Tangible Fruits and a Reconfigurable Game Engine for Technology Outreach

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Introduction

Georgia Gwinnett College (GGC), an open-access public institution established in 2006, ranks as the most ethnically diverse Southern regional college, with a large percentage of underrepresented minorities in computing, ~59% Black and Hispanic students and ~59% female students. Technology Ambassador Program (TAP) is a service-learning course offered by the Department of Information Technology (IT). Its main goal is to break down the stigmas surrounding technology and increase the participation in IT among traditionally underrepresented groups for both students taking the course and those in the college and the surrounding community. The TAP course gives students opportunities to build real-world-like projects and provide authentic teamwork, leadership, and various public speaking and outreach opportunities. Each team consists of three to four students, with varying levels of computer knowledge and skills. They collaborate to develop project ideas, divide tasks, and meet project deadlines. Students demonstrate to themselves and others that technology is not as intimidating as it appears. Most teams choose to develop computer games. They demonstrate their games at various outreach events. They also conduct workshops where participants either learn programming concepts through playing the games, modify the games, or develop mini versions of the games by following step-by-step instructions [1]. Due to the effectiveness of the workshop approach, it was adapted to improve student motivation and learning in an introductory programming course [2].

Description of Game and Its Reconfigurability

We enrolled in the course in spring 2023 and were motivated by the creative and collaborative nature of the course. We designed and built a fun educational quiz game, Fruit Rain, that allows others to try out technology in an approachable and enjoyable way. The game first presents a player with a question and then has the answer choices embedded in fruit images "raining" down on the screen. Figure 1 shows the game interface. To make the game more engaging, we used Makey Makey, a toolkit that can make anything conductive a key, to make a "keyboard" composed of real fruits. The player must physically touch the fruit to select their answer. If they answer the question right, the game presents the user with another question. If they answer it wrong, they lose a life and must try again. By using physical fruit, we were able to gain more attention and provide a better learning experience for the participants. As stated in [3], "alternative approaches such as collaborative play and physically embodied designs may also provide important benefits to learners". Our demos were well-liked by kids and adults.

In the middle of the development process, we added a reconfigurable feature to the game, which proved to be a good decision. The quiz questions are stored in a .CVS file, which the game loads upon selecting a level. This feature gives us a high degree of flexibility and allowed us to reconfigure the game, often on the spot, for different audiences. For example, during the Atlanta Science Festival, we had initially planned to have our game focus on variables and Boolean expressions. However, based on our observation, we quickly changed the questions to simple arithmetic questions so that young kids can enjoy the game with questions they understand, while interacting with technology. Figure 2 is a snapshot of a kid playing our game at the Atlanta Science Festival.

Figure 1: User Interface of the Fruit Rain Game

Figure 2: A Kid Playing Fruit Rain at Atlanta Science Festival

Evaluation of Outreach Workshops for Early-College Students

During the spring 2023 semester, the Fruit Rain team attended several IT outreach events. This abstract focuses on the two workshops we conducted in freshman-level general education IT classes. For these workshops, we decided to focus on arithmetic operators such as modulus (%), the numeric variable types, and simple and compound assignment operators, such as += or -=. We first taught students these basics and then had them use our game to practice their newly acquired knowledge. It is worth noting there were differences in the ways the two workshops were conducted. The initial plan was to have students download the game from GitHub onto their computers and play on their own. However, we underestimated how long the setup process would take, and with roughly 20 minutes remaining, we decided to switch to a collaborative approach, where students would shout out the answers to the questions, and one of our team members would input their guesses accordingly to the game. This created an atmosphere of fun, collaboration, and learning. This process of trial and error allowed us to observe how workshop experience could be improved by on-the-spot adaptations.

For the second workshop, we kept the collaborative approach. After explaining the basics of the topics, we showed students the code for controlling the size and speed of the fruits and the number of points earned from a correct guess. Students gave their inputs on what to set these variables to, and we would run the game to examine the effects. Afterwards, we had students taking turns to come to the front of the room to control the game, interacting with real fruits, while the rest of their classmates would shout out the answers.

Students were given a pre/post survey asking how confident they were towards programming. Additionally, the post-survey asked students to rate the workshop, their engagement, and their learning, as well as whether the workshop made them more curious about IT, and if they would consider taking a programming class in the future. All questions have a Likert scale from 1 to 5.

Figure 3 (left) shows the ratings from two workshops. We can see that both workshops gathered positive ratings and the second workshop gained higher ratings for all metrics: student confidence improvement, overall workshop, engagement, and learning. It shows that the workshop format adjustment we made was effective. Students interacting directly with the game through real fruits at the second workshop might also be a contributing factor. Figure 3 (right) shows the comparison of workshops' impact on students' confidence between IT majors and non-IT majors. For IT majors, confidence was improved from 2.72 to 2.88. For non-IT majors, the confidence improvement was much more drastic, from 1.94 to 2.84. This shows the effectiveness of this outreach format, especially for students who did not originally choose IT as their career path.

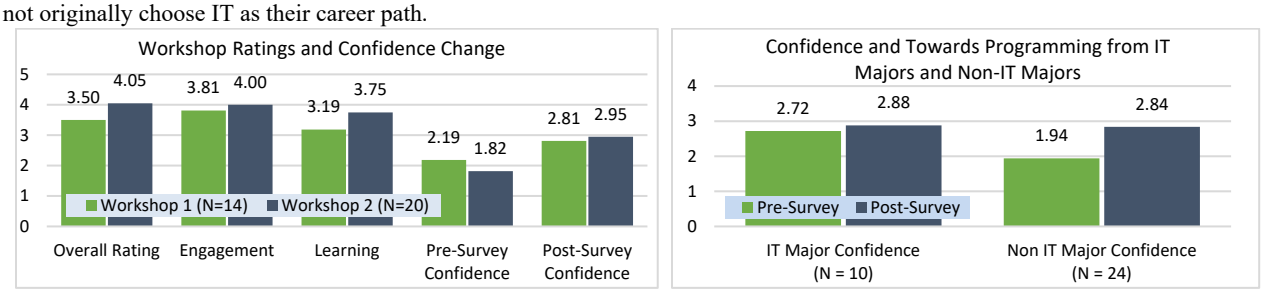

Figure 3: Confidence Ratings from Workshop Participants

Figure 4 shows the post-survey ratings on whether the workshops improved students' curiosity for IT and programming and whether students would consider taking a programming class if not already planning to, respectively. Again, we can see that both workshops had positive impacts and the second workshop's impact is substantially higher. It is worth noting that six of the 14 students in workshop 1 and six of the 20 students in workshop 2 were already planning to take a programming class before their respective workshop, therefore they were not included in the right chart.

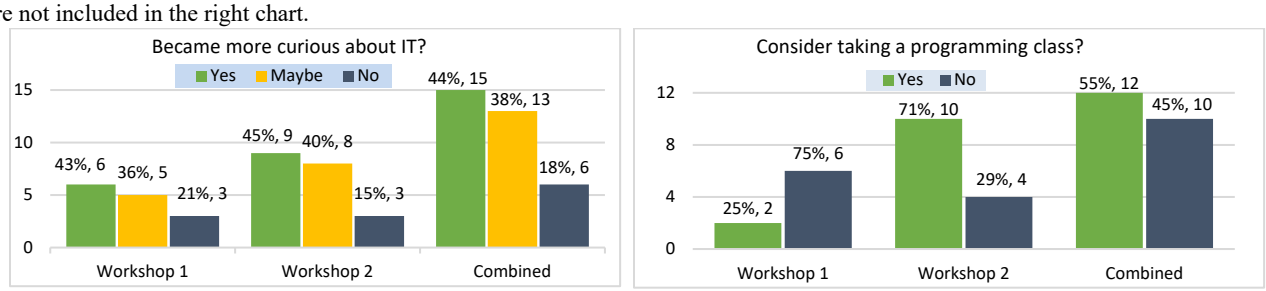

Figure 4: Attitude change because of workshops

Conclusion

This project was a wonderful opportunity to develop our programming capabilities and our team building, leadership, and communication skills, which will be instrumental in our IT careers. As a result, one of us who was contemplating changing their major to Management Information Systems of the Business School decided to stay in the IT major. We also made an impact on others. Many who had the opportunity to interact with Fruit Rain enjoyed its novelty. Interacting with the game through real fruits gave our product a strong impression among workshop participants, helping improve their curiosity for IT and be open to the idea of learning to program.

The design choice for a reconfigurable game mechanism is one of our project's greatest strengths. It allowed us quickly to adjust to the change of workshop approach and topics during the planning stage of the workshops as well as during community outreach events. One IT professor already expressed interest in using our game in her classes. We also plan to advertise our game as a teaching tool for other disciplines.

References

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