Engineering Educators Bringing the World Together
2025 ASEE Annual Conference & Exposition
Palais des congrès de Montréal, Montréal, QC • June 22–25, 2025
Paper ID #45983

How effective is a ”Cheesy” setting for Student Academic Success? Setting the table for a memorable lesson. . .

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How effective is a "Cheesy" setting for Student Academic Success? A Case Study by setting the table for a memorable lesson…

Abstract

Traditional classroom settings, while familiar, often fail to captivate students, especially when teaching broad engineering concepts to introductory level engineering undergraduates. To address this challenge, the authors developed an innovative learning experience set in a staged pizzeria, complete with red-and-white checkered tablecloths, bistro lighting, swanky background music, and fresh cooked pizza for the students. This immersive environment transforms a standard lesson into an engaging, hands-on exploration of energy and power concepts, tying course material to a relatable and memorable context. Students collaborate to estimate the power demand of pizzeria equipment, calculate the energy required from a generator, and compete to estimate fuel consumption, connecting theoretical engineering principles to practical applications— all while enjoying freshly baked pizza. This unique educational setting builds on the Department of Civil and Mechanical Engineering's (CME) reputation for using creative, interactive lessons to maintain student interest, scaffold student learning in memorable events, and improving conceptual understanding. By integrating problem-solving activities into a collaborative and dynamic environment, such as escape rooms and live demonstrations with chainsaws and blowtorches, the program aims to foster active engagement and holistic comprehension of course objectives. The "Boodler's Pizza Shop" lesson represents the latest effort to tie multiple learning objectives together through an experience that appeals to both logic and emotion. This paper details a study that evaluates whether these efforts translate into measurable improvements in student learning outcomes. Key metrics include individual performance on homework, timed assessments, and student surveys. The investigators seek to understand whether enhanced knowledge retention is worth the costs in terms of additional resources (Facilities, supplies, faculty time) and potential curriculum tradeoffs. This research aims to assess the broader impact of active and collaborative learning experiences in unique settings. By exploring the intersection of setting, activity, pedagogy, and student motivation, this work contributes to the development of innovative teaching strategies that enhance both student engagement and performance. The findings will help refine future course and lesson designs, ensuring that such efforts provide meaningful value across diverse learner populations.

Introduction

At every level of education, one characteristic of a masterful teacher is the ability to keep the material engaging, promoting learning, and maintaining engagement. Joseph Lowman states that "college classrooms are fundamentally dramatic arenas in which the teacher is the focal point, like the actor or orator on stage." [1] Few experienced educators will deny this statement, striving to prepare activities and master material such that each lesson is impactful and educational. That said, the actor is not the only consideration in a masterful performance; a beautiful setting, and deliberate blocking (movement in the space), and especially bringing the audience (students) into the scene as key actors in their own education can deliver a highly impactful educational experience. While a conscientious instructor can enhance the student experience using these techniques, it is likely not feasible for every lesson, but this break from the traditional setting has value and magic in its capacity to hold the students' attention while scaffolding key knowledge for the students' own actions within the space. This is not a new way to capture the students' attention. Off-beat lessons have long been part of a teacher's bag of tricks, but a change in delivery and interest can capture the students' attention, leading to deeper engagement with the material, higher attendance rates, and longer lasting interest in the subject matter [2]. This change in scenery and delivery style from the traditional rhythm can break the monotony of the day-to-day classroom. This creates a "significant learning experience" which will result in something highly memorable to the student that could remain relevant to their lives through more than just a single lesson or course. Unique or exciting experiences can engage students, raise energy levels for everyone in the classroom, and strongly support desired learning outcomes [3]. As educators in engineering, placing our course material into real contexts carries considerable value for the student beyond that hour or day or week, reaching towards design and real-world impacts that the student contemplated when signing up for an engineering course of study. Typically, we do this theoretically by stating the application through a case study of a scenario in discussion alone. This is an invaluable practice; relating course content to real-world applications motivates students by providing relevance to the topics at hand and reinforcing the value of problem solving or technical problem identification [4]. While in some rare instances a field trip or site visit is feasible, these on-site visits to share the industry with students are often hampered by administrative or logistical restrictions (time, money, resources, etc.) and become difficult for the instructor and institution to sustain. The classroom experience described herein is intended to bring some of the reality of being on a site into the classroom, but also to transform the space into a surprising and more engaging place for the students, much as a theatrical set designer seeks, through simulation, to transport the action to a new place. The activity was also designed to be a principally self-guided exploration, and to some degree competition, for students working in groups; to succeed in the experience, they must manipulate course content and information presented to generate new links and ideas within the content, an approach shown to lead to better results than simple identification or recall[5]. The instructor team attempted to synthesize many different techniques to improve student engagement, but this paper will focus on the setting for this case study. Since executing the enhanced lesson that is Boodler's Pizzeria requires considerable effort by the instructor team, a key question remained - how effective is this endeavor in terms of making the course content memorable and applicable? Student scores across homework assignments, mid-term exams, and final grades were analyzed to determine if the effort improved student learning.

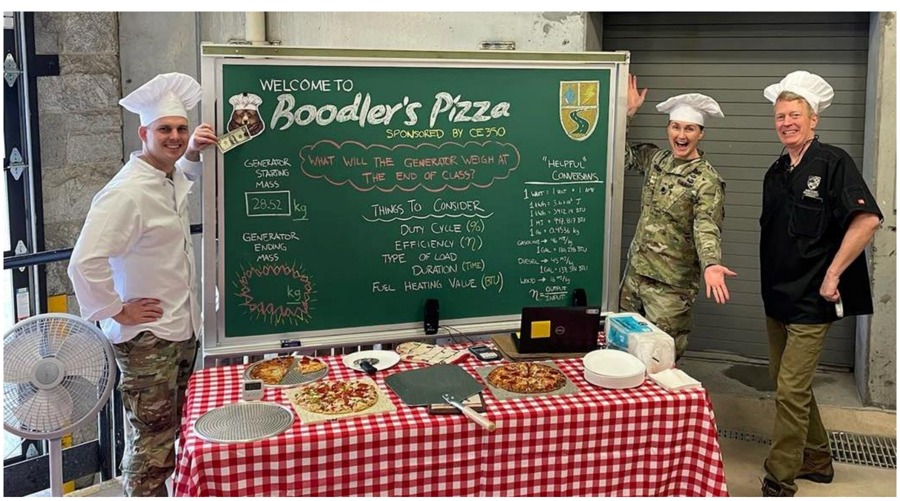


Figure 1: Kevin Scruggs, Erin Duhon, and Ledlie Klosky at the Boodler's Pizza Grand Opening prior to the first execution of the lesson

The Value of Collaborative Learning

Researchers and educators have recognized the value of group work and collaborative problem solving as an effective way of learning engineering concepts that inherently prepare young engineers for what they will experience as practicing professional engineers [6]. Mercier et al. highlight how collaborative learning differs from cooperative learning, or when team members learn cooperatively by dividing the task into different elements and then building upon each other's results to accomplish the overall task. In the Boodler's Pizzeria Case Study, students learn through collaboration by developing knowledge through shared performance of the learning activities. Mercier et al. emphasize the value of collaborative learning in engineering education as it increases student engagement, particularly from students who may feel underrepresented or less competent in more traditional classroom methods such as drill problems or memorization. Students taking the CE350 - Infrastructure Engineering course at the United States Military Academy come from a variety of educational experiences and competencies, with many students feeling ill-prepared for the rigor of engineering coursework due to a lack of higher-level math and physics prerequisites and competencies. This course is the second in a sequence of three engineering courses required to graduate; as such, many within the student population are not engineering majors, or even STEM majors in many cases. Underrepresented populations might feel alienated with traditional classroom methods, and collaborative learning activities provide a space where they feel more comfortable contributing to the group work [7]. Students experience a more favorable learning environment when they feel their contributions have value and thereby can better achieve their learning outcomes. Research indicates greater student success in achieving learning outcomes through collaborative methods over lecture-based methods [6]. In this case study, the students collaborate in a unique, fun learning activity. It is a low-threat environment, meaning that students can freely contribute to the group work, even make mistakes, without anxiety regarding the result.

Creative Teaching, Teaching Creativity

Practicing professionals stress the importance of creativity in addressing complex problems. Literature asserts that creativity in the classroom fosters creative students [8]. A classroom favorable to developing creativity is one that promotes social interaction, reduces stress, generates attraction and interest, and elicits positive emotions. While many educators claim that the function of adding the 'A' (the Arts) to STEM (STEAM) is in developing creativity, literature concludes that whether STEM or STEAM, the program should encourage cooperative work, the resolution of real-life problems, and have relatable utility for daily life to have a positive impact on student creativity. Researchers have suggested methods for teaching creative problem-solving in small groups. Common across these methods is the idea of placing students in realistic, ill-defined, complex, and meaningful problems that have no obvious or correct solution [9]. Faculty at the Academy teach energy infrastructure and power demand concepts in a traditional classroom environment, writing notes on boards for students to copy, sprinkling in a question here and there, and reviewing example calculations – a fairly unimaginative approach. To solidify the content, the instructors take a more creative approach by physically transporting the students out of the classroom and to 'Boodler's Pizzeria' (perhaps a loading dock of the engineering building or an alternate teaching space that is available) to apply fundamental energy principles to determine the shop's power demand. Placing students in a realistic 'out of the classroom' environment where they apply meaning to book-learned concepts allows students to deepen their understanding of the concepts, and in effect, feel less intimidated by the technical content. Often a barrier to creativity in technical education, students can feel anxiety when presented with a problem with no formulas or direct guidance on how to complete the work [9]. The pizza shop activity seeks to lessen that anxiety through small group work and a fun learning environment that was designed to build upon previous in class examples and aid in the completion of graded assignments.

Research indicates that students learn creativity through hands-on activities [10]. Soomro et al. define makerspaces as creative learning environments where individual or groups of students explore, design, play, tinker, collaborate, inquire, experiment, solve problems and invent. In STEM fields, makerspaces provide means in which students can apply learned concepts in a hands-on way and enable practice and use of creative problem-solving. The literature highlights several approaches for implementing hands-on learning spaces to foster creative thinking. The first approach is to implement a makerspace pedagogy that joyfully engages students in learning [10]. This approach is evident in the Boodler's Pizzeria Case Study through the details – the checkered tablecloths, write-on menus and crayons, and instructors in chef's hats and jackets – all to elicit excitement and joy from the students. Another approach is to encourage interdisciplinary collaboration, which contributes to knowledge sharing and offers multiple solutions, thus encouraging a culture of co-creation. Working in the physical and social environments is another approach and motivates students to become innovative and creative [10]. The Case Study uses this approach through individual 'dining' tables (or makerspaces) where small groups work together to determine the power demand while also communicating with each other to better understand the problem. Encouraging students to imagine is another approach highlighted in literature. The Case Study aims to encourage students to imagine themselves running the pizza shop and using their technical skills to determine a basic requirement of the shop, its power demand. The Boodler's Case Study leverages the 'learning-by-doing' method to place students in a hands-on environment where they can physically measure voltage, wattage, duty cycle, energy, and more to creatively think through how to determine the power demand needed to bake their pizza (and then eat it).

Figure 2: Cadets utilizing the Power Demonstrator Board to aid in the problem-solving component of the Boodler's Pizzeria exercise.

The instructor team did not develop a new process or idea when hoping to transform an academic space into “Boodler’s Pizzeria” for a lesson but instead built upon ideas and concepts presented in many undergraduate classrooms. The following examples are fundamentally based on the American Society of Civil Engineers (ASCE) Excellence in Civil Engineering Education (ExCEEd) teaching model, focused on hands-on learning supported with physical models and demonstrations, which allows students to better conceptualize, understand, and retain the material presented in the classroom [11]. The only limitation in maintaining student attention is the creativity of the instructor. The U.S. Military Academy (USMA) Department of Civil and Mechanical Engineering (CME) has a long history of in-class demonstrations and active learning activities to place fundamental concepts in context. In the introductory statics course, a device called the “Free Body Diagram Demonstrator” is used to show the importance of a well-developed free body diagram. The magic of the device is that the forces are physically removed by various tools (chainsaws, blowtorches, and grinders for example) [12]. In the dynamics course, a flaming golf ball has been used to demonstrate the properties of rigid body kinematics, similar to the scene in Gladiator where catapults fire flaming pots of oil onto an enemy force [12]. Even taking students out of the classroom and into an escape room has been tried in multiple courses at USMA with great success. This escape room is used to serve as a course review that ties all the relevant course topics through a series of puzzles to be solved. This has proven effective in a mechanics of materials course as well as a course on reinforced concrete [13, 14]. The previous examples increased in the complexity and effort to develop and implement for an instructor (or instructor team), simplicity can be effective (even cost effective) as outlined by “the Compression Cadet” to demonstrate a statically indeterminate system or by the “Shear Demonstrator” which can show differences in single or double shear [15]. Hands-on demonstrations are vital to student understanding, and functional representations of difficult-to-understand concepts like power, energy, and electricity are needed. The “Power Demonstrator Board” has been effective in peeling the walls back from standard electricity distribution practices so students can better understand how their residences or small-scale infrastructure receive electricity [16]. In essence, these hands-on demonstrations help bridge the learned, and sometimes abstract, concepts with the application of these concepts in “real life.” All these demonstrations or training aids are simple enough to ensure there is an understanding of the concept at hand. That is central to each example Dr. Emerson notes in her use of “Engineering Toys” in the classroom. The beauty of each of her toys is scaled and clear labeling to demonstrate the concept at hand (deformation, shear, bending, torsion, etc.) [17]. The goal of every instructor is to improve student understanding. This case study has been designed and built upon each of the examples presented before to make learning fun, interactive, memorable, and most importantly, effective.

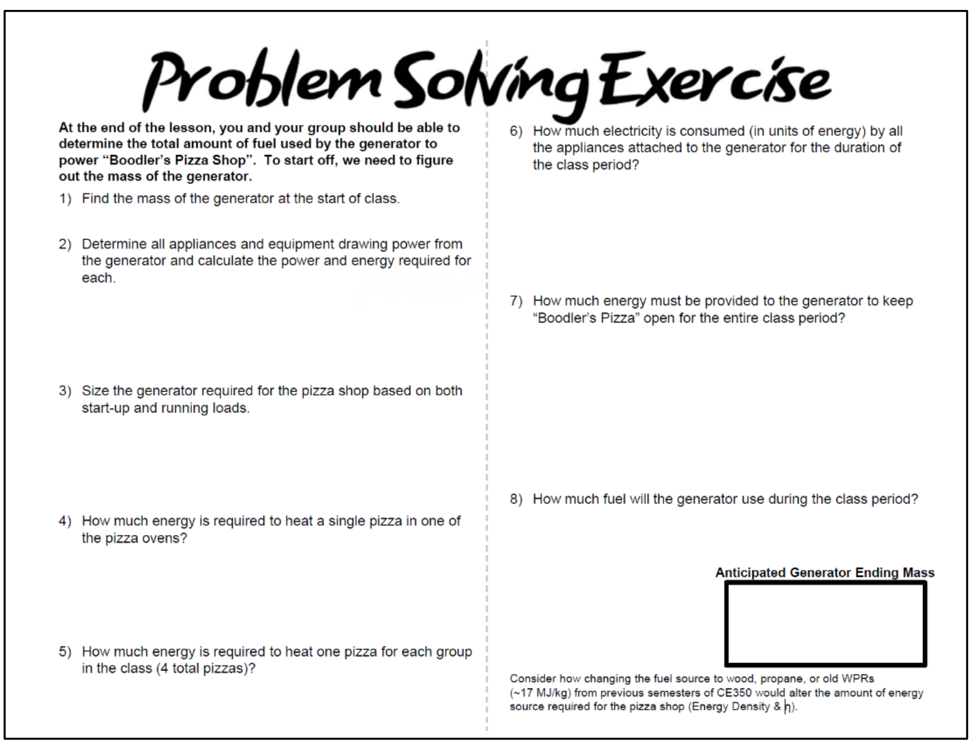
Case Study Design

The nexus of Boodler’s Pizzeria was a course assessment following a year of teaching the course and one instructor made the comment, “Can we turn the classroom into a pizza shop?” At first this seemed unrealistic, but after some thinking and resourcing it became an experiment in teaching effectiveness. The goal was to build upon the in-class examples regarding power and energy and to show how each lesson objective was nested into the operation of a mobile pizza shop. Through a series of assumptions, investigations, calculations, or use of engineering judgment the students would be able to calculate how much fuel was needed to operate all the associated equipment for the pizza shop at the end of the 55-minute lesson.

The technical progression was straightforward and logical. The general flow of problem solving can be seen below in Figure 3. This guides the students' progression through the lesson and serves as a time marker for the instructor as well. The students should be able to complete the left half of the sheet in the first 20 minutes, then complete with the remainder of the sheet before the end of the lesson. The first step, finding the starting mass of the generator, is the only portion of the exercise that is logically out of order. Placing the generator on the scale to start the lesson is only to get the known starting point of fuel (gasoline) within the generator to compare after the pizzas have finished cooking. Each group then follows the outlined problem-solving process:

- Identify the equipment drawing power from the generator.
- Determine the minimum generator size.
- Determine how much energy is required to cook one pizza in the oven.
- Determine the energy required for all four pizzas to cook in the oven.
- Determine the total energy load by all the equipment for the duration of the lesson.
- Determine the efficiency of the generator.
- Determine how much fuel must be in the generator to run the pizzeria.

Ultimately, the groups had to estimate the final mass of the generator at the end of the session based on their calculations. The group that got the closest was awarded the coveted "Pizza Bear" sticker and some bonus points for the effort. This process parallels a similar exercise required in a course problem set due after the completion of the exercise. It is typical to have questions on the midterm that are similar to one or two of the problem-solving steps. This exercise links course content with graded requirements and another opportunity to practice the course material in a low-threat environment in established small team groups that they use elsewhere in the course.


Problem Solving Exercise

At the end of the lesson, you and your group should be able to determine the total amount of fuel used by the generator to power "Boodler's Pizza Shop". To start off, we need to figure out the mass of the generator.

1) Find the mass of the generator at the start of class.
2) Determine all appliances and equipment drawing power from the generator and calculate the power and energy required for each.
3) Size the generator required for the pizza shop based on both start-up and running loads.
4) How much energy is required to heat a single pizza in one of the pizza ovens?
5) How much energy is required to heat one pizza for each group in the class (4 total pizzas)?
6) How much electricity is consumed (in units of energy) by all the appliances attached to the generator for the duration of the class period?
7) How much energy must be provided to the generator to keep "Boodler's Pizza" open for the entire class period?
8) How much fuel will the generator use during the class period?

Anticipated Generator Ending Mass

Consider how changing the fuel source to wood, propane, or old WPRs (~17 MJ/kg) from previous semesters of CE350 would alter the amount of energy source required for the pizza shop (Energy Density & η).

Figure 3: Student handout guiding them though the problem-solving exercise.

This completed the technical portion of the lesson, which achieves all the lesson objectives to support the course goals for the students. A polished instructor can execute this as a laboratory exercise in a classroom with extreme clarity and understanding. However, performance can be enhanced through the setting, which is the magic of the exercise. The teaching team wanted to maximize the cheesiness of the setting by going over the top in replicating a stereotypical Italian American pizzeria. The team went to the lengths to identify key items to include checkered white and red tablecloths, haphazardly hung bistro lights, a squeaky fan in the corner to spread the scent of hot pizza throughout the room, a "signed" picture of an old celebrity expressing familiarity, the first dollar ever earned framed on display, and most functionally usefully to the students a "kids' menu" with puzzles to keep the students engaged. The front of the kid's menu can be seen in Figure 5, with a maze and word search but more importantly containing the lesson objectives for the exercise. This menu was accompanied by a pack of four colored crayons to enhance the nostalgia or to be the writing implement for the problem solving (which most students utilize). However, on the reverse of this menu is the actual problem-solving process as previously mentioned in Figure 3.

The administrative and logistical burden of the exercise is likely the most prohibitive aspect of the implementation of Boodler's Pizzeria. The team developed the technical requirements first, then identified and purchased the necessary equipment to run the exercise. The most cost-prohibitive equipment that would need to be purchased is the generator (although we repurpose an existing generator used in capstone applications) and the pizza ovens. If purchased for the sole purpose of this exercise, the cost would be ~$1,000 without the generator. Thankfully, we were able to repurpose some existing equipment and find some overlapping requirements that could utilize the equipment outside of the Pizzeria. The logistical burden is twofold: first, finding an available space that is suitable for teaching a lesson with tables and appropriate facilities, and second, one that is near an outside access point to run a generator safely without disturbing others nearby (except for the delicious smell of freshly baked pizza). We had first tried a loading dock in the engineering building successfully, but the acoustics and intermittent traffic was not

Figure 4: [Left] COL Hill weighing the generator at the end of a lesson; [Right] COL Hill ensuring the pizza is coming out perfectly while students solve the problems.

ideal. Then the pizzeria was moved to an available "classatory" with ample space, better acoustics, and access to an exterior roof (we did have to trade classrooms for a single lesson, with minimal impact to both courses). Neither the administrative nor logistical burden was too difficult to overcome but required coordination and communication to ensure all impacted parties understood the impact of the exercise.

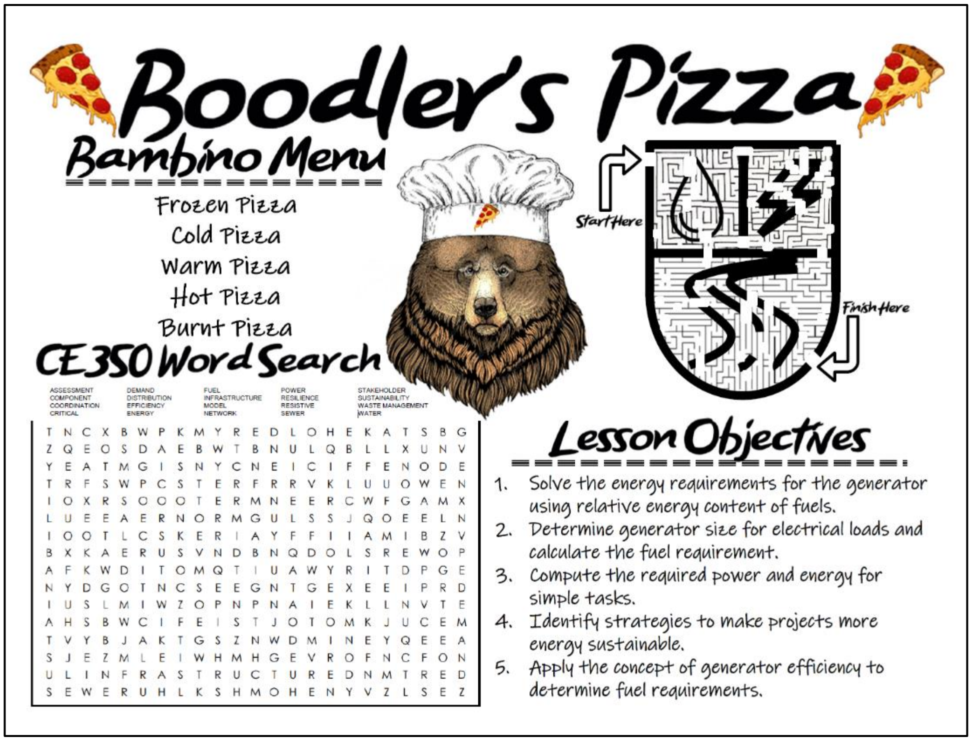


Figure 5: The front of the kid's menu stating the lesson objectives.

Results

Before determining if the effort and resources required to set up and execute Boodler's Pizzeria every semester is worth it, we must assess the value it has resulted in for the students. The course, CE350 – Infrastructure Engineering typically enrolls ~100 students every semester (with spring semesters being slightly larger enrollment than fall semesters). In an attempt to balance the semesters over as large a data set possible, the analysis was conducted over four consecutive semesters immediately before implementing the pizzeria and the four since the exercise was introduced. Attempting to minimize the changes to individual student demand both within the course (as course change over time) as well as competing demands outside the course in the overall curriculum. Five critical data points were analyzed for this purpose; Problem Set 3 (the problem set for the Energy Block), the energy section on Midterm #2 (focused on generators, fuel consumption, and energy usage), Midterm # 2 in total, the energy section of the Final Exam (remains unchanged year over year), and the overall course grade. The three data points missing were unable to be validated based on the records available to the authors. The compiled averages for each term and for the before and after groups can be seen below in Table 1.

Table 1: Course averages for each key critical data point for student achievement both before and after the implementation of Boodler's Pizzeria.

Academic Term (# of Students)	Course Average Scores (%)				
	Energy Problem Set	Energy Section Miderm 2	Total Midterm 2	Energy Section of Final Exam	Total Course Grade
Before Bodler's Pizzeria Implemented					
AY21-2 (152)	85.1%	86.2%	83.6%	84.9%	87.5%
AY22-1 (118)	-	87.3%	87.8%	79.9%	88.2%
AY22-2 (111)	90.5%	84.6%	84.8%	85.0%	88.3%
AY23-1 (112)	88.9%	72.3%	73.8%	73.3%	85.8%
Average	**88.1%**	**82.6%**	**82.5%**	**80.7%**	**87.5%**
After Bodler's Pizzeria Implemented					
AY23-2 (90)	86.3%	83.5%	89.2%	80.9%	89.0%
AY24-1 (117)	85.2%	88.8%	82.7%	89.5%	86.9%
AY24-2 (112)	83.3%	90.4%	81.3%	83.6%	87.5%
AY25-1 (130)	-	-	87.5%	87.0%	86.8%
Average	**85.0%**	**87.6%**	**85.2%**	**85.2%**	**87.6%**
Change	**-3.1%**	**5.0%**	**2.7%**	**4.5%**	**0.1%**

At first glance, the results seem mixed and unclear. Initially, there is a degradation of performance on the Problem Set immediately following the exercise by more than 3%. This is concerning as the exercise has a problem that parallels this exercise nearly identically. Although there are a total of four problems to solve on this problem set, the drop in performance cannot be directly linked to this case study. However, after closer inspection, there appears to be a clear benefit to the exercise. The retention of the material and problem-solving process is clearly demonstrated in the Midterm #2 and the course Final Exam sections. Weeks later, the students perform 5% better on Midterm #2 when solving problems relating to generators and energy usage. Similar results are shown with student performance on the course final exam, as students perform 4.5% better on those topics over a month after the exercise is conducted. The other two data points that do not show drastic changes in student performance are not concerning, as there are too many other topics covered in the remainder of Midterm #2 or the course overall to expect large impacts from this single exercise from a single class session.

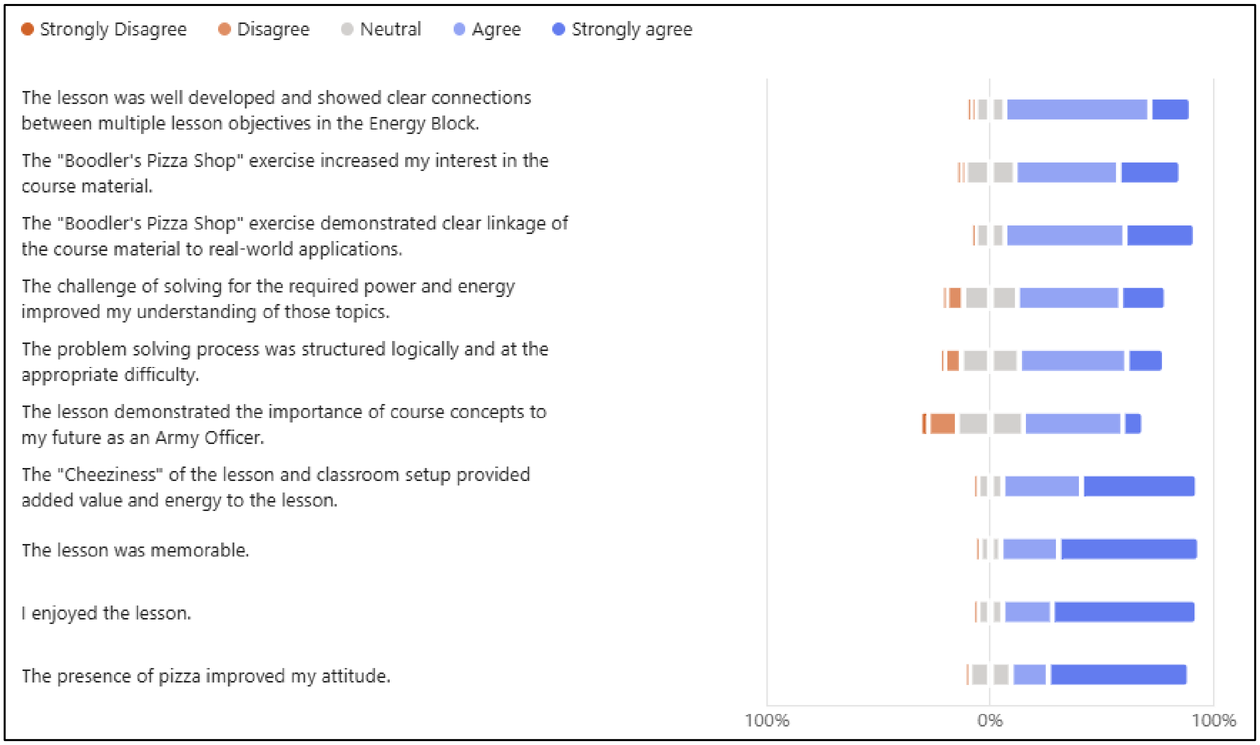


Figure 6: The qualitative student feedback from the post-exercise survey gauging student sentiment on a Likert Scale. The results display a total of 54 responses out of over 200 students, as students opted out of releasing the responses for research and publication.

Following the first two semesters when Boodler's Pizza was implemented (AY23-2 and AY24-1), the authors conducted a survey of the students to gain qualitative feedback. The goal of the survey was twofold: first, to determine the interest and sentiment the students had regarding the exercise, and second, to identify any points of friction to continue to improve and streamline the lesson for more effective offerings semester to semester. The student sentiment was gauged on a Likert Scale from Strongly Disagree to Strongly Agree. The results of the survey are shown below in Figure 6.

Based on the survey results, overwhelmingly, the students were satisfied with the execution of the newly developed lesson. The responses showed a perceived benefit by the students shortly after the exercise was completed, for most students. Some were dissatisfied with the complexity of the problem-solving, the logical progression, and the application to material outside of the course. The authors suspect these respondents were lower performers academically or students less interested in engineering topics who were forced to take the course. As shown in Figure 6, the three most positive responses in the survey were that the lesson was memorable, enjoyable, and that having hot pizza in class is great for student attitude.

In the survey, students were able to provide free response feedback to the instructor team. Some of the more detailed and eloquent comments are noted below:

> "Literally one of the best lessons of any class I have had at West Point. Thank you. It is very easy to tell that you really care about your students and want them to learn in engaging ways."

> “I liked how low stress the structure of the lesson was. It was challenging but also engaging. I felt as if I was learning the course concepts, without dealing with the stress of a graded assignment.”

> “I think everything is a sustain, I loved the atmosphere, and I thought that it was a great way to bring a real-world problem to the fore. Almost like acting out a problem set question or in-class exercise. I loved the restaurant theme and of course the crossword [on the menu].”

> “I appreciated the effort to make the lesson both memorable and educational.”

Inspired by the effort to create the lesson, some innovative ideas and constructive feedback were provided by two students to make it better the next time around:

> “I wish you could involve the [students] with actually making the pizza and putting it in the oven! Just another way to make the class even more engaging than it already was.

> “I would have liked to see more of an Army application if possible. Maybe having us do the same thing but in a field TOC outside of Mahan Hall or up behind Lusk [reservoir on campus], similar to the problem set question but in real application.”

All of the feedback leads the instructor team to say the effort was worth it as the students are engaged with the material. Students even invested in the lesson itself by offering suggestions to improve to be more relevant to the coursework, their futures, or just be more involved and hands-on overall. Ultimately, any lesson where you can enjoy some hot pizza and solve some engineering problems in a new setting is better than a traditional lecture.

Conclusion

The goal of this study was to determine if the implementation of a unique single lesson that is outside the standard classroom delivery was worth the effort and made any impact on student outcomes. Anecdotally, the interactions with students after the exercise in the following weeks and even semesters are overtly positive. The exercise is clearly highly memorable and sticks with them in their memory for the unique delivery of engineering content. As any performer would be pleased to have their performance be remembered long after the show, as an instructor, this is highly impactful and worth the effort. This is due to both the ability to be engaging as an individual, but also the value of the new setting and props during the delivery.

Quantitatively, this exercise helped students perform better in the long term relative to the course without the Boodler’s Pizzeria exercise. Students performed 5% better on the sections of the midterm dealing with similar content weeks later and 4.5% better on the cumulative final when dealing with similar content over a month later. The impact of better student outcomes and improved student performance is demonstrated across the two different populations. Given some limitations in the sample size and other confounding factors, the trend has shown beneficial results for the students, but a drastic change to a delivery method does not guarantee improved student outcomes. Qualitatively, the students both appreciated and enjoyed the exercise and change of setting. Anecdotally, the authors notice a different energy in this lesson with excitement, enthusiasm, and giddy energy as they are transported out of the formal educational setting into the Pizzeria. Even semesters later, students comment about this lesson and the memory of the process and change of the traditional setting. This lesson has become a staple in the course and is even well known to other inhabitants of the building as a result of the ever-present hot pizza smell through the stairwells and hallways. The authors vehemently believe the effort to develop, resource, and implement Boodler's Pizzeria each and every semester does benefit the student in terms of achievement, but also through an improved attitude and outlook on the course concepts.

Future Work

This case study serves as a great foundational exercise, but each semester, minor adjustments are made. The most prominent discussion amongst the teaching team is the format and prescriptiveness of the problem-solving process. A study could be undertaken to assess the value of the highly guided problem-solving process as shown in this version, or a more open-ended document only asking for the total mass at the end, with fewer intermediate gates. This could be assessed in different student populations based on performance on the problem set as well as the midterm. Another possibility for more study and improvement would be to enable some additional engineering analysis by the students to determine how much equipment the generator can handle before starting the exercise, at the risk of overloading the generator and failing to provide pizza in a timely manner to the whole class. This would place the students under a time restriction early in the lesson and apply the course content to ensure the pizzeria has sufficient power to fully function.

Acknowledgements

The authors would like to thank COL Scott Katalenich and the rest of the department leadership for enabling and supporting the idea of transforming a classroom into a pizzeria. This is a lot of effort and overhead to execute, but not a single doubt or restriction was ever placed on the process. CME at West Point has for many years been focused on hands-on and active learning techniques and pushing the envelope for cadet engagement. This is yet another resounding example of making learning interesting, fun, and applicable every single day in the classroom.

The authors would like to acknowledge the contributions of their students who participated in the study. This study was approved by the USMA Institutional Review Board (CA-2024-15).

Disclaimer

The views expressed in this work are those of the authors and do not necessarily reflect the official policy or position of USMA, the Department of the Army, the Department of Defense, or the U.S. Government. Reference to any commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, neither constitutes nor implies endorsement, recommendation, or favor.

[a] [b] [c]

Figure 7: [a] Dr. Klosky sharing his excitement for the exercise as Cadets diligently solve the problems in the "classatory"; [b] Cadets working through the problem solving on the loading dock; [c] Boodler's First Dollar and Frank Sinatra prominently displayed on the instructor help board at Boodler's Pizzeria

References

[1] Lowman, Joseph, *Mastering the Techniques of Teaching*. San Francisco: Josey-Bass, 1995.

[2] Shyr, W. J. (2010). Experiences with a hand-on activity to enhance learning in the classroom. *World Transactions on Engineering and Technology Education*, *8*(1), 86-90.

[3] Fink, L. Dee. *Creating significant learning experiences: An integrated approach to designing college courses*. John Wiley & Sons, 2013.

[4] Cunningham, Christine M., and Cathy P. Lachapelle. "Designing engineering experiences to engage all students." *Engineering in pre-college settings: Synthesizing research, policy, and practices* 21.7 (2014): 117-142.

[5] Menekse, M., Stump, G. S., Krause, S., & Chi, M. T. (2013). Differentiated overt learning activities for effective instruction in engineering classrooms. *Journal of Engineering Education*, *102*(3), 346-374.

[6] Mercier, Emma, Molly H. Goldstein, Preethi Baligar, and Robin Jephthah Rajarathinam. "Collaborative Learning in Engineering Education." In *International Handbook of Engineering Education Research*, by Aditya Johri, 402-432. Routledge, 2023.

[7] Prabhu, Neha, Michelle Perry, Renato F. L. Azevedo, Lawrence Angrave, and Suma Bhat. "Study Partners Matter: Impacts on Inclusion and Outcomes." *Virtual Conference.* American Society for Engineering Education, 2021.

[8] Aguilera, David, and Jairo Ortiz-Revilla. "STEM vs. STEAM Education and Student Creativity." *Education Science*, 2021.

[9] Lavonen, Jari, Ossi Autio, and Veijo Meisalo. "Creative and Collaborative Problem Solving in Technology Education: A Case Study in Primary School Teacher Education." *The Journal for Technology Studies*, 2004: 107-115.

[10] Soomro, Sohail Ahmed, Hernan Casakin, Vijayakumar Nanjappan, and Georgi V. Georgiev. "Makerspaces Fostering Creativity: A Systematic Literature Review." *Journal of Science Education and Technology*, 2023.

[11] A. C. Estes, R. W. Welch, and S. J. Ressler, "The ExCEEd Teaching Model," *Journal of Professional Issues in Engineering Education and Practice,* vol. 131, no. 4, pp. 217-312, 2005.

[12] Hanus, Joseph, and Allen Estes. "Keep them on the edge of their seats: Bringing drama into the engineering classroom." *2002 Annual Conference*. 2002.

[13] Rocha, Brett, Kevin Francis McMullen, and Michael Rocha. "Say yes to the stress: Escape rooms in civil engineering classrooms." *2023 ASEE Annual Conference & Exposition*. 2023.

[14] Rocha, Brett, and Kevin F. McMullen. "Mechanics Escape Room: Escaping the Monotony of Solving Problems." *Journal of Civil Engineering Education* 150.3 (2024): 05024004.

[15] Klosky, James Ledlie, and Reid Vander Schaaf. "Hands On Demonstrations In Introductory Mechanics." *2002 Annual Conference*. 2002.

[16] Scruggs, Kevin Taylor, Scott M. Katalenich, and James Ledlie Klosky. "Infrastructure Live! A Hands-On Electric Power Classroom Experience Requiring a Single Rolling Chalkboard." *2024 ASEE Annual Conference & Exposition*. 2024.

[17] Emerson, Tonya. "Enhancing Students' Understanding Of Key Engineering Concepts Through The Use Of Civil Engineering Toys In The Classroom." *2002 Annual Conference*. 2002.