Session 2023

Assignment Choice Roadmap in Computer Science Service Courses

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Abstract

Students taking introductory classes in Computer Science, especially those who are required to take a "coding class" for their non-computer science major, can be very intimated by the thought of learning to program. Many students, particularly those underrepresented students in engineering (Hispanics, African Americans, and women), are discouraged by being grouped with peers who have coding experience or have otherwise been involved with computers before.

Computer Science service classes will continue to encompass students from many diverse majors, as more degree plans require a coding class. Coding does not always come easy for these students. This paper examines assignment choice in an undergraduate CS-1 course. Guided by the Self Determination Theory, the authors will implement assignment choice as a means for students to plan a path to meet the course learning objectives. We will integrate the choices in the curriculum into Canvas, the Learning Management System, and provide a course grade calculator to students. Students receive a customized course road map to visualize their path through the assignments and to plan their own road to success. The approach applies to students' own internal motivation, whether intrinsic or extrinsic, by allowing students to choose their own path or set of assignments to complete the course. By allowing choice, the assignment set is more likely to meet the various interests of the students. We see a higher overall success rate, including the underrepresented students.

Introduction

In recent years, there has been an increase in the number of non-computer science students enrolled in Computer Science (CS) courses. These students come from a variety of academic backgrounds and may not have had prior exposure to Computer Science concepts. As such, they may face unique challenges when completing assignments in a CS course. To support the success of non-computer science students in these courses, it is important to consider ways to make the assignments more accessible and relevant to their interests and skills[1]. One strategy that has been shown to be effective in promoting student engagement and motivation is offering students choice in their assignments[2].

This paper presents the observations of multiple semesters investigated the impact of providing non-computer science students taking a CS course with assignment choice. The observation was conducted over the course of two academic semesters and involved a group of non-computer science

students who were given the option to choose from a range of assignments. This was compared to semesters where no choice was given. The results of the observation suggest that providing non-computer science students with assignment choice can lead to increased engagement, motivation, and satisfaction with the course.

Overall, this observation provides evidence for the importance of offering assignment choice to non-computer science students taking a CS course to support their success in the course. Competency-Based grading scheme is presented for the successful implementation of assignment choice. It is hoped that these findings will encourage a study in this and for instructors to consider the benefits of offering assignment choice to non-computer science students and to consider implementing this strategy in their own courses.

Strategy for Providing Choice

Using CSCE 111, a CS service course as the course we observed, initially there was a concise set of assignments that needed to be completed with a standard grading policy of 90% or greater for an A, 80% a B, etc. Many students were making the maximum grade of 100% and even taking any bonus opportunities to exceed this grade. Other students found it frustrating to have to complete this work when it was not their major. They struggled to see the relevance in the topics.

While looking for ways to improve the Academic Integrity in early CS courses, an entirely different topic, we found an approach to help prevent cheating by offering some choice in the assignments students must complete[3] over the span of a course. Offering a variety of assignments for the completion of the course seemed like a viable solution. Switching the course grading from an average to a total points scheme allowed students to choose assignments until the point total they wanted met their grade goal. After looking at the paths students could take to earn the desired points, it seemed the students needed more guidance[4] to prevent cherry picking of assignments and taking the easy route.

This path still had issues with the core assignments being able to be passed over for more fun or less challenging assignments. Observing that a large percentage of the students were currently making high grades, while the rest were doing poorly, adding two more requirements to the assignment choice concept would hopefully give students a better chance at succeeding while also raising the overall learning goals of the class. The first requirement was accomplished by dividing the assignments into core (required) assignments, and optional assignments. Competency-based grading ensures that a minimum level of knowledge must be reached to pass the class. The core assignments must be met with 70% of the points earned to receive a C or passing grade in the class. For the remaining, or optional assignments, the points earned are added to the total, allowing students to continue to work to gain and show mastery in the course work. Again, to prevent just taking the easy route, students must earn 70% of the total value for any points to be awarded. The justification is that most students could earn 20% of a grade value with little to no effort or learning. The other benefit to students is that doing poorly on an assignment does not bring down their grade, it simply doesn't add to it either.

The total points available in this course prior to assignment choice was 1000. So, 900+ were needed

for an A, 800+ for a B, etc. New assignments were added to the course curriculum, so 1500 points were now available. To receive an A, students must earn 1050 points, or the equivalent of a previous student making a 105% in the non-choice version of the class. This is how the overall learning goals of the class were increased. Adding additional assignments allowed students to find pathways that interested them and bypass other paths of assignments that they did not need or prefer. The Course Map in Figure 1 was introduced to the students in the first week of the course.

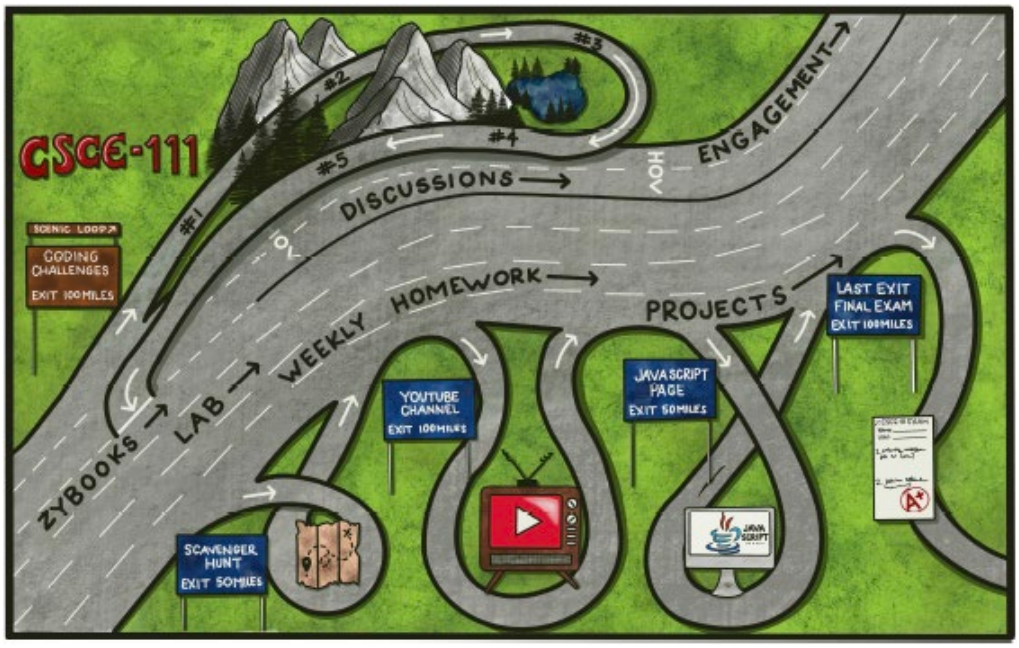

Figure 1. The CSCE 111 Course Map

The highway, specifically the right four lanes, represent the core requirements needed to pass the course. Completing only these four lanes result in a C in the course. Students are then given a web-based calculator that helps them pick a set of assignments that will result in the desired grade. One example given is that if all the lanes of the highway are chosen, including the HOV lanes, they can earn the points for an A. But, if classroom engagement or discussions are not something a student enjoys, they can pick from any of the side trips or optional assignments. These optional assignments may include coding challenges, a five-week adventure into solving coding puzzles or a technology scavenger hunt (identifying specific types of technology not previously thought of as using computers). Or students may reteach concepts we have learned through creating a YouTube channel. Successfully adding JavaScript to a webpage assignment will get them more points. Finally, an optional final gives them the chance to show they learned more than they feel their grade represents.

The grade calculator is web-based and designed to support the assignment choice system as follows:

- The calculator is accessible via a web browser, allowing students to easily access it from any device with an internet connection.
- Upon launching, students can view a list of all required assignment categories for the course,

along with their corresponding point values and the minimum grade required to earn credit for the assignment.
- The calculator shows a list of optional assignments that are available for students to complete, along with their corresponding point values.
- Students can select the optional assignments they wish to complete and add them to their list of completed assignments. The calculator automatically updates the total number of points earned from optional assignments.
- As students complete required assignments, they enter their grades into the calculator. The calculator checks whether the minimum grade requirement for each assignment has been met and displays a message indicating whether the requirement has been satisfied or not.
- The calculator displays the total number of points earned from required assignments and the total number of points earned from optional assignments.
- Based on the total number of points earned from required assignments, the calculator determines whether the student has met the requirement of earning at least 70% of the total value of required assignments to receive a passing grade in the course.
- The calculator determines the student's overall grade in the course based on the total number of points earned from both required and optional assignments. It displays the overall grade as a total number of points earned. A table corresponds the points with the course letter grade. (e.g., A, B, C).
- The calculator provides students with feedback on how many more points they need to earn to reach their desired overall grade. This is helpful for students who are aiming for a specific grade in the course and want to know how much more work they need to do to achieve it.

Students are introduced to the course calculator in the first week of the course and required to take a screen shot of the initial path of courses they plan to choose and the resulting grade they would earn.

Initial Observations

A final survey is available to the students at the end of the semester. We letting them know the new things we did with grading and assignment choice. We ask them what worked and what did not work for them, then what could make it better. Overwhelmingly the opinion was that students appreciated assignment choice and were glad they could skip some assignments. The idea that doing well on an assignment helped their grade, and doing poorly did not hurt them, was also a positive. Only a few students seemed to feel they should receive the low number of points when an assignment did not meet the minimum 70% to be added to their score.

Allowing students to choose their own assignments for college courses can have several benefits compared to a strict assignment set.

First, allowing students to choose their own assignments can increase their engagement and motivation in the course. When students can choose assignments that align with their interests and goals, they are more likely to be invested in the work and motivated to complete it. This can lead to better learning outcomes and higher grades[5].

Second, giving students the freedom to choose their own assignments fosters creativity and critical thinking skills[6]. By allowing students to explore their own interests and come up with their own ideas for assignments, they can develop their own unique perspectives and approaches to the material. This can lead to more innovative and creative work.

Third, providing choice in assignments can also help to foster a sense of ownership and responsibility among students. When students can choose their own assignments, they are taking on more control over their own learning, which can help them to develop a stronger sense of ownership and responsibility for their work[7].

The retention in the course increased from previous semesters. With more students staying in the course to completion, there was a higher overall class grade average. Students had access to the course calculator all semester and were asked to regularly check to see how they were doing. Students seemed to "own" their path to learning, resulting in increased student engagement.

Future Work

This observation has inspired us to set up a more formal study, looking at both the assignment choice and the competency-based grading scheme we are developing. We have also had the ability to collect some data on recent traditionally taught classes and can use that as part of our control group to study the effect of this course design and implementation.

Overall, allowing students to choose their own assignments for college courses can be a beneficial approach that can lead to increased engagement, motivation, creativity, and responsibility among students.

Summary and Conclusions

Summary:

The purpose of this paper was to examine the impact of providing non-computer science students taking a Computer Science course with the option to choose their assignments. The observation was conducted over two academic semesters and compared the performance and satisfaction of non-computer science students who were given the choice of assignments with those who were not. The results of the observation showed that providing non-computer science students with assignment choice led to increased engagement, motivation, and satisfaction with the course.

Conclusion:

The findings of this observation provide evidence for the benefits of offering non-computer science students taking a Computer Science course the option to choose their assignments. Based on these results, it is recommended that instructors consider offering assignment choice as a way to support the success of non-computer science students in their courses. Further research could be conducted

to explore the impact of assignment choice on the performance and satisfaction of non-computer science students in different contexts and in different subject areas. The opportunity to create a study of this type is possible due to the number of service courses currently being taught in the Computer Science department.

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