Plastic Waste Reduction at GW
Final Project

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December 18, 2023

Table of Contents **Page**

Introduction

George Washington University has been recognized for its commitment to eliminating single-plastic use. Plastic pollution is environmental contamination caused by the accumulation of plastics. Plastics have a significant carbon footprint and emit 3.4% of global greenhouse gas emissions (Organization for Economic Co-operation and Development). Single-use plastics such as disposable cups, cutlery, straws, and takeout containers have become a main part of the modern lifestyle. The production and disposal of these items contribute to severe environmental consequences for wildlife and ecosystems. Plastic in the oceans may also interfere with the ocean's capacity to absorb and sequester carbon dioxide, thus creating another pathway through which plastic pollution contributes to accelerating climate change.

Even though GW is leading the way in adopting sustainable practices that engage their students and help them to be part of the change, GW still contributes to large volumes of plastic pollution. Thus, this project provides in-depth research on methods to reduce single-use plastic consumption at GW. The paper will explore different educational approaches and challenges associated with transitioning to more sustainable alternatives in the GW community. Specifically, this issue will be approached by implementing educational requirements at different levels of GW's education system. The educational strategy requires students to take a mandatory sustainability class either through their respective departments or through a school-wide policy enforced by the institution. Making it a graduation requirement will also engage a significant number of students and contribute to the reduction of single-use plastics.

In summary, our first approach will be to require a percentage of GW departments to require sustainable classes for its students. The second approach is to make a University-wide sustainability class requirement which requires all students, regardless of department, to take a sustainability class. Through these approaches, we expect to find a reduction in plastic waste and analyze the policy that is more effective in doing so.

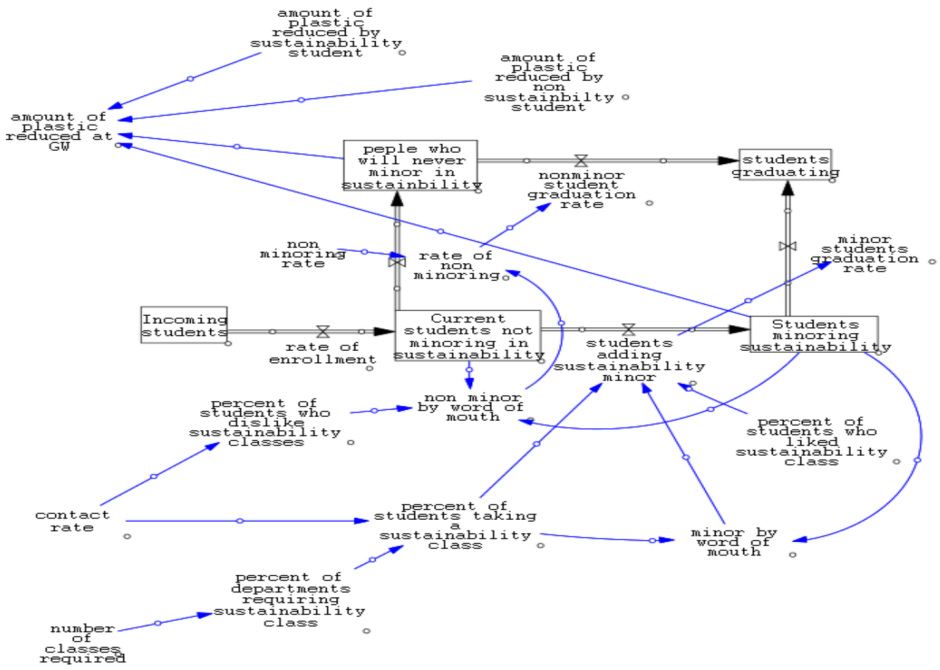
Using an educational approach to address the issue of plastic waste serves several benefits. Besides being highly effective in engaging the GW student population, this approach also introduces the topic of sustainability to the diverse student population who weren't educated on the matter. Lastly, this approach leverages GW's location in the capital and epicenter of politics to access political figures, policymakers, and progressive keynote speakers who can promote sustainability and environmental education further. Through panel discussions, speakers, and a mandatory course, this method can simultaneously educate the GW community and decrease single-plastic use.

Methods

Baseline:

Before analyzing the effects of the proposed policies above, a model of the current systems operating at GW regarding plastic use and sustainability is required. Real data sources from GW's websites in combination with assumptions are used to create parameter estimations that provide semi-realistic results. Specifically, our main data source was obtained from GW's sustainability website where we gained the total number of students minoring in sustainability to be 2%(Office of Sustainability). However, since we encountered a shortcoming of data sources about GW's plastic waste, an assumption about the percentage of plastic wasted at GW by sustainability and non-sustainability minors was made. The diagram presented in Figure 1 below demonstrates the baseline of our model:

Figure 1: Baseline Model

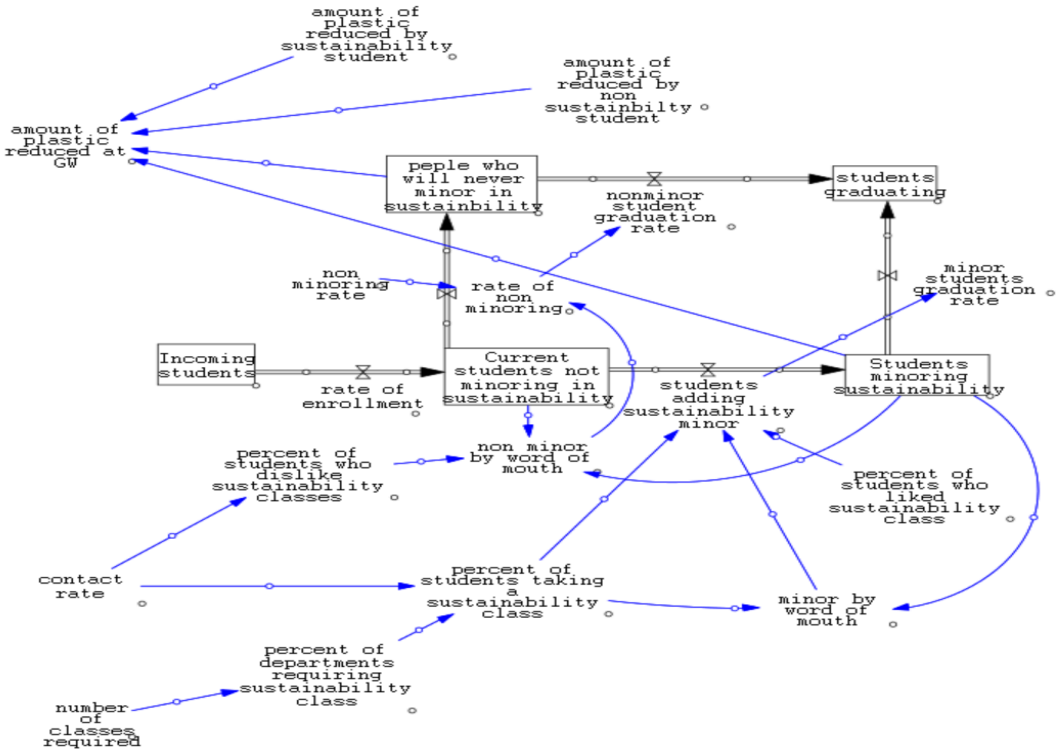


The baseline displayed in Figure 1 above encompasses the number of incoming students and graduating students while also incorporating the number of students minoring and not minoring in sustainability. The model also includes a variable called "amount of plastic waste reduced at GW" which shows the total amount of plastic waste reduced at the school by both sustainability and nonsustainability students. In this scenario, the data assumes that sustainability students reduce more plastic than non-sustainability students.

Policy 1:

Next, the efficacy of the proposed policies is tested by implementing them into the baseline model. The first policy seeks to enact a department-enforced sustainability class requirement. This policy is demonstrated in the Figure 2 model below:

Figure 2: Policy 1 (Department-Enforced Sustainability class requirement)

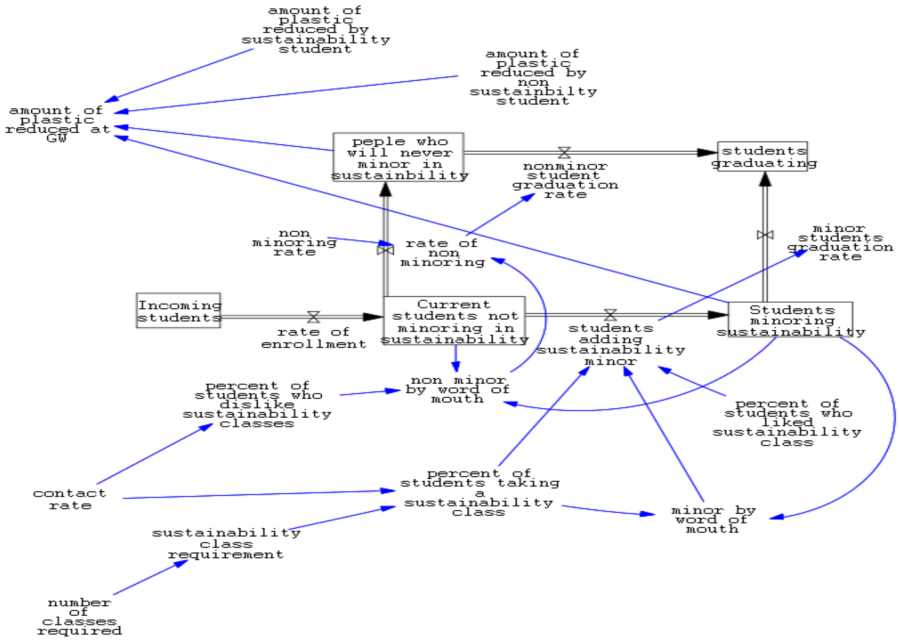


In the Figure 2 model above, we observed the class requirement under a goal-seek variable called “percentage of departments requiring sustainability classes”. This policy assumes that 25% of the GW departments already require a sustainability class for their students and models a scenario where instead 50% of departments at GW require their students to take a sustainability class. This is done by having the variable encompass a STEP function where the percentage of departments that are requiring sustainability classes is 50%.

Policy 2:

The second policy proposed is an institution-enforced sustainability class requirement policy that requires all students at GW to take a sustainability class regardless of their department and as part of their degree requirement. This policy is modeled in Figure 3:

Figure 3: Policy 2 (Institution-Enforced Sustainability class requirement)



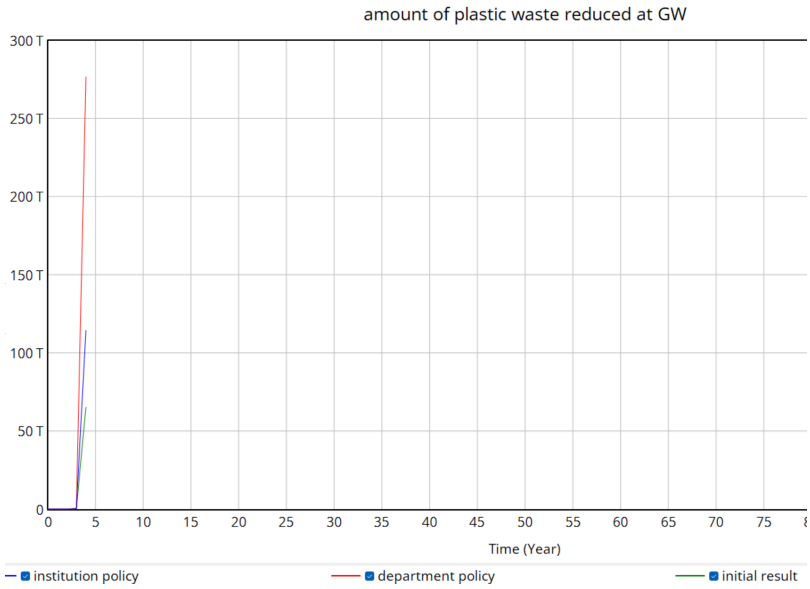
In the Figure 3 model above, we observed the class requirement under a goal-seek variable called “sustainability class requirement”. This model takes into account the 2% of students who already minor in sustainability which was found in our original data source. However, this percentage is increased to 97% which reaches a total of 99% of all students at GW who take a sustainability class. This is done by having the variable encompass a STEP function where the percentage of students who take a sustainability class is 97%. The goal-seek variable was set to 99% instead of 100% because it provided a better and more realistic outcome.

Results

Policy Outcomes:

After modeling each policy, we observed the results they had on the system’s performance over time. In Figure 4 below, the results that policy 1 and 2 had on GW plastic waste is demonstrated:

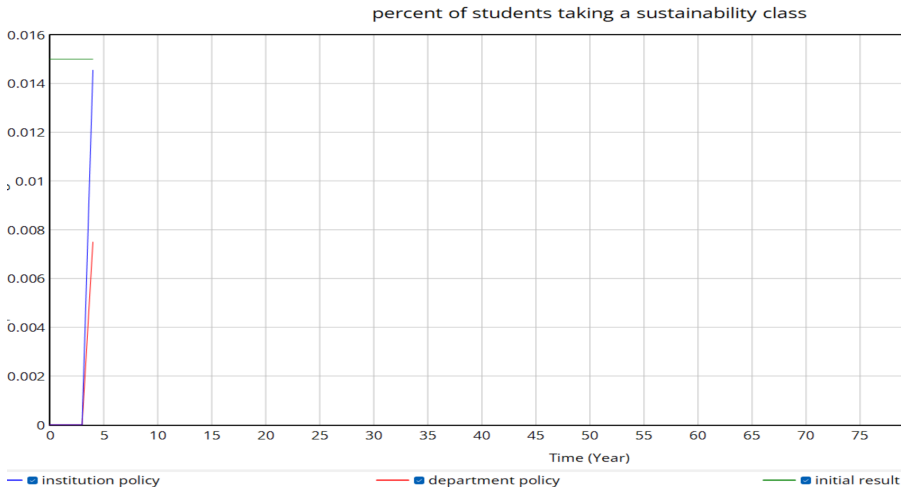
Figure 4: Policies' effects on GW plastic waste



Through Figure 4 above, it can be observed that within a 4-year time frame, the amount of plastic waste reduced at GW is the highest when the department policy is implemented rather than the institutional policy. However, both policies increased the amount of waste reduced than the baseline which is represented by the initial results. This evidence supports the research's proposed methods of reducing single-use plastics using sustainability class requirements as both policies were able to meet the goal of reducing plastic waste.

However, different results occur when the percentage of students who take a sustainability class is modeled as demonstrated in Figure 5 below:

Figure 5: Percent of Students Taking a Sustainability Class



Thus, although the department policy reduces plastic waste the most, the policy that increases the number of students who take a sustainability class is the institutional-enforced requirement as seen in Figure 5 above.

A similar trend can be observed when the amount of students adding a sustainability minor and graduating with a sustainability minor is analyzed as seen below in Figures 6 and 7 respectively:

Figure 6: Students Adding Sustainability Minor

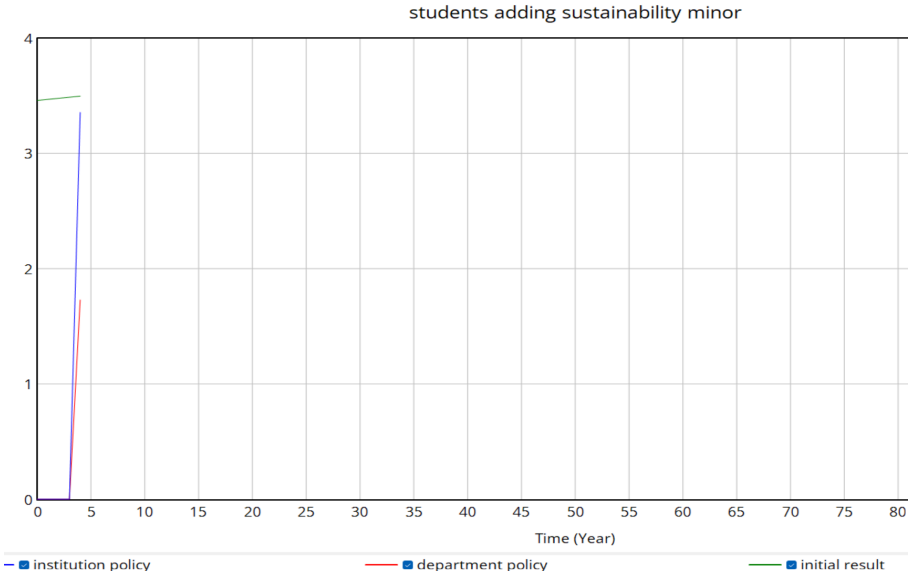
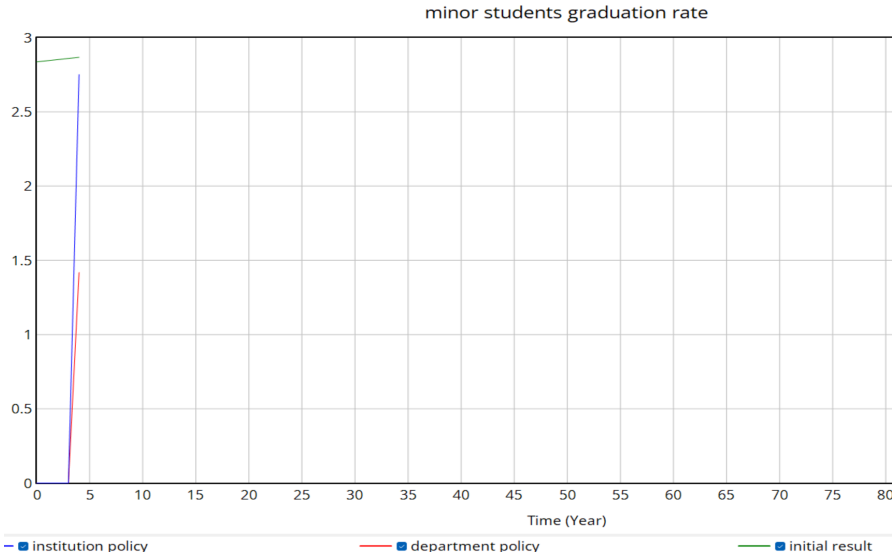


Figure 7: Students Graduating With Sustainability Minor



Through the graphs illustrated in Figure 5-7, the dramatic effect of the institution-enforced sustainability class requirement policy on the rate at which GW students who go on to minor in sustainability is clear as it increases them drastically. This can be caused by various factors such as the institution policy exposing a larger population of GW students to sustainability than the department-enforced policy which only exposes students of specific departments.

Moreover, an interesting observation is made concerning how the sustainability minor is spread. When the spread through word of mouth is modeled, it is found to have almost identical results as Figure 6 above. This demonstrates how word of mouth directly affects the number of students who go on to add sustainability as their minor and the important role that it plays in these trends. Thus, it can be concluded that word of mouth positively affects the number of students who add sustainability as their minor.

Sensitivity Analysis:

To analyze the responsiveness and vulnerability of the models and the results that were incurred, a sensitive analysis was conducted where different parameters within the model were tested.

Test 1 analyzed the sensitivity by adjusting the parameters within the policies to achieve 100% for both the percentage of departments requiring a sustainability class in policy 1 and the percentage of students who were required to take a sustainability class in policy 2. This is achieved by adjusting the height arguments within the STEP functions. The initially used argument of 50% for policy 1 was changed to 75% and the initial argument of 97% for policy 2 was changed to 98%. This adjustment brings both models to 100% when combined with the status quo that was formed using real data and assumptions. The results analyzed in Test 1 found that the parameter change in Policy 2 saw no effects. However, the policy 1 adjustment saw dramatic effects as the amount of plastic reduced using the department approach decreased from previously analyzed to match that of institution policy. This makes sense as both policies now require almost all students to take the required sustainability class. Moreover, it saw an increase in the percentage of students taking a sustainability course and adding a sustainability minor. Thus, the department policy was more sensitive and responsive to the parameter changes than the institutional policy.

Test 2 analyzes sensitivity by adjusting the number of sustainability classes that are required by adjusting it from 1 class to 2. The results from Test 2 rejected expectations of observing an increase in the amount of plastic reduced as we instead observed a decline in the amount of plastic waste reduced in department policy and no change in plastic reduction in the institution policy when the two classes were required. However, there were dramatic increases in the number of students adding the minor, graduating with the minor, and the percentage of students taking the sustainability course overall. This can be due to the two class requirements facilitating a natural progression towards pursuing a minor in sustainability.

Test 3 analyzes sensitivity by adjusting the time frame argument in which these policies are implemented by increasing it from 4 years to instead 10 years. The results collected from modeling Test 3 saw a dramatic increase in the amount of plastic reduced using both the department and institutional policy. This can be explained by the increased time frame as students are given more time to reduce plastic waste. The institutional policy also experienced a slight increase in students graduating with minors in the institutional policy but saw no change in the number of students adding minors since it just happens slower given the increased time interval. However, the departmental policy experienced a decrease in the amount of students adding the minor which shows a lack of interest in sustainability minor farther in the future. Although some sensitivity was detected in the variables about the time parameter adjustments, significant changes weren't observed.

Trade-off:

When an alternative policy that combines both policies 1 and 2 was analyzed, the amount of plastic waste reduced saw errors and unrealistic results. Furthermore, we observed a dramatic decline in the number of students who minor in sustainability. Thus, even though choosing the combined policy can potentially help reduce the amount of plastic waste, it also decreases the number of students adding sustainability minor when compared to other policies. Since these tradeoffs posed significant negative results, the alternative option of a combined policy package is rejected.

Policy Recommendations:

After comparing the two policies and scenarios, the policy of department-enforced sustainability class requirement can be recommended because it produces a higher amount of plastic waste reduction while simultaneously increasing the number of GW students who minor in sustainability after taking their required course. Furthermore, it's recommended that the number of classes required remain at 1 and that only 50% of the departments be required to implement the sustainability courses in addition to the 25% of departments that are assumed to already have implemented this mandate. This is effective because it allows for a total of 75% of departments to require the minor. Thus, the students within the remaining 25% of GW departments would experience a minor spread through word of mouth. This is a better approach than requiring all departments to require this mandate which was seen to decline the amount of plastic waste reduced when tested in the sensitivity analysis above. Implementing this policy has a greater magnitude and is thus able to help GW achieve the goal of reducing plastic waste at a faster rate which would directly solve the problem being addressed in this project.

Conclusion

Overall, the evaluation of these two policies aims to decrease plastic waste at GW by increasing the number of students enrolling in the sustainability minor program. Both policies saw an increase in the number of students minoring in sustainability but this trend was more dramatic for institution-enforced policy. Even though we were planning to reduce the use of single plastic use through the minor of sustainability, our research found that the requirement classes are a great way to create awareness and create a drastic decline in single plastic use. We concluded that students do not need to minor in sustainability to be able to practice being sustainable and we plan to achieve that by requiring students to take a sustainability class as a graduation requirement. However, our expectations were disproven as we saw the highest plastic waste reduction in the department-enforced requirement.

Furthermore, we found that both suggested policies show a positive influence in reducing plastic waste at GW, the first policy yielding more significant results and showcasing a steeper decline in plastic waste. For policymakers, our recommendation is to prioritize the implementation of the department-enforced sustainability class requirements, specifically having 75% of the total departments requiring it. This results in a decline in plastic waste and helps GW achieve its strategic goals to be more sustainable. Even though this research had great results, there were some limitations. For instance, there was not enough data about the sustainability program at GW, and would have especially helped make the study more effective if GW had a sustainability major program. Future research can explore different factors that influence students during decision-making. It can also assess the effectiveness of these policies at different universities in diverse educational settings. In summary, our findings provide valuable insights into the effectiveness of these two policies at GW. Implementing the policies not only enhances students' engagement in sustainability but also contributes significantly to the reduction of plastic waste.

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