It’s All In The Mix:
Leveraging food to increase students’ persistence in Computer Science

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Abstract—Computer Science courses seek to hone students’ computational algorithmic thinking (CAT) capabilities. Oftentimes, students fail to recognize the connection between CAT in everyday life and its application in academic settings. One context in which people have a great deal of experience and expertise engaging in the design, implementation, and assessment of algorithms is food. This paper describes It’s All In The Mix, which provides an anchoring experience for African-American undergraduate STEM majors.

Keywords—African-American students, computational algorithmic thinking, computer science education, cooking, recipes

I. INTRODUCTION

Given that Computer Science (CS) is a required course for most college students, it is critical that students develop their computational thinking skills [1, 7, 11, 15]. Computational thinking involves not only choosing the “right abstractions to solve a problem”, but also choosing the “right computer for the task” [18]. In contrast, computational algorithmic thinking (CAT) focuses specifically on how humans design, implement, and assess an algorithm or set of algorithms to solve a problem. CAT is not focused on choosing the “right” abstractions to solve a problem with the “right” computing agent, but rather, the algorithms designed, adapted, implemented, and discarded by the human computing agent on the journey toward choosing the “right” abstractions. Thus, CAT is defined as the ability to design, implement, and assess algorithms [10, 16-17].

African American women comprise only 6% of all the Bachelor’s Degrees awarded in CS in the United States [20]. The literature reveals a number of efforts focused on pedagogical strategies designed to engage and impact the persistence of African Americans and women in CS from K–18 [4, 6, 8, 11-13]. However, in spite of these efforts, the needle seems to have barely moved [20]. African-American women who choose to declare Computer Science as a major often have little prior experience with Computer Science. As a result, this population of students may not have a clear idea about what Computer Science is, and they likely do not know how to “think like a Computer Scientist”, leveraging their everyday understanding of algorithms to creatively solve complex problems that Computer Scientists are well-suited to solve. Given these difficulties and barriers, our introductory course, taken by all STEM majors, focuses on designing, articulating, and assessing algorithms as a way to understand what CS is and how Computer Scientists approach and solve problems in a step-by-step, logical, and unambiguous way in the absence of a high-level programming language, like C++ or Java [1-3, 9, 15].

Cooking and food touch the lives of every individual in every culture and from every walk of life. We focus on food as a bridge to Computer Science for a number of reasons. First, cooking, eating, and engaging with food are common experiences that cut across culture, race, age, and socio-economic status [5]. Second, food utilizes basic tools that are readily available in any grocery or convenience store. Third, food is widely popular - not only does everyone eat, but with the advent of food-related reality television, food and cooking have become not just a form of nourishment, but also a form of entertainment. Fourth, cooking requires creativity, something that students often mistakenly think is not valued in Computer Science. Finally, cooking involves computational algorithmic thinking as a recipe is an algorithm.

II. It’s ALL IN THE MIX

It’s All In The Mix is a module that consists of a set of integrated activities that expose students to CAT not only through the design, implementation and assessment of recipes (both existing and novel), but also through the design and development of games and mobile apps that address cooking, nutrition, food sustainability, and food’s connection to and impact on health and wellness. It’s All In The Mix has been integrated for five semesters into an introductory Computer Science course at a small liberal arts women’s college in the Southeastern United States. One hundred African American female students and one male enrolled in the course and completed learning activities in the module during the first 3 weeks of class as well as the last 4 weeks of class.

The Peanut Butter and Jelly challenge focuses on helping students, working in groups of two, understand ambiguity and the importance of articulating algorithms as specifically as possible. The first group member writes a recipe for making a peanut butter and jelly sandwich. Once the recipe has been written, the group members exchange places, and the second group member acts as the computing agent, following the recipe of the first group member. Pictures of the recipes and
corresponding by-products are viewed by the class as the instructor leads the entire class in a discussion about the characteristics of an algorithm, specifically the need to provide unambiguously clear instructions for completing a task in a finite amount of time [14].

The Dessert Wars challenge focuses on the creativity of algorithms. Each person in the class is given the same ingredients and utensils to construct a dessert using all of the ingredients provided and write a recipe describing how to make the dessert. Each dessert and recipe is presented informally as students walk around looking at their peers’ creation. Finally, the instructor leads the class in a discussion about the similarities and the differences between all of the desserts and the role of creativity in algorithm design.

In the Cooking Wars challenge, each student asks an elder in his/her family for a recipe of a favorite dish. Following a recipe draw, each student has two recipes: one from her familial elder and one from another student’s elder. Students who have the same recipes then get together and talk about the recipes, identifying areas of ambiguity, including unnumbered steps or instructions that may not be clear, crafting five questions about the recipe to ask the familial elder for clarification. The responses are gathered and shared. Both students prepare the recipe outside of class, and on the day of the Cooking Wars challenge, like dishes are placed side by side. The class engages in a blind taste testing, voting for the best tasting and looking dish for each pair of similar dishes.

### III. Reflections of the Experience

Our experience with the *It’s All in the Mix* module has revealed several insights in creating effective pedagogical strategies for introductory Computer Science courses. First, the module has created a socially and culturally inclusive learning environment for STEM majors. Sharing recipes is a very social act, and in the context of the module, sharing, preparing, adapting, and assessing recipes become a part of the social norms of the class. Second, the module has been shown to bridge the gap between students’ understanding of the definition of an algorithm and their very deep understanding of recipes and preparing dishes. The module serves as a anchoring experience throughout the remainder of the course (e.g., “Remember when we talked about ambiguity in recipes...”). Finally, inclusion of the module has resulted in a notable increase in the persistence of Computer Science (CS) majors and non-CS major students completing the course with a passing grade, moving from 25% of students consistently dropping or withdrawing from the course within the first 9 weeks to no students have withdrawing from the course in any semester, even when their midterm was not a passing grade of C- or higher. In every case, students referred back to their experience with the “Food Module” (as they call it) and the confidence the module gave them that they could succeed in the course, which enabled students to ultimately succeed in passing the course.

### REFERENCES


