The First CRAM Minigame for Cardiovascular Anatomy

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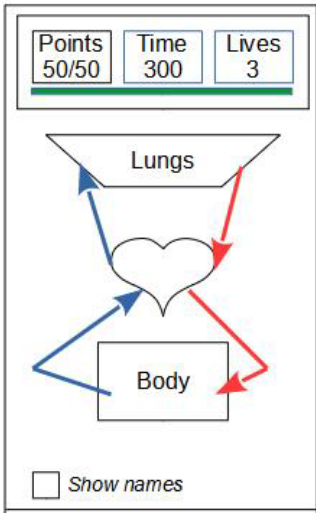
Topic and domain. This paper describes a cell phone minigame for teaching students the fundamentals of the relationship between the heart, the lungs, and the oxygenation of body tissues. It is one of the first of a series of minigames belonging to the CRAM (Cardiovascular and Respiratory Anatomy) project, whos goal is to improve student learning in anatomy and physiology. Minigames are smaller or simpler games incorporated within a larger framework. Chunking the material into minigames has advantages for both students and game authors by limiting the amount and complexity of material in each game. This game covers the most basic things students need to learn about the anatomy of the heart in a way that we believe will be more engaging and effective than the high detail level in conventional textbooks.

Pedagogical activity and feedback. The figure to the left contains a sketch of the game. The top contains typical gamification features, including a difficulty level. The difficulty level is currently set to green, which gives the student the most time to play the game. The main part of the screen shows a simple schematic of the cardiovascular system, showing just three objects, the lungs, the heart and the body. It also shows four connecting vessels, two between the heart and the lungs and two between the heart and the body. It also contains a flag allowing the student to see the vessel names if interested.



The student's job is to state which direction the blood is flowing and whether the blood in that vessel is oxygenated (red) or not (blue). If the student gets the color or direction wrong, the game pops up a contextualized sentence. The second author, who has taught different types and levels of anatomy throughout her career, chose the contextualized sentences for this game. For example, if the student gets either fact wrong about the pulmonary veins (upper right arrow), they see this sentence: "Pulmonary veins carry blood, oxygenated in the lungs, back to the heart."

The inner loop of the game allows students to keep trying until they get all the items correct. The outer loop allows them to move on to another game or another level of this game once they have mastered this one. The next level of this game increases the complexity by adding the four chambers of the heart. We plan to expand the game repertoire according to the hierarchical concept map in our previous work (Kluga, 2019).

Instrumentation and evaluation. We are now arranging to study the effectiveness of this approach in a graduate anatomy classroom, including a questionnaire on student preferences and gaming experience, use of the game, and class performance.

Implementation and novel technologies. The game is implemented in C# using the Unity game engine (Unity, 2021) to take advantage of Unity's responsive design features.

Related work. There are many online anatomy tools available, including some for cell phones (for example, `https://www.educatorstechnology.com/2012/04/11-free-tools-to-teach-human-anatomy-in.html`), but we do not know of any that belong to a hierarchically based ecosystem.

Plans for availability. We would be pleased to share our experience with Unity as a platform for ITS development with other researchers.

Kluga, B., Jasti, M.S., Naples, V., Freedman, R. (2019). Adding intelligence to a textbook for human anatomy with a causal concept map based ITS. In: First Workshop on Intelligent Textbooks, at AIED 2019. Pp. 124-134. CEUR-WS.

Unity (2021). `https://unity.com/`.