Comparison of the Effectiveness of Two Games at Teaching Binary to Students Online and In-person

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**Purpose:**

Our project provides students with the opportunity to develop an interest in the technology field by engaging them in educational games that teach the conversions between binary and decimal. We aim to evaluate the learning method (games) in two different learning environments (online and face-to-face) to determine which method and environment is more effective for students’ learning. This will be determined by the pre- and post-survey collected during the workshops. Our hypothesis is that immediate feedback and instructor interaction will increase student engagement and understanding of binary-decimal conversion in face-to-face learning. We expect the game-based approach to improve comprehension and retention over conventional teaching methods [1]. This study applies to students in middle school through college.

**Technology Ambassadors Program (TAP):**

The Technology Ambassadors Program (TAP) at Georgia Gwinnett College (GGC) integrates scholarship, leadership, service, and creativity to retain underrepresented IT students by building their technical, communication, and leadership skills through hands-on projects, workshops, and community engagement. Originally established in 2012 as an extracurricular program, TAP was transformed into a service-learning course in 2015, allowing students to earn credit while enhancing their various skills [2].

**Methods:**

For our TAP experience, we have designed an interactive game that provides an engaging learning experience for learning binary. The project is built with Unity [3], which is a popular cross-platform game engine used for developing 2D, 3D, AR, VR, and simulation-based projects. This technology will be used to build an interactive 2D game that will instruct participants about the basics of binary conversions and decimal conversions similar to existing games Binary Game [4] and Hexadecimal Bee Game [5]. We plan to post the game online so the participants can play directly from the web, which allows for easier access to the game for both our in-person and online participants. We will be presenting our project at several events. Our project will be shown to non-IT major college students within introductory computing classes. We will also be presenting at the Super Saturday Series (S3), which is an all-day STEM event for middle school students hosted on our campus. Both of these events will provide students with a brief introduction to binary and decimal conversions. Afterwards, the participants will put their knowledge to the test by answering conversion questions in one of two interactive games that we have designed to solidify their learning. In addition to the in-person classroom workshops, we will host these workshops in online classes as well to test whether there is a difference between the learning modalities.

We will also present our project at local symposia in our college. However, these events will be demonstrations only and will provide a brief explanation of our game, demonstrating all its features. After the demonstration, the audience will be able to play the Unity game on the website. They will not be getting any instruction about binary and decimal conversion due to the lack of time given at these events.

**Planned Results:**

A survey will be conducted before the workshops to assess the user's prior knowledge of binary conversions. After giving a short presentation explaining TAP, binary conversions, and the project, participants will get the chance to play the game and enforce what they just learned. There will be tips and tricks included in each game to help further enhance the concept. After getting a chance to play the games, users will retake the survey to measure any changes in their understanding. Results will be collected from S3 and classroom workshops. Afterwards, a comparison of the data will be conducted to test whether our games provide a valid method of teaching binary conversions as well as which style of game is preferred. We will also compare between online students and face-to-face modalities. We will present the results of this study in our poster.

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