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Autonomy, Motivation, and Inclusive Teaching: Engineering Museum Exhibit Class Project

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Autonomy, Motivation, and Inclusive Teaching:
Engineering Museum Exhibit Class Project

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Abstract

To encourage autonomy, improve motivation, foster inclusion, and spark curiosity, the Engineering Museum Exhibit (EME) classroom project was developed for use in a junior-level, required civil engineering course. The EME provides a creative way for students to make connections and create value across course content, while learning science communication in a unique way. The junior-level course has traditionally focused on real-world examples, labs, and lecture content. Adding the EME allows for student autonomy, which boosts motivation, thus leading to better competence of course content. With this autonomy, students can create their own connections to real-world applications of course content. Research shows that a focus on autonomy in course projects engages students, specifically their curiosity and motivation. Furthermore, autonomy enhances inclusion in the classroom, as students can explore topics of interest while creating content in ways personally meaningful to them. In addition to the emphasis on autonomy and inclusion, the creation of museum exhibits promotes science communication in new ways for students, which leads to enhanced value creation. Within the class project, students must create EMEs for a general audience, with a live showcase featuring interdisciplinary judges from across campus. This work will highlight the EME project assignment, its ties to the Kern Entrepreneurial Engineering Network (KEEN) 3Cs (curiosity, connections, and creating value), and student perceptions of the EME. Additionally, the detailed rubric, developed specifically for the EME, is presented. This work is part of an Engineering Unleashed (EU) Fellowship through KEEN and the Kern Family Foundation, with a research focus on project development, assessment, and inclusive teaching.

Introduction

The Engineering Museum Exhibit (EME) was initially conceptualized during the Kern Entrepreneurial Engineering Network (KEEN) *Enhancing Inclusive Teaching* (EIT) workshop in 2023. The EME project incorporates inclusive practices to promote autonomy, motivation, and belonging as part of a robust entrepreneurial-minded learning (EML) course design focusing on *curiosity*, *connections*, and *creating value.* These 3Cs are the tenets of the entrepreneurial mindset (EM), a mindset, or mental habits, necessary for engineers to excel at problem identification, innovation, and value creation [1]. While motivation and autonomy might not be direct facets of EML, they are linked with the 3Cs, and provide students the opportunity to take ownership of their learning. Furthermore, an entrepreneurial mindset (EM) instills in students such attributes as uncertainty tolerance, opportunity recognition, and healthy competition [2].

Research has shown that a student's motivation in a given educational assessment directly influences their creativity, as well as critical thinking skills [3]. Related to motivation, inclusive classroom practices enhance student autonomy or self-efficacy [4]. Linked to inclusion, autonomy improves learning outcomes, and motivation, in diverse student populations [5].

Furthermore, autonomy, particularly as related to learner choice within a learning assessment, allows for inclusion of diverse backgrounds and skill levels [6]. Sereti & Giossos [7] define autonomy as the learner's ability and skill to decide *what* and *how* to learn a given topic. Layering choice (the "what") within a unique educational assessment can open new pathways for students to "fit in" to a given career path. And providing students with opportunities to see themselves as part of the field of study can increase overall belonging, motivation, and achievement [8] [9].

With the aforementioned research in mind, the EME was developed to enhance inclusion and autonomy, and thus motivation, in a third-year required civil engineering course (*CE 3311: Geotechnical Engineering*), rooted in EML course outcomes. Two specific course outcomes as written in the course syllabus, which are assessed as part of the project grade and reflection, are as follows:

> *Create connections between class content, and create value for general audience science communication, via a museum exhibit group project.*
>
> *Function effectively in a team environment by establishing goals, assigning tasks, and meeting objectives.*

The project and its ties to EML are outlined below, with student motivation analysis using self-determination theory questionnaires, and reflection results, discussed later in this work.

CE 3311: Geotechnical Engineering

The course in which the EME project takes place is a junior-level civil and environmental engineering (CEE) course, CE 3311: Geotechnical Engineering. The course is part of the CEE core curriculum, and is taught every fall as a 3-credit course which meets for 50-minutes, three times a week. Topics covered in the class include traditional soil mechanics and soil labs, with a more advanced foundation design course taught the following spring semester. The broad course topics listed on the course syllabus include: *soil characterization, phase diagrams, compaction, consolidation, stress columns, permeability, moisture density relationships, geology and landforms*. Within each topic, various equations, case studies, labs, and/or real-world applications are presented. For example, the compaction module includes quantitative and qualitative assessment of compaction curves, a standard Proctor soil lab, and conceptual applications of compaction and soil pollution within landfills, sports fields, and cemeteries.

The suggested topic list for the EME project includes any of the labs done in class (e.g., Proctor lab, Casagrande liquid limit lab), geotechnical engineering history, the use/management of soil, pollution at landfills, sports fields, or graveyards, etc. Students may also suggest a tangentially-related topic of their choosing for individual approval (e.g., how soil makeup and quality affect coffee bean growth and flavor; an approved topic from 2024). Students must demonstrate within their project how their exhibit relates to core civil/environmental topics, thus building connections across the course content.

Engineering Museum Exhibit Assignment

Roughly half-way into the semester during CE 3311, students are given the EME assignment guide (Appendix A), and provided class-time to form groups and preliminary exhibit ideas. The

EME is considered the one and only project in the course, which is weighted as 20% of the course grade. Students are told from the onset that creativity and autonomy are both foci of the project, as well as provided with information on EM/EML. As juniors, students will have encountered EM in previous courses including, but not limited to, their required first-year engineering sequence.

The essential content for the EME includes: title, summary blurb, physical artifacts/figures, facts, and any notable contributors to the field. Museum exhibits in the real world are often interactive in nature, and meant for a general audience (with some museums targeting young children, others targeting the average reading level, which is 7^{th}-8^{th} grade in the United States [10]). As such, students are encouraged to target a general, but scientifically curious, audience. Additionally, pamphlets are required for each exhibit, which connects back to previous EM content on value creation in their first-year courses (ENGR 1041 & ENGR 1051 [11]). Students are provided links via Canvas® software to more than ten online resources on museum exhibit development, including a comprehensive guide from The Smithsonian [12]. To further enhance opportunities for an inclusive environment, resources, like the Rhode Island School of Design's *Museum Social Equity & Inclusion Work Plan* [13], should be provided to students. Another resource provided in class is the Design Handbook [14], which includes sections on finding and selecting appropriate scholarly resources, and ideation. The Design Handbook, which is used during students' first-year courses, allows students to connect the engineering design process in new ways with required geotechnical engineering course content. Thus skill-building from first-year courses scaffolds into the EME.

After the EME is assigned, but prior to peer review, CE 3311 students complete a field trip to a local museum. The field trip is one method to enhance inclusion, as students who might not have previously been provided with the opportunity to visit a museum are able to have the same in-person interactive experience as others in the course. Additionally, the field trip includes a private tour and presentation from exhibit designers, including a Q&A session. Exhibit designers have diverse technical backgrounds, which promotes student conceptualization of engineering and STEM as existing across diverse career paths. When students can self-identify within their chosen field, motivation and perseverance are positively impacted [4]. For reference, the students in CE 3311 in 2024 visited the *Armstrong Air and Space Museum* in Wapakoneta, OH, as (astonishingly!) there are no geotechnical engineering-specific museums near campus. The field trip is provided free of charge to students (transportation, ticket, and meal are provided), and all students enrolled in the course are expected to attend.

As the semester progresses, students are given project work days, and encouraged to seek help from each other, professors, etc. in creating an exhibit. A budget of $50 is provided to each team for materials. Teams are required to bring signage and pamphlet drafts for a peer review day in class, and are provided with rubrics to assess each other's work. The process of peer review encourages students to add value to the greater EME via their suggestions and discussions, thus tying to the *creating value* facet of EML. As observed by Trimble & Lichtenstein [15] in their work with students, peer review scores were overly generous, and some teams provided more substantive feedback than others. Although the rubric is useful in supplying detailed requirements and associated scores during peer review, future iterations of the EME could benefit by providing students with detailed instructions on *how* to provide meaningful peer review feedback. A lesson on *how to peer review materials* would be a wonderful opportunity to partner with the campus library and/or writing center.

The end goal of the project, from the students' perspective, is to create and present their museum exhibit artifacts, signage, and pamphlets during a live showcase event open to all faculty and students on campus. Each team's exhibit is judged in three rounds during the live showcase (e.g., interactive demonstrations), and by four additional judges during the silent showcase (e.g., displays are up, but students are not present at their displays). During live judging, students may be asked questions from judges and general audience members, and are assessed not only on the exhibit display, but also their ability to present the display. For more information on the EME, and to view sample pamphlets, see the associated EU card [16].

Rubric Creation

To accurately assess a creative project like the EME, a thorough examination of assessment literature was conducted. Given the multi-faceted approach of the EME from both the instructor and student viewpoint, an analytic rubric was desirable [17]. Initially, *creativity, presentation, display materials*, and *sources used* (e.g., quality and breadth of sources) were the main categories anticipated for grading. A deeper dive into the phrasing used within museum sciences [12], and quantitative assessment of creative works [18] [19], provided the springboard for the EME rubric. Of note, the *AAC&U VALUE Rubrics (Oral Communication, Integrative Learning, Inquiry and Analysis, Written Communication)* [18], and the *NCTE Museum Exhibit Rubric* [20] were combined and adapted to create the finalized EME rubric used for both silent and live judging, as well as peer review, in 2024. Future iterations of the EME will include emphasis on *universal design principles*, as recommended by an ASEE reviewer. As such, an updated rubric for 2025 will include in particular principle three on *simple and intuitive use,* and principle four on *perceptible information* [21].

For the finalized analytic rubric as used in 2024, seven categories (display quality: communication to audience; display topic: relation to course content; display content: sources; exhibit creativity; visual appearance; presentation delivery; presentation organization) were assessed across four achievement levels (benchmark: minimum evidence; milestone: moderate evidence; milestone: major evidence; capstone: skillful evidence). Each category was weighted equally, and a detailed description for each category and achievement level was given. The complete rubric is provided in Appendix B.

The EME as a class project is tied to ABET Student Outcome Three: "*an ability to communicate effectively with a range of audiences*" and Seven "an ability to acquire and apply new knowledge as needed, using appropriate learning strategies" [22]. For fall 2025, ABET SO4 ("*an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts*") will be tied to the EME. For SO3, science communication as a tangible skill feeds into an engineer's ability to create value for others/society, while learning in new ways provides students with adaptability and grit needed for the workforce. The developed rubric emphasizes written/visual and verbal communication to a diverse audience of judges. Museum exhibit attendees and judges were provided with information (visual, verbal, interactive) on how geotechnical engineering relates to our everyday lives.

Methods to Assess Motivation

To measure students' attitudes and motivation, a Likert scale questionnaire and reflection survey were administered pre- and post-project. Both surveys were provided via Google Forms, and answers were anonymous (e.g., the survey did not ask for identifying information, or collect email addresses). In both surveys, students were provided with basic information about the Engineering Unleashed Fellowship and associated research project, as well as some additional questions on thoughts and attitudes about the project, class as a whole, etc. Out of thirty-two students, twenty-four completed the pre-project survey and twenty-one completed the post-project survey. Students were asked to create their own unique catch-phrase for individual pre- and post-project comparison. Out of the 24 and 21 responses, 10 catch-phrases provided were a match. It is unknown if the other 14 and 11, respectively, responses had student matches, and therefore further analysis on matched pre- and post-project individual answers is not warranted.

Likert scale questionnaires have been used in many situations to measure motivation [23], [24], and intrinsic vs. extrinsic motivation has been explored within the EML framework [25], [26]. Using questions by Guay et al. [24] which were also presented during a KEEN workshop on Motivation and Mindset in 2019, students responded using a Likert scale with ratings 1 (corresponds not at all) to 7 (corresponds exactly). The questions can be found in Appendix C, and students were asked to answer each one with "*Why are you currently engaged in this (EME) activity?*" in mind.

This work follows the methods in Henslee et al. [3], which are rooted in self-determination theory (SDT) as outlined by Ryan & Deci [27], and others. The motivation metrics are intrinsic motivation, amotivation (or introjected motivation), internal regulation, and external regulation. Henslee et al. [3] defines each type of motivation as follows:

Intrinsic motivation: "a state of enjoyment and inherent satisfaction"
Internal regulation: "a state where initiative in the learning activity is prompted by identified value"
External Regulation: "a state where initiative in the learning activity is prompted by external rewards and punishments"
Amotivation: "occurs when a learner finds no value in the learning activity"

To quantitatively compare each motivation metric, the average score (1-7, Likert scale) for each question was determined, and then the average of the four questions pertaining to each metric was found. Quantitative comparison of the SDT metrics is important, as intrinsic motivation and internal regulation are both shown to boost learning outcome success [28]. Thus, a student scoring higher in these categories, compared to amotivation and external regulation, is a desirable outcome when designing student assessments (e.g., homework, project).

A self-determination index (SDI) was derived from pre- and post-project survey results using the pre-validated questions (Appendix C) ascertaining motivation metrics. The SDI was calculated using standard methods (e.g., [29], [30], [31]) as opposed to adjusted SDI methods [32], for simplicity. The SDI provides a numeric representation of motivation, autonomous vs. controlled, with higher numbers associated with greater self-determination [33].

Results of Quantitative Motivation Assessment

During the fall 2024 offering of CE 3311, thirty-two students were enrolled and participated in the EME. The pre- and post- project survey was completed by twenty-four and twenty-one students, respectively. Results for each self-determination category, as represented by class averages via Likert scale, are shown in Table 1. The same pre- and post-project survey will be used again for the upcoming fall 2025 course offering of CE 3311 in an effort to collect more data.

Table 1: Results of the pre- and post- project self-determination (e.g., motivation) survey. The questions used were derived from Guay et al. [24], with the Likert scale allowing for answers to rate as a whole number in the range of 1 to 7. Out of 32 enrolled students, 24 completed the pre-project questionnaire and 21 completed the post-project questionnaire.

Engineering Museum Exhibit	**Likert Scale Questionnaire Results**					
	Pre-project		*Post-project*		*Comparison*	
	Average Score	Standard Deviation	Average Score	Standard Deviation	Increase in Average (Raw)	Percent Increase in Average
Intrinsic motivation (IM)	4.76	0.93	5.13	1.35	0.37	7.78%
Identified regulation (IR)	4.64	1.39	4.92	0.97	0.28	6.07%
External regulation (ER)	5.09	1.77	4.93	1.45	-0.17	-3.24%
Amotivation (AM)	2.43	1.35	2.63	1.83	0.20	8.38%

Comparing the self-determination categories intrinsic motivation (IM), internal regulation (IR), amotivation (AM), and external regulation (ER) as shown in Table 1, and visually demonstrated in Figure 1, the class's overall internal motivation for the project was higher than external motivation, with an overall rise in the SDI from +1.54 to +2.69 pre- vs. post-project.

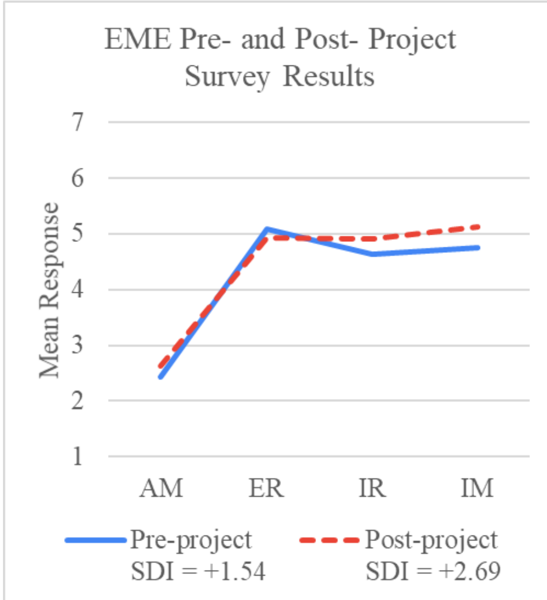

Figure 1: Quantitative results of motivation pre- and post-project using questions developed by Guay et al. [24], via a 7-point Likert scale. IM = intrinsic motivation, IR = internal regulation, AM = amotivation, and ER = external regulation. SDI is included for comparison as well. Notably, the students' overall internal motivation increased, and specifically the SDI nearly doubled.

All self-determination categories, except external regulation, increased from pre- to post-project, and the SDI increased as well. This means that although the overall positive motivation increased throughout the project, the external regulation (e.g., "*I have to get this done, I want a good grade")* did as well.

Qualitative Results of Motivation Assessment

As part of the pre- and post-project questionnaire, students were given open-ended questions on their motivation, the field trip, autonomy, and the 3Cs of curiosity, connections, and creating value. Additionally, students had a required, individual reflection assignment, which was worth a small portion of their overall project grade. Excerpts from student responses are shown in Tables 2 and 3. While the overall feedback on the project was positive, some students noted concerns over such an open-ended project. Others provided feedback for improvement in future iterations, such as having pre-arranged meetings with the instructor to ensure their project is "on track." Some students asked for more time to complete the project (increase timeline by one or two weeks). Concerning the 3Cs, students had more substantive feedback (quantity and quality) on both curiosity and creating value as compared to connections. The field trip feedback tended to be positive, but short. A few students did comment on the disconnect between course content (geotechnical engineering) and the theme of the Armstrong Air & Space Museum (space flight history, rocketry, and astronauts). Concerning motivation, more comments mentioned getting a good grade in the pre-project responses compared to the post-project responses. This observation supports the quantitative findings that intrinsic motivation increased from pre- to post-post project.

Table 2: Selected student feedback from pre- and post-project questionnaires, as well as from the individual reflection assignment, has been reproduced here. The feedback is grouped according to the key word used within the questionnaires and reflection, and is specifically tied to the 3Cs of curiosity, connections, and creating value.

Key Word	**Feedback**[1]
Curiosity	*"We picked our topic primarily out of curiosity."* *"This project was fueled by curiosity. The goal was to research a topic enough to be able to present the topic confidently. ...there was minimal taught in class about landfills, so the aspiration to learn more was high. This project required curiosity but it also allowed the class to want to know more for themselves."* *"The museum project sparked my curiosity because it allowed me to take this project wherever I wanted to. It also allowed me to think outside the box on what it takes for drainage to be successful in each type of sports playing field."* *"I originally did not really know much about my topic. So, learning about the information in order to be able to present it and make a display about it was interesting. Also, the hands-on portion of the project allowed me to see and learn interactively."* *"I feel the exhibit related to curiosity because I felt like everybody that walked by the exhibit was looking into the room and seemed curious after seeing some of the tables filled with exhibits."*
Connections	*"Some connections I made during the project related to the content we covered in class. The lecture content gave a basic overview of landfills and how compaction is important, but the project allowed me to build on that base and explore more deeply into certain aspects of landfills, such as the role compaction plays in landfill management."* *"We were able to make connections because some of our judges had stories or insight into the basis of our topic."* *"I applied skills from [ENGR 1041] in a couple aspects such as working as a team, how to build a good display or exhibit, and how to research about the topic."*
Creating Value	*"Our project drew in a lot of attention from faculty, and students, and our live judges were very interested in what we did. I say because of that we created value because people were interested and were learning something new. This could help city developers or engineers to get more knowledge on cemeteries, how to plan them or design them for the better to limit pollution which would help improve the environment... to give more ideas and develop solutions for the future."* *"I personally engaged with every exhibit and I was able to gain some portion of knowledge from each one."* *"The project not only created more knowledge for me but also for people at the university to see what goes on in the classroom. Sometimes I feel like engineering goes under the table and no one sees behind the scenes but it was nice to express, as a class, what we've been learning."* *"When speaking with other geotechnical engineering students in my class, it felt as though I was helping to create a better understanding pertaining to the importance of soil behaviors and proper compaction procedures. When speaking to the general public, I felt as though I was contributing to a greater cause by urging the consideration of alternative practices to that of traditional burials, or at least developing awareness surrounding the potential environmental concerns in traditional burials and cemetery compaction. Our purpose was even presented to a broader public, seeing as our exhibit and its content was published in [News]."* *"I thought the group that discussed how soil can impact the quality of coffee beans cultivated from it was pretty interesting. They created value with their project by using pieces of geotechnical engineering to explain how different soils may allow different flavors and qualities of coffee to exist. They also caused their viewers to embrace curiosity as the effects of soil on coffee is most likely not something that a person would consider. Finally, they made connections to the geotechnical field within their exhibit, but also, even though maybe indirectly, to the field of plant biology as they discussed why different types of coffee beans grew from different soil types around the world."*

[1] Note that minor spelling and grammar mistakes in student responses have been corrected for presentation here.

Table 3: Selected student feedback from the individual reflection assignment has been reproduced here. The feedback is grouped according to the key word used within the reflection.

Key Word	**Feedback**[2]
Motivation	*"I liked that we got to pick out a topic and what direction we wanted to take it and that everyone could do and pick different things."* *"The motivation to learn about it to feel confident presenting was the goal."* *"This project motivated me by 1) having a bad grade in the class and 2) learning the material as a whole for my future career."* *"Originally I was really just doing it for a good grade but once I started it was a pretty enjoyable, stress-free project that taught me something. I was more motivated to just make a quality project once I started."* *"My main motivation on this project was that I enjoyed it. I found the whole thing fun and was motivated the whole time."*
Field Trip	*"One key takeaway was to have a visual representation of our museum exhibit. This helps track the viewer in and start looking at the exhibit. Another key takeaway was to have very short and understandable writing in the exhibit."* *"…museum curation is attention to detail; it's also understanding people."* *"One key takeaway from the museum trip was the use of auditory relaying of information as well as a visual description."* *"The key takeaway from the museum field trip was that each exhibit does not need to be very wordy and contain all kinds of information. The exhibit just needs to get the point across with information while accompanying it with the visual artifact."* *"Signage is an important but overlooked factor in the design of such exhibits. It ties in some elements of social engineering and directing the people interacting with your exhibit effectively and in the correct direction."*
Autonomy	*"While this project has so much less structure and more learning involved than any other project we would be doing in another class, the less structure meant that sometimes the information gathering was hard to find good viable sources."* *"This project had minimal guidance and groups were supposed to get creative. This is a pro because groups were able to have free will when creating the project and just use personal skills learned in classes before. The con for this method is not knowing how much to do to receive a higher grade."* *"The lack of detailed instructions made me the most nervous at the beginning of the project, but as our group progressed, it turned out this was a non-issue and instead gave us more creative freedom to really let us make our project what we wanted it to be."*

Discussion and Future Work

The Engineering Museum Exhibit (EME) was overall a success. Students were encouraged to get creative, and the resulting displays at the live showcase embodied the KEEN 3Cs. Using Guay et al.'s [24] pre-validated questionnaire to assess intrinsic motivation, students' overall intrinsic motivation increased from pre- to post-project, and the SDI increased from +1.54 to +2.69. Notably, qualitative evidence from student questionnaire responses and reflections indicated that curiosity was a driving factor for project performance, and many students articulated well the value creation of their and their classmates' exhibits. Godwin-Jones [6] noted that personal connections drive motivation and skill-building, and similarly the EME allowed students to connect their personal interests to course content for a richer, more exciting class project.

[2] Note that minor spelling and grammar mistakes in student responses have been corrected for presentation here.

The activity has thus far been completed twice in the same class, CE 3311 (piloted in fall 2023 and enhanced in fall 2024) but the ideas behind the activity can be applied in a variety of disciplines and courses. The newly updated rubric provides other educators with an adaptable assessment tool, should they wish to do a similar activity. The student-centered, creative aspect of the EME allows for freedom from an instructional perspective as well. For example, a museum exhibit capstone-style project could require cross-disciplinary efforts with students in disparate fields. For a lower-level major course (or high school courses), intentional scaffolding (e.g., check-ins) for students and more guidelines on exhibit requirements might be necessary.

The project was successful in terms of learning outcomes for the course, generating curiosity and connections, and creating value for others. The interactive and live nature of the exhibit showcase could be expanded not only to judges from across campus (faculty and students in and outside of engineering), but future versions could incorporate local K-12 schools and/or the general public. The EME could serve as an outreach activity for students in CE 3311, which would further promote the science communication aspects of the project. There are plans to work with the writing center to further develop the rubric, particularly with an emphasis on multi-modal communication, which would target creating value and ABET SO3.

For future iterations of the EME, student-specific motivational assessments would provide more granularity within the motivation assessment. While for this study the SDI increased overall, it is unknown how wide the variation was in motivation from student to student pre- and post-project. In other words, did all students experience the moderate increase in intrinsic motivation, or did some students experience a tremendous increase in intrinsic motivation while others actually experienced a decrease in intrinsic motivation, but calculating motivation metric averages has removed such information? Additional motivation assessment check-ins mid-way during the project would also provide more quantifiable data to produce a motivational time series, but increasing student surveys comes at the cost of survey fatigue [34].

Conclusion

The engineering museum exhibit project in CE 3311 provides students with autonomy, bolstering motivation to learn course content. Additionally, a class field trip promotes inclusion in understanding museum exhibit design, while also being a fun class activity. Through the use of self-determination theory’s motivation assessment, the EME generated high intrinsic motivation for students, with an increase in overall SDI from pre- to post-project. Inclusion and autonomy provided a platform for internal motivation, while EME project guidelines enabled the 3Cs to shine. In particular, science communication to a broad audience via museum exhibit displays created value, and students’ autonomy to self-select project topics enhanced their curiosity about a range of course content. The EME will be in future offerings of the course, with improvements made to further contextualize the 3Cs, and further study student motivation.

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Appendix A: Engineering Museum Exhibit Assignment Guide
CE 3311 Geotechnical Engineering
Fall 2024
Museum
Exhibit
Weighted as 20% of course grade via "project" category
Due by 8am Nov 15 (PDF files to Canvas, physical work/items for gallery walk)

From Syllabus:
**Museum Exhibit: In this course, you will create a physical and/or virtual museum exhibit based on course topics, and present/showcase your exhibit during a "gallery walk" event. This assignment is new to the course (second iteration), and is based on pedagogical tools learned at a KEEN conference on Enhancing Inclusive Teaching. Note that this assignment will be fun, collaborative, open-ended, and unique.*

Scope:
In teams of 2-3, you will create a virtual and/or physical version of a museum exhibit, with a topic related to content learned in this course. The exhibit should target a general audience, with expanded information for a "scientific" audience. The exhibit should include physical components (e.g., soil, diorama, instruments), signage, and a printed pamphlet (including pictures), which is also submitted digitally. Example materials (e.g., pamphlets) and resources (e.g., how to design a museum exhibit) are provided on Canvas, and we will discuss past exhibits in class as a whole for guidance.

Timeline:
Oct 4: Assigned (form teams!), start brainstorming
Oct 11: Submit proposed topic to instructor (via email from the team)
October: Field trip to Air and Space Museum on October 31st
Nov 6: Peer review (complete pamphlet, complete signage, physical set-up plan sketch)
Nov 12: Deadline to submit any materials for print to instructor (can be 8.5"x 11" or 11" x 17")
Nov 15: Gallery walk during class, with external judges (judges TBD)

Broader Educational Impacts:
This assignment is open-ended to enable creativity and autonomy, as well as fostering curiosity. The creativity and autonomy allow you to embrace your own **curiosity**: learn something new about a geotechnical topic, dig deeper (pun intended). By having to generate new material for use in a public "museum" setting, you'll need to make **connections** across not only this course's content, but also rely on your Writing Seminar knowledge, as well as the design process and NABC (Need, Approach, Benefits, Cost) method from Foundations of Design (ENGR 1041). And with the design process in your skillset, you can **create value** for general and technical audiences looking to learn more about how geotechnical engineering is important for our everyday lives. For more on the KEEN 3Cs, refer back to your Design Handbook from ENGR 1041 (Chapter 1). With the 3Cs, this assignment requires you to think critically about science communication, which is fundamental for today's engineers (*ASCE Civil Engineers of Today*). This assignment is tied to ABET SO7: "an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Funding:
In order to properly create your exhibits, each team will have a budget of $50 to spend on materials. This funding is provided through an Engineering Unleashed Fellowship, which your instructor was awarded specifically for this class project and associated research. You are encouraged to make full use of the project funding to maximize your exhibit display materials. You must save all receipts, and fill out a reimbursement form at the conclusion of the project.

Grades:
Your project score will be based on the newly created rubric, which was developed via research as part of the KEEN fellowship.

Each team will be graded by external judges, who will all use the same rubric for judging. Your instructor will also assess each project using the rubric. The average score from each rubric will be used to generate the team score. Within each team, individual grades can be adjusted at the discretion of the instructor, based on observations from judges, and peer feedback.

Additional Resources:
See linked resources on canvas. Talk with a librarian, visit the writing center!

Appendix B: EME Rubric

Museum Exhibit Project: Rubric　　　Team #:　　　Team Topic:

	Benchmark* (Minimum Evidence) 10 pts	Milestone (Moderate Evidence) 14 pts	Milestone (Major Evidence) 18 pts	Capstone (Skillful Evidence) 20 pts
Display Quality; Communication to Audience	Demonstrates minimal attention to context, audience, purpose, & to the assigned tasks(s) (e.g., faculty or peer as audience).	Demonstrates awareness of context, audience, purpose, & to the assigned tasks(s) (e.g., begins to show awareness of audience)	Demonstrates consideration of context, audience, & purpose & a clear focus on the assigned task(s).	Demonstrates a thorough understanding of context, audience, & purpose that is responsive to the assigned task(s).
Display Topic; Relation to Course Content	Identifies a topic that is too general. Relation to geotechnical engineering profession is tenuous at best. Artifacts in the exhibit have little to do with topic.	Identifies a topic too narrowly focused or leaves out relevant aspects. Relations to geotechnical engineering profession is demonstrated. Artifacts in the exhibit relate to topic.	Identifies a focused topic, appropriately addresses relevant aspects. Relation to geotechnical engineering profession is demonstrated. Artifacts in the exhibit clearly relate to topic.	Identifies a creative, focused topic that addresses significant aspects of the topic. Relation to geotechnical engineering profession is well demonstrated. Artifacts in the exhibit clearly relate to topic.
Display Content; Sources	Communicates info from few sources. The information is fragmented &/or used inappropriately.	Communicates & organizes info from multiple sources. The information is not synthesized. Source documentation include.	Communicates, organizes, & synthesizes info from sources. Source document is included, variety of sources used.	Communicates, organizes, & synthesizes info from many sources. Source documentation prominent, variety of sources.
Exhibit Creativity	Little thought was put into making the exhibit interesting or fun.	Some thought was put into making the exhibit interesting & fun, but some of the artifacts &/or signage made it harder to understand/enjoy.	Some thought was put into making the exhibit interesting & fun as shown by artifacts & signage. Display is interesting & you want to learn more.	A lot of thought was put into making the exhibit interesting & fun as shown by creative artifacts, signage, etc. Display is exciting & drive you to learn more.
Visual Appearance	The display is unattractive with no use of color/theming. Display is unorganized & not labeled. Exhibit feels untidy.	The display is attractive with moderate use of color/theming. Display is slightly organized & labeled. Exhibit feels untidy.	The display is attractive with good use of color/theming. Display is organized & labeled. Exhibit is neat.	The display is attractive with excellent use of color/theming. Display is well-organized & labeled. Exhibit is neat.
*If a team did not meet the minimum benchmark, assign 0 points for that category. Please provide a total score out of 100 (silent judging) or 140 (live judging). Please provide specific comments on the back of this sheet. **Presentation to Judges: <u>Live Judging Below</u>**				
Presentation Delivery	Delivery techniques (gesture, eye contact, vocal expression) detract from the comprehension of the presentation, speakers appear uncomfortable.	Delivery techniques (gesture, eye contact, vocal expression) make the presentation understandable, speakers appear tentative.	Delivery techniques (gesture, eye contact, vocal expression) make the presentation interesting, speakers appear comfortable.	Delivery techniques (gesture, eye contact, vocal expression) make the presentation compelling, speakers appear polished & confident.
Presentation Organization	Organizational pattern (specific intro & conclusion, sequenced material within the body, & transitions) is not observable within the presentation.	Organizational pattern (specific intro, conclusion, sequenced material within the body, & transitions) is intermittently observable within the presentation.	Organizational pattern (specific intro, conclusion, sequenced material within the body, & transitions) is clearly & consistently observable within the presentation.	Organizational pattern (specific intro, conclusion, sequenced material within the body, & transitions) is clearly & consistently observable & makes the presentation cohesive.

Appendix C: Questions used in this EME study, as presented originally in Guay et al. [24]**.**

Why are you currently engaged in this activity?
1. Because I think that this activity is interesting
2. Because I am doing it for my own good
3. Because I am supposed to do it
4. There may be good reasons to do this activity, but personally I don’t see any
5. Because I think that this activity is pleasant
6. Because I think that this activity is good for me
7. Because it is something that I have to do
8. I do this activity but I am not sure if it is worth it
9. Because this activity is fun
10. By personal decision
11. Because I don’t have any choice
12. I don’t know; I don’t see what this activity brings me
13. Because I feel good when doing this activity
14. Because I believe that this activity is important for me
15. Because I feel that I have to do it
16. I do this activity, but I am not sure it is a good thing to pursue it

Coding for type of motivation for each question number:
Intrinsic motivation: Items 1, 5, 9, 13
Identified regulation: Items 2, 6, 10, 14
External regulation: Items 3,7, 11, 15
Amotivation: Items 4, 8, 12, 16.

The Likert scale is as follows: 1: corresponds not at all; 2: corresponds a very little; 3: corresponds a little; 4: corresponds moderately; 5: corresponds enough; 6: corresponds a lot; 7: corresponds exactly.