply the foundation for curriculum from which the instructor can explore many disciplines to include art, writing, engineering, math, and science. The enigma of Da Vinci is the starting point for an exploration of how art and science interact. Students are introduced to the EM and biomimicry topics during the 8th week and then explore them further as part of an EDP (Engineering Design Process) Challenge during the 10th week.

This EM/Bio lesson provides an engaging cross-discipline venue for teaching many topics and concepts. When the researcher presented on the lesson idea at two university-wide conferences, many attendees followed-up afterwards to discuss how they already had a lesson thought through

where they could use the Da Vinci and Biomimicry base as a foundation for their history, English, or accounting class. Following an introduction engaging the students with elements of the life of Da Vinci and his exploration of biomimicry, the instructor may then direct the lesson to align with the needs of their discipline such as historical significance, various perspectives of the Da Vinci writings, or financial impacts and incentives of resulting innovations.

Methods

Engineering Mechanics (ENGR 216) is the second-semester course in the first-year engineering program. The course covers many physical interactions to include force and analysis, object collision analysis, and harmonic motion. This course is designed to allow for the introduction of new and innovative teaching and learning techniques. Spring 2019 brought the introduction of two ITS (Intelligent Tutoring System) tools to assist with sketching and truss system analysis. Fall 2020 included the introduction of a CNC-like lab to connect with the programming focus of the students' first semester course. Spring 2021 saw the launch of Final Artifacts in place of the typical multiple-choice final exam. Spring 2022 became an opportunity to introduce this EM and bio-inspired lesson.

This is a qualitative study to understand the impact of an engineering lesson with an EM and bio-design foundation on first-year engineering student thinking. The lesson requires two separate full hour class times (week 8 and week 10) as well as some out-of-class time for student products.

The application of EM and bio-design within an Engineering Design Process (EDP) structure which the students were familiar with supported the new learning within a venue of recalling a previously explored EDP activity [13], [14]. The lesson design uses the familiar flow of EDP activities as a framing for exhibiting how engineer project visions expand to include inputs and impacts outside of the typical engineering product realm. Engineer explorations need to reach into the ABET Student Outcomes #2 and #4 which account for considerations of public health, safety, and welfare on the global scale [15]. The typical EDP structure was adjusted to take a wider view by overlaying the vision of EM [16] to include the impact to various people groups of sourcing and disposal of materials and exploring how to manage any potential worker displacement occurring as a result of their innovative designs.

All students were 2nd semester first-year engineering students. All 54 students in the ENGR 216 (Engineering Mechanics) course completed the noted activities as part of participation in the class. The reflection activities evaluated as part of this study were completion grades and not scored based on the content of their submission. The demographics of the class were 8 female, 46 male, and 30 non-white students.

Two different research instruments, a photovoice reflection with image and essay [17], [18] and a reflection through essay, were assigned three weeks after the 2nd week of the lesson. The first was a three-question open-ended essay regarding the impact of the lessons, and the second were three open-ended essays regarding EM, STEAM, and bio-inspired (conceptual) design. Each was posted as an assignment in the LMS. The submissions were collected digitally, names were

removed, and then the comments were analyzed en masse. This study of student artifacts is approved by Texas A&M IRB #IRB2023-047.

Following is a week-by-week flow of the lesson activities, and the related deliverables. More lesson detail and associated artifacts may be explored at Engineering Unleashed (registration required). https://engineeringunleashed.com/card/3168

Week 4	1. The photovoice assessment tool is new to the students, so this activity is introduced early in the semester in order to address challenges with the activity before being used in the bio-inspired design plan reflection in week 13.
Week 8	2. Students are grouped in teams of four per table. This will be the team that they go through the EDP with in week 8 and week 10. 3. Introduce the vision of bio-inspired design through some examples of Biomimicry, and an introduction to Leonardo Da Vinci's work. Engage students to share connections that they may have to any of these topics. Students share with the four peers at their table, then as a class. 4. Describe the process and the expected products for this activity. 5. Discuss the definition of Entrepreneurial Mindset and have students share about elements that they know and what they call them. Students share with same four peers at their table, then as a class. 6. Lead a recall of the EDP flow. The students completed an EDP activity in a prior semester. 7. Student exit ticket from each student is a sketch and description of their initial thought regarding a product to explore.
Week 10	8. Return week 8 exit tickets with instructor comments. Engage students to share current thoughts on the topic and process. Instructor provides any additional or revised guidance based on student feedback, including clarification needs. 9. Students dive into the bio-inspired EDP to include capturing their brainstorming ideas, then filtering those ideas to agree on a design to pursue. The week 10 teams are the same as the week 8 teams. 10. Student teams share digital snapshot of how far they got during the class time. This is a team-level exit ticket.
Week 11	11. Students submit a digital multi-media artifact showing and describing their device to include the biomimicry relationship and a reflection on their process (brainstorming and filtering) to include entrepreneurial mindset elements.
Week 12	12. Post student products in the digital discussion board for a gallery view/comment and challenge students to continue to explore their current project and explore alternate applications of their product.
Week 13	13. Administer a final PhotoVoice assessment to encourage the students to reflect on the impact of the process and target concepts.
Week 13	14. (Optional activity to get feedback on the impact of the lesson.) Administer the open-ended question activity to spur student thought regarding the impact of the bio-inspired lesson on their thinking.

Photovoice Reflection Assignment:	Evidence of Biomimicry	In Engineering
Hydrophobic Lotus Leaf:	Kingfisher and the Shinkansen	Antimicrobial surfaces derived from shark skin

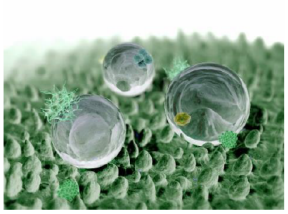

Figure 1

Figure 2

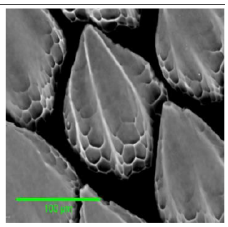

Figure 3

In the world of Engineering and innovation, many ideas were not imagined out of the blue. In fact, many solutions to the problems often plaguing society can be found right outside. The natural world has already provided solutions to the issues we as humans find ourselves struggling with in this modern world. Ideas such as the ability to fly derived from the wings of a bird or the antibacterial affects observed from fungus that led to the creation of penicillin. When caught up in the high speed of the 21st century, it's important to slow down and observe a natural world full of engineering marvels waiting to be discovered and mimicked.

Nearly 200 hundred years ago, transportation was officially transformed as the introduction of the steam fed train and rail system was invented to increase the speed at which travel could be done. A marvel of innovation has only become more efficient in recent years. Today, trains could reach speeds of 300+km/hr which can effectively break the sound barrier (figure 2). As cool as that may be, the concussion from the event caused tremendous noise pollution and even damage to surrounding areas. An idea derived from the beak of the Kingfisher bird in Japan all but solved this issue and increase the aeronautics of the train itself.

Plants have been used to solve numerous problems worldwide, as their diverse genetic structures have faced hundreds of problems as the organisms simply attempt to survive. One such mutation led to the discovery of a hydrophobic ability that can wipe away water deposits and rain hassle free. The leaves of the lotus plant (figure 1), have what's known as a super-hydrophobicity effect built into the nanostructure of the leaf itself. Using this "lotus effect", scientist have been able to mimic the design and create hydrophobic surfaces and sealants used across the globe to keep them completely dry.

As seen with the Lotus leaf, nature has an uncanny ability to adapt to its surroundings. In the harsh environment of the ocean, survival is based on ability. Sharks, for example, have adapted a skin that not only protects them from the environment but also reduces drag and includes an anti-microorganism effect that deters parasitic organisms. Shark skin (picture 3) has a Riblet design that under the momentum and pressure of the water, lay flat and reduce friction over the scales. Studies of the skin have led to further advances in ship hulls and even wetsuits for divers to reduce drag and increase speed under water.

Image #1: PhotoVoice Sample

The 14 lesson activities spread over 9 weeks allowed for student task completion followed by student reflection on their thinking [19], [20].

Prompts for module reflection essay:

1. The interdisciplinary approach of integrating the entrepreneurial mindset, STEAM (specifically, the arts), and bio-inspired design has been shown to improve student engagement, motivation and learning outcomes. How did this interdisciplinary learning experience affect your ability to engage with the newly developed curriculum?

2. What went well? What didn't go so well? What will you do differently next time?

3. What skills did you learn? Please consider both professional skills (e.g., communication, collaboration, etc…) and context specific skills (e.g., topic area). Why are these skills important for engineers in the real world?

Prompts for conceptual interaction essay:

1. The entrepreneurial mindset is defined as "the inclination to discover, evaluate, and exploit opportunities." Explain how participating in the newly developed curriculum incorporated the entrepreneurial mindset, and lessons learned relevant to the entrepreneurial mindset.

2. STEAM (science, technology, engineering, arts, math) goes one step beyond the well-known STEM to acknowledge the importance of integrating the arts and humanities into more analytical coursework such as that found within engineering. Art can be incorporated through pieces, process, and movements. Explain how participating in the newly developed curriculum incorporated STEAM (specifically, the arts), and lessons learned relevant to STEAM (specifically, the arts).

3. Bio-inspired design uses the nature-focused context of sustainability, security, and/or biomedicine and health outcomes to motivate analogical thinking and improve the engineering design process. Explain how participating in the newly developed curriculum incorporated bio-inspired design and lessons learned relevant to bio-inspired design.

This study followed a qualitative approach using thematic analysis. According to Braun and Clark (2006) a thematic analysis is a foundational qualitative method for exploring patterns within the data [21]. Researchers initially familiarized themselves with the data in order to generate a list of keywords to explore more deeply. Grouping the keywords allowed for development of themes. The data was then systematically explored in light of the target themes to create the basis for the findings analysis. The researchers then chose to include specific quotes that captured themes well to allow readers to make their own judgement on credibility, accuracy, and fairness (Corden & Sainsbury, 2006) [22].

Results

Three themes emerged from the analysis of student responses. The three themes and supporting student comments are included in Appendix. Select examples are shared below.

1) **Change in Perspectives** - Students acknowledge a change in perspective while completing the project. Viewing the activity through a different lens was new thinking for many students. This student impact is reflective of ABET Student Outcome #7. [15]

"The interdisciplinary approach has **opened my mindset** toward engineering. This way of teaching has **changed my opinion** because I have learned that there is much more to engineering than just doing what you are told to do."

"Where **once I would have seen** just an ordinary object, I now find myself looking for where the inspiration could have come from."

Students often pursue engineering with the perspective that it is the intersection of math and science. Though true, this EM/Bio activity reinforces that engineering is much more than the melding of those two disciplines. Engineering is about exploring the world for needs and evaluating others or new solutions to address those needs. A key element that this lesson drives towards is considering how similar challenges are addressed in other realms and applying that thinking to the current challenge.

2) **Increased Engagement in the Classroom** – Students denote that the EM/Bio-design venue of viewing engineering needs connected their curiosity and interest to the work. "Enjoy" and "fun" were common terms. The student impact is reflective of ABET Student Outcomes #1, #2, and #5 [15].

"This project provided a **feeling of excitement** when thinking of new ways I can help the world which made it feel less like schoolwork and more like fun."

"I **really enjoyed** this project because it took the cookie cutter assignment feeling out of the project and allowed for outside the box thinking."

The terms "enjoy" and "excitement" are not common in reflections regarding engineering lessons. First-year engineering students are often overwhelmed by the many elements involved with transitioning from secondary programs to collegiate programs and instructor attempts at injecting exciting elements often do not find receiving audiences.

3) **Realizing Brainstorming Benefits** – The sharing and discussing of ideas was a new experience for many and brought new insights into the thinking of their peers. This student impact is reflective of ABET Student Outcomes #1 and #3 [15].

"I think that the new curriculum was useful in **learning how other people approach problems**. By doing group brainstorming I **gained insights** into how people pursuing different engineering degrees think and approach a problem."

"The point of brainstorming was not necessarily coming up with the idea, but it is **bouncing ideas off of my other group members** so that we could work together to make an effective design."

First-year engineering students are typically not adept at effective brainstorming, yet brainstorming is a key element of the EDP and a step benefitting from applied creativity [23]. The emphasis on bio-design drove students to explore an area where few, if any, have experience evaluating. This limited the number of "experts" that sometimes dominate the brainstorming session when first-year engineering students deliberate during typical engineering EDP exercises. The solid result found in these reflections is how often students mention considering the ideas of other team members. This is the focal objective when first-year engineering students brainstorm. Mastering this element during the journey is key.

Discussion

The research question being pursued is: "How do engineering student perceptions change as a result of participating in this first-year engineering interdisciplinary project?"

The study of student reflections clearly highlighted multiple ABET Student Outcomes being addressed by the EM/Bio-Design lesson. Changing perspectives, engaging in the activities, and better understanding brainstorming are solid learning advances for first-year engineering students. The Da Vinci engagement and EDP activity provided an engaging topic and guiding platform for students to use to explore some areas of thought new to many.

Applications of biomimicry piqued the curiosity of first-year engineering students and EM expanded the view that they take when evaluating a project. EM discussions helped them to expand their view to include sourcing materials and planning for end-of-life of their project.

The lesson solidly captured the attention of a majority of the students and spurred them to think in a space that they had not typically explored. Future deployments may benefit from implementing this lesson earlier in the semester to allow additional referencing and recall at a later date and to provide more opportunities to use the PhotoVoice formative assessment during the course.

Additional exploration will involve evaluating other cross-disciplinary topics that might provide an engaging platform from which to launch interdisciplinary lessons. The topics can range from recent innovations to cultural connection to common life events. The goal is to impact and engage students from a wide range of backgrounds and perspectives.

Conclusion

The research question being pursued is: "How do engineering student perceptions change as a result of participating in this first-year engineering interdisciplinary lesson?"

The three themes extracted from the review of student reflections are:

- Change in Perspectives
- Increased Engagement in the Classroom
- Realizing Brainstorming Benefits

The themes denote a positive enhancement of student vision and motivation for continuing in their learning in the engineering discipline.

The framing of new learning within a known venue reinforces the benefits seen from incorporating Gagne's Nine Events of Learning [11]. Highlighted are events #1 (Gain attention) with the intro of Da Vinci's life and work, event #3 (Recall) with the use of the EDP, and event #9 (Transfer) with the digitally delivered student multimedia and photovoice assessment artifacts [25].

Though constructed with an engineering focus, sharing of findings at wider view conferences has identified an interest in using the Da Vinci bio-design foundation to explore other disciplines such as English, biology, and history.

Student feedback reflects that greater inclusion may be achieved through adding more definition to potential problems to be solved as many first-year engineering students were not comfortable with the complete freedom of solving any issue using bio-design as an impetus. Future iterations of the lesson will expand beyond the Da Vinci focus and will use the NAE 14 grand challenges for engineering [26] and 17 UN sustainable development goals [27] as a starting point for issues to be addressed.

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Appendix

Change in Perspectives

"I found it much easier to see connections between the three subjects and it **enhanced my ability** to be both creative and innovative simultaneously."

"I would say that everything went well and has definitely made me **adapt to think** in a different way."

"Being able to discuss and listen to all the unique ideas that were shared amongst my teammates and peers allowed me to **open my mind** to all possibilities for various solutions."

"The interdisciplinary approach has **opened my mindset** toward engineering. This way of teaching has **changed my opinion** because I have learned that there is much more to engineering than just doing what you are told to do."

"It **exposed me** to a broader mentality."

"This experience has really **opened up my view** of how things are designed and the thought of advancements in this world."

"Learning about the interdisciplinary approach of integrating the entrepreneurial mindset, STEAM, and bio-inspired design showed me very interesting aspects of engineering that **I never really thought of**."

"Where **once I would have seen** just an ordinary object, I now find myself looking for where the inspiration could have come from."

"This newly developed curriculum has **changed many things in my path in life**."

"I started to **think about things in a very different way**."

"It has really opened my eyes to **seeing things differently**."

"I enjoyed learning about biomimicry the most as **I had no idea** how much our world was affected by it."

Increased Engagement in the Classroom

"I found myself **enjoying** the small details that made my design unique, even if they held little value in the big picture of the design."

"I **enjoyed** learning about biomimicry the most as I had no idea how much our world was affected by it."

"I **enjoyed** this lecture and project a lot."

"In my opinion, this was my **favorite project** and to me it was the most beneficial."

"I found it **enjoyable and interesting** to listen to the different opinions and ideas that we all had when brainstorming."

"It was a **lot of fun** to collaborate with teammates to brainstorm ideas that were unique and creative."

"I **really enjoyed** discussing ideas with my teammates and it was interesting to listen to other's ideas."

"I **really enjoyed** this project because it took the cookie cutter assignment feeling out of the project and allowed for outside the box thinking."

"This project provided a **feeling of excitement** when thinking of new ways I can help the world which made it feel less like schoolwork and more like fun."

"The learning experience was satisfactory, the group work was excellent, and the **concepts were brilliant**."

Brainstorming Benefits

"I was allowed to freely brainstorm **without fear** of being criticized or being wrong. I was then able to **debate several points** about those ideas."

"I think the brainstorming portions went well, forcing the student base into a **deeper dive** into how engineering and nature are indeed connected at some level which was good."

"I really enjoyed **discussing ideas** with my teammates and it was interesting to listen to other ideas."

"I think that the new curriculum was useful in **learning how other people approach problems**. By doing group brainstorming I **gained insights** into how people pursuing different engineering degrees think and approach a problem."

"The point of brainstorming was not necessarily coming up with the idea, but it is **bouncing ideas off of my other group members** so that we could work together to make an effective design."

“Brainstorming strategies is definitely not something that I would assume is required for an engineer, but as I went through the assignment I saw just how **important** it can be. Not only would it be linked to **higher skills** such as problem solving, but it can also be linked to **communication** with well written papers or research with knowing topics that may be discussed.”