The Use of Food in the Classroom to Increase the Performance of Students in an Engineering Technology Course

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Smaller commuter and regional campuses often have a high percentage of students who are working full-time jobs or have significant familial commitments outside of the classroom. Because of this, there is a chance that student schedules may not have allowable time for students to eat or even have access to nutrition throughout the average workday. The research team, after observing that students in course sections around noon were underperforming compared to other sections in the previous year, decided to study the impact that providing access to food during class time would have on student performance and overall well-being in the course. This led us to two research questions in particular: (1) What percentage of students at a regional campus are hungry in this post-COVID-19 environment? (2) What are student perceptions of having food available to them during class?

To study this, food was purchased and brought into the classroom for students to have while working as teams during project workdays in a first-year engineering technology (FYET) class. A variety of different options were brought in including candy, doughnuts, savory snacks, and a full meal were provided once throughout the semester to each of the four sections. The course had four sections on two different days at four different times of day ranging from 9:00 am – 3:00 pm. Instructor observations were recorded, and a survey was used to gauge how often students have food and what type of food they consume. Additionally, students were asked what they preferred, if the different provided options were enough, and what kind of food should be considered for a full-scale study. From a financial standpoint the cost increased as the meals did, but so did the nutrition and level of distraction. More students were willing to take food when dietary restrictions were considered. Not everyone was willing to consume candy and certain snacks, but lower costs allowed for increased diversity in food.

The initial awkwardness could be mitigated with small, prepackaged items like candy and snacks where full meals took a few people to go through the line before the entirety of the class would. When excess food was purchased, there were a small number of students who took home a handful of bananas, or a box of muffins for later. Overall, the food in the classroom was appreciated by students, and after the initial awkwardness of eating during class, the food allowed students to relax. Students were observed to be more conversational and engaged but also tended to get off task. Future work hopes to take these findings and continue to understand the role that hunger plays in the performance of students in an environment like the one in this study and beyond.

Introduction

There are some needs so fundamental that they must first be met for individuals to be motivated to continue towards higher goals. We know that the first line of needs that a person must have met are their physiological needs such as water, food, and shelter long before they can begin to worry about success in a learning environment [1]. In recent years, due to the COVID-19 pandemic, food insecurity and hunger have been on the rise in the United States [2]. This increase in food insecurity will impact those from low socioeconomic backgrounds the hardest, many of whom may be more likely to end up at a smaller commuter campus, community college, or a regional campus if they can even find a pathway to college. Our exploratory study begins to try to understand the role of food in the classroom within this larger context.

Purdue University Fort Wayne (PFW) is a regional campus where traditionally many of the students commute to campus or are working to help fund their education. Additionally, nearly half of the campus is made up of first-generation students [3]. These students are often incredibly hard-working but often have immense challenges that can make retention and persistence through the entire degree difficult [4]. Because of the recent spike in hunger across the country, and the fact that these students may be hit the hardest by the increases in food insecurity, our study looks to explore two exploratory questions to understand if food insecurity may be an issue in the PFW classroom: (1) What percentage of students at a regional campus are hungry in this post COVID-19 environment? (2) What are student perceptions of having food available to them during class?

Methods

Course Information & Intervention

Food was purchased and brought into an Introduction to Engineering Technology course during four project workdays across the semester. The course had four sections: 1. MW 9:00 am, 2. MW 10:30 am, 3. TTH noon, 4 TTH 1:30 pm. The food options varied across the semester with each of the following options being used for the four project workdays: candy, doughnuts, snacks/chips, full meal. The full meal was pizza and fruit for all three sections except the 9:00 am section. Pizza was not available at that time of day, so a large breakfast spread was brought in instead. Foods that needed quick refrigeration, drinks, and nuts were avoided. A gluten-free option was included for the full meal day. The intervention was chosen to understand student perceptions around food availability and student hunger. The authors acknowledge that a longitudinal study with long-term food options would be needed to address food insecurity.

Data Collection and Analysis

Observations by the instructor were recorded. In addition, a survey was given at the end of the semester to understand students' perceptions of food in the classroom. The survey was anonymous and bonus points were worth 1% of the total class grade. Students were allowed to put "I prefer not to answer" on any question they chose except on the first two questions which ensured they were older than 18 and in the School of Polytechnic. Responses of individuals under 18 and not part of the School of Polytechnic were removed from the dataset. The survey was analyzed after final grades were submitted. The survey questions are shown in Table 1.

Table 1: List of the survey questions considered in this study after the first two initial questions.

Survey Question	Type of Question
1. Which section were you in?	Multiple Choice
2. Why did you sign up for this section instead of the other five? Please also indicate if you have priority registration if you are willing. You can also enter "I prefer not to answer")	Open-ended
3. Are you a first-generation college student?	Multiple Choice
4. How are you paying for college? Select all that apply.	Select all that apply
5. How many credits are you taking this semester?	Multiple Choice
6. How many hours a week do you spend working at a job?	Multiple Choice
7. What is your expected grade in ET 106?	Multiple Choice
8. Do you get three full meals a day?	Multiple Choice
9. How often are you hungry during class?	Multiple Choice
10. How many days a week do you get at least 1-3 full meals?	Multiple Choice
11. If you are hungry during class or throughout the week, why is it? You can put "I prefer not to answer" if you choose to.	Open-ended
12. What type of food do you usually have? You can put "I prefer not to answer" if you choose to.	Open-ended
13. Of the food provided in class which was your favorite?	Multiple Choice
14. Did the food help you focus or distract you in the classroom?	Multiple Choice
15. Do you think having food during class had an effect on your class performance? If yes, please describe if it was positive or negative. Put "I prefer not to answer "if you choose to.	Open-ended
16. Of the food brought to class (Candy, Doughnuts, Snacks, Full meal) was any of them not enough to have an effect? Put "I prefer not to answer" if you choose to.	Open-ended
17. What other food should be considered? Put "I prefer not to answer" if you choose to.	Open-ended
18. Do you have any other feedback about food in the classroom and its effect on your overall well-being? Put "I prefer not to answer" if you choose to.	Open-ended

Survey results were analyzed in multiple ways. The multiple-choice questions were analyzed by looking at the frequency and then descriptive statistics via spreadsheet software were used to understand quantitative student responses. The selected all that applied responses were categorized into bins based on financial burden and the frequency for each was recorded. Open-ended questions 2,11,12,& 15 had themes pulled to make bins and the frequency of each was recorded. Question 12 allowed for one response to be recorded into multiple bins as many different foods were often listed. Key takeaways were pulled from questions 16-18. Finally, the average GPA for each section was found by Equation 1 from both the gradebook and survey.

$$Average\ GPA = \frac{\#A's*4+\#B's*3+\#C's*2+\#D's*1}{Total\ number\ of\ Responses} \qquad \text{Equation 1}$$

Finally, a one-way ANOVA test on the means of each section's final points received was performed in Microsoft Excel.

Results

Demographics

There were 108 students who finished the course. About ten students dropped the course during the first half of the semester. Of the 108 students, 84 students completed the survey with 14 of those students being removed as they were not in the School of Polytechnic. Of the

remaining 70 students the distribution of the responses in sections 1-4 are shown in Table 2. There was another section taught by another instructor and not part of the study.

All the percentages given are out of the usable number of responses with a max of 70 responses as the amount of "I Prefer Not to Answer" responses varied with each question. The demographic 33% first-generation and 69 of the 70 were full-time students. 45% of the students had no direct financial burden as the college was being covered by a given iteration of parents, financial aid, or scholarship. 52% of the students were directly responsible for a portion of college tuition and 3% were fully responsible for college through student loans or out of pocket. 64% of the students had a part-time job with 31% of students working 20 hours or more.

Grade Distribution and Section Enrollment

The idea for the study came from the previous year's observations where noontime sections performed the worst. So, it was thought that sections closest to lunch and breakfast would perform the worst. However, the average GPA for each section is given in Table 2.

Table 2: Average GPA for Each Section from the Survey and Actual

Section #	Time	Expected From Survey			Actual from Gradebook		
		Average GPA	Standard Deviation	Count	Average GPA	Standard Deviation	Count
1	MW 9:00 AM	3.05	0.802	18	2.43	1.345	28
2	MW 10:30 AM	3.15	0.587	20	2.48	1.326	29
3	TTH Noon	3.4	0.598	20	3.11	1.031	28
4	TTH 1:30 PM	3.25	0.622	12	2.78	1.043	23

As can be seen in Table 2 this was not the case. Also, none of the responses expected to receive a grade less than a C. The 14 that were not included were students from First-Year Engineering, juniors from Education, and high school students. 18 students received a D or F, and a majority of these students did not take the survey which may be why: (1) the first-generation percentage was lower than the campus average, (2) the level of financial burden was less significant, and (3) the number of students working was less than previous semesters.

Based on Table 2 it cannot be inferred that students being hungry was the cause for different section performances. Additionally, the one-way ANOVA test had a P-value of 0.27 which means that a difference in the means cannot be statistically claimed, and more data is needed to show the different section performances were statistically different. Thus, the data in Table 2 will be observed as trends to spark research questions for future work. Some of the other factors to consider were that section 1 filled up last and section 2 was added after section 1. The noon section filled up first and had the largest number of student-athletes. The majority of the 10

students who dropped came from section 4. It is suspected that a sizable percentage of these students were working more, had a larger financial burden, and/or were first-generation students as well. These observations suggested why the survey demographic was slightly skewed away from what was expected. Finally, the trends suggest that sections that fill up first are more likely to perform better with a hypothesis being that these students are more prepared or eager for college. This hypothesis can be tested in future work.

The prevalence of hunger in the classroom

The number of students being hungry was less than expected and the expected demographic skewness could be a cause. 50% of the students reported not having three meals a day with 16% of students reported being hungry during class most of the time. An additional 46% were sometimes hungry during class. 52% of the students reported not having a full meal at least one day a week. The main reasons for hunger were attributed to not having time or forgetting to eat. The next largest reason was students chose to skip meals. A few cited a lack of options or unhealthy choices from the cafeteria or food pantry on campus and money as potential barriers. 59 students listed what they eat with 17 mentioning cereal grain foods, 17 had a focus on protein-based foods, 10 stated fast food or snacks, 6 ate campus food, 7 ate with family or cooked, 7 mentioned fruits or baked goods, and 3 had sandwiches. The question analysis allowed for an overlap between responses. The main takeaway from the responses was that some did mention good or healthy food as a usual choice, but no one directly mentioned vegetables. Additionally, a large focus was on foods that were quick and easy to prepare.

The perceived impact and preferences of students

Students were asked about the food brought to class. 56% said the full meal was their favorite with only 5% choosing candy. 63% said the food helped them focus while 6% stated the food distracted them. 67% thought the food had a positive effect on their performance, 26% thought it had no effect and 7% thought it had a negative effect. The main negative complaints were other people's eating habits being distracting.

The students were asked if any of the food was not enough, and the consensus was that having something was appreciated. There were also concerns about the amount of sweets. The food brought in considered students who may have allergies but did not consider other health concerns. Students suggested drinks, healthier snacks, and foods such as vegetables, yogurt, trail mix, and dried fruit. The drink suggestion could result from drinking fountains being avoided in response to the pandemic. Finally, suggestions range from tacos and sandwiches to steak as well.

Knowing food would be provided in the classroom was appreciated by students and they stated that it showed their instructor cared about them, something that is integral to student motivation [5]. Additionally, it allowed them to spend more time on getting rest outside of class since they were going to be able to eat during class.

Instructor Observations

Student participation on project workdays increased when food was present. Students' preferences regarding the food provided were positively correlated with how much the food cost. However, the larger the cost and spread the more awkward it was for students to grab food. Students were more willing to partake if the food was spread out at each table. There were a

small number of students who took home extras. Surprisingly providing the breakfast spread was more filling, cheaper, and appreciated than having pizza delivered. It was clear some students would avoid eating high sugar foods, which also showed up in the survey. Students visibly relaxed more and became more conversational with their classmates while eating. However, the conversation tended to stray off-topic creating distractions for those trying to work.

Discussion

Impact on teaching and learning

The results of this study showed that food in the classroom may help students' overall well-being but can be a distraction if not managed properly. If done more frequently, it can improve their well-being and their grades as they are more likely to show up to class given the motivational and engagement advantages that come with students knowing they are walking into a caring environment [6]. Also, students in a morning class may have more time for sleep before class, which can also help their overall well-being. Food in the classroom does help students be more engaged overall despite the cited distraction concerns. Finally, it can potentially have the largest impact on first-year students who may be going from having a set meal and time provided for them in high school to having to provide it for themselves for the first time while juggling studying, classes, and work.

Future work

A larger scale study needs to be done across the entire campus to understand the causes for why certain sections of the same class underperform and if the differences are statistically significant. It was inferred that the students who register first are most likely to succeed and are most prepared, but more data points are needed. Finally, more funding is needed to do this study on a more consistent basis to understand if food in the classroom can directly cause increased performance and to provide healthier options to ensure all students can partake.

Conclusions

Overall, it is not uncommon for students on a regional campus to be hungry during class. However, the main cause was from not having time to cook and eat with only a few citing money as the barrier. Additionally, most college students do not have a focus on nutrition with what they eat, but there were a small portion who did especially when it came to sugar. Students enjoyed having food in the classroom and it helped their overall well-being. Unfortunately, the data was potentially skewed as only students who were succeeding in the course responded to the survey and this led to the hypothesis that the ones who failed were of the demographic of students who may need food in the classroom the most. Despite not having those potential vital viewpoints it was clear that food in the classroom was a positive based on student perceptions. However, the grade distributions did not show a potential link to being hungry and academic performance. Finally, it could not statistically be stated that there was a difference in the mean academic performance between the sections.

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