



Seattle, February 3,-4, 2019

Interaction Design and Educational Video Games: Motivating Undergraduate Students to Explore New Territories

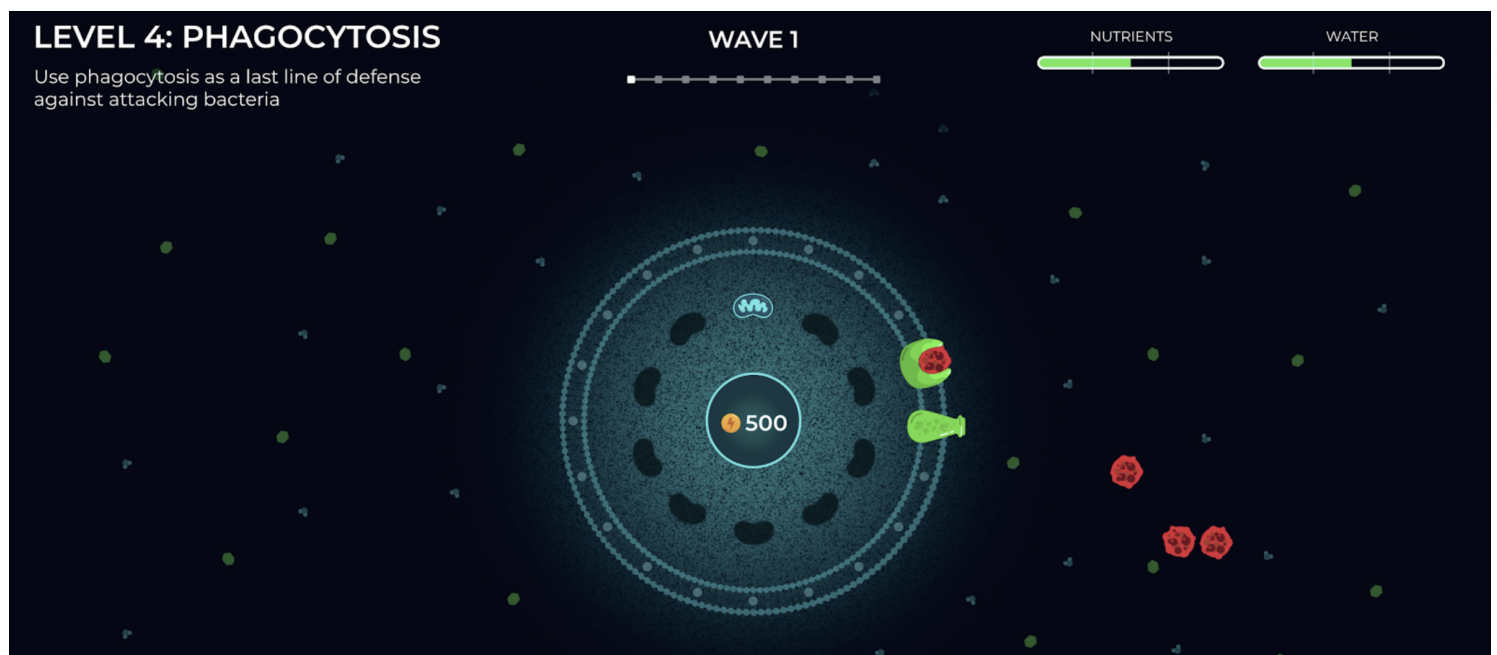


Interaction Week [Follow](#)
Apr 16, 2019 · 13 min read

Isabelle Sperano, Assistant Professor, Design Studies, MacEwan, University, Edmonton, Canada

Robert Andruchow, , Assistant Professor, Design Studies, MacEwan University, Edmonton, Canada

Ross Shaw, , Assistant Professor, Biological Sciences, MacEwan University, Edmonton, Canada



The educational video game environment in K-12 is extensively developed. However,

once at university, students rarely encounter video games as a supplemental resource in their learning experiences. Additionally, most of those games are often too serious or not fun enough to play and engage with the content. Poor graphics, weak playability, bad usability: we have all encountered this experience at least once with an educational video game.

Can interaction design students design a game that is educational and fun to play? In which areas could undergraduate interaction design students be involved when designing an educational video game? What unique learning experiences could be acquired by designing an educational video game? What are some challenges for the integration of educational game design in design education?

To answer these questions, we partnered with a Biological Sciences professor interested in developing a video game for undergraduate biology students. We thought this could be both an interesting interaction design problem to tackle and an engaging pedagogical experiment. To do so, we hired undergraduate interaction design and computing science students to work with us on the concept and then on the development of a video game prototype.

Pedagogical goals

With this project, we wished to pursue multiple pedagogical goals for interaction designers.

Build a game created **by** students (design and computer science) **for** students (biology)

Give students an opportunity to:

- work on a real project
- work as a team (design team and multidisciplinary team)
- collaborate with professors from various disciplines (Design, Biological Science, Computer Science)

Team

From the beginning, the team was composed of 2 design professors, 3 design students and 1 biology professor. A computer science team composed of 2 students and 1 professor joined a little bit later in the project. With this team, our goal was to build a playable prototype within 2 months (mid-April to mid-June). We faced this time constraint mainly because of students and professors availability, and funding.

Design Process

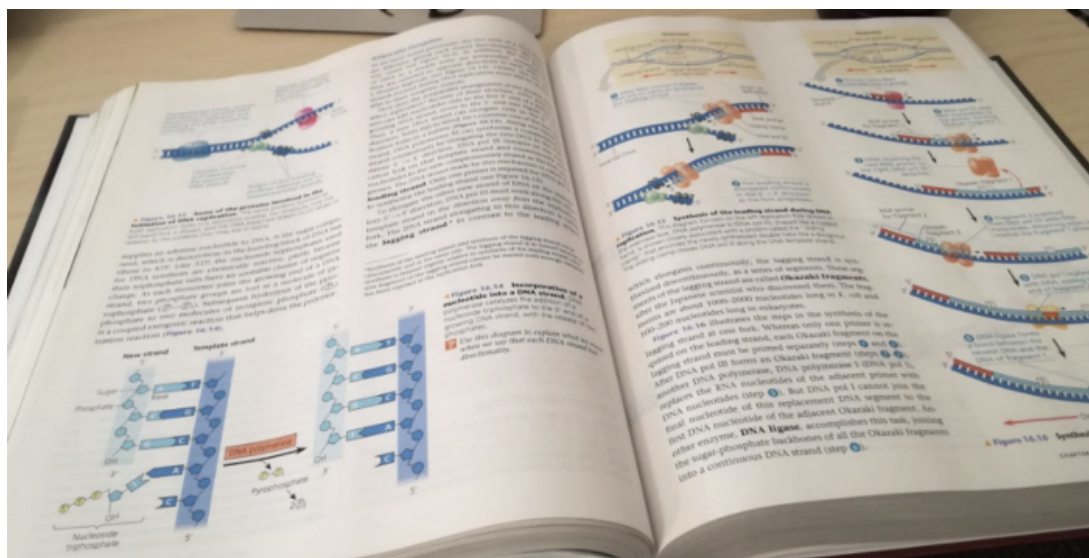
To create the game, we mainly followed the Design Council Design process (Design Council, 2015) which is divided into 4 stages: Discover, Define, Develop and Deliver. This process seems appropriate since this is the process used by our students throughout

their design degree. Throughout the process, we often circled back to an earlier phase as we completed iterations of our work.

Discover: Understanding Topic, Content and Context

The discover phase started with an extensive literature review on videogame design in general and on the particularities of educational video games. Then, the designers learned about biological concepts by reading standard cell biology textbook content. As designers are not biology experts, it was important to understand the main cell biology concepts. Also, since we had no idea yet what cellular biology topic we were going to address in the game, it was also a good opportunity for the design team to identify biology content that could be developed into a game. We also discussed at length with the biological science professor to understand the student's context and particularities (demographic profile, context of usage and difficulties in understanding the content). We learned they are mainly women and most are not videogame experts. Finally, we conducted a comparative analysis of biology videogames. This confirmed two hypotheses we had:

1. There are not many videogames for students above year 12.
2. Either the the games overly prioritize academic learning over fun or the learning components of the game are not clear and the focus is only on the entertaining aspect of the game.



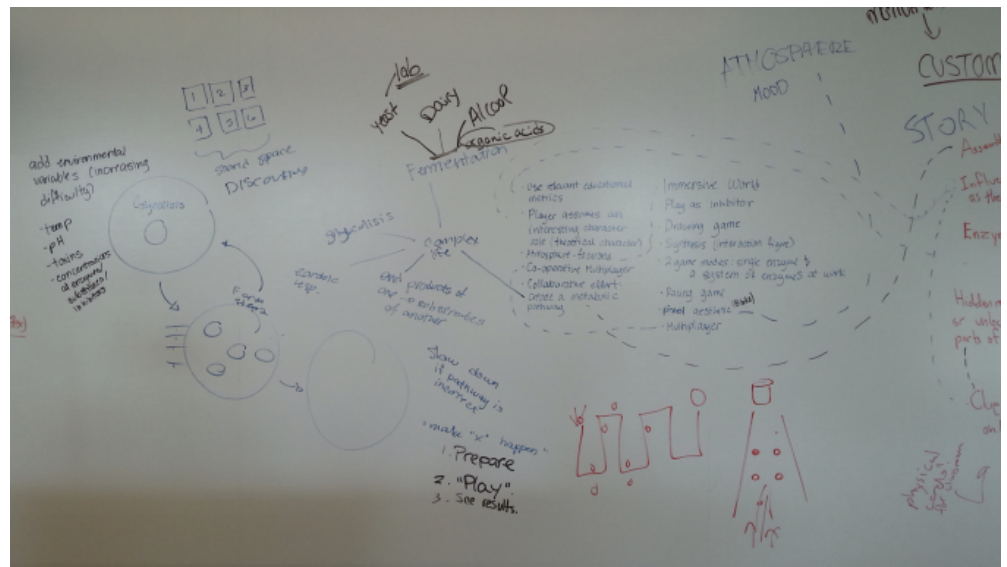
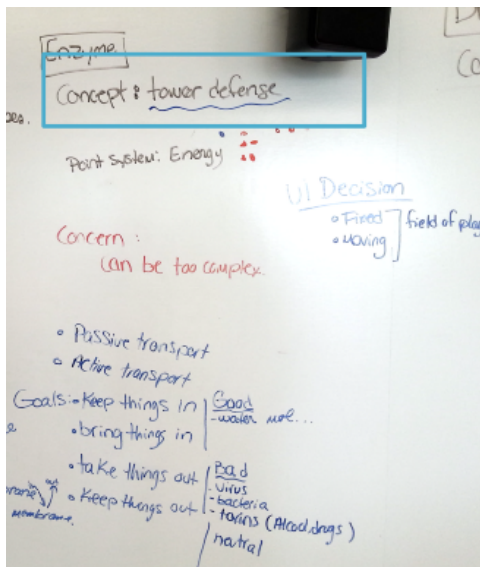
Reading a Cell Biology Textbook

Define

Imagining the game concept. During the ideation phase, we imagined different game concepts related to biology concepts we identified as “gamifiable” during our readings. We also took into account the biology student profiles to identify a suitable concept.

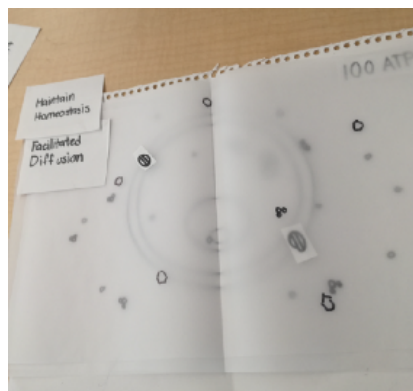
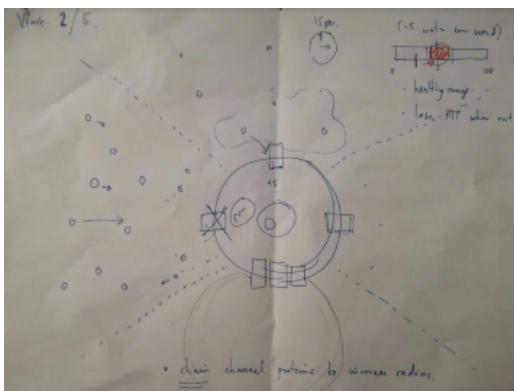
The concept we finally selected was a tower defense game where players defend their cell to stay alive. Tower defense games are strategy video games in which players defend

territories or possessions from attackers by placing defensive structures (Reece, 2015). The tower defense game lends itself nicely to how a cell functions biologically. Cells have to constantly “battle” to maintain their health and structures within the context of the surrounding environment. The key biological concept being taught in this game is homeostasis or how a cell establishes and maintains a balance with its external environment and cell defense against bacteria and viruses. With this game, we also wished to help students realize how every component of cells are interconnected and can rapidly become complex to manage.



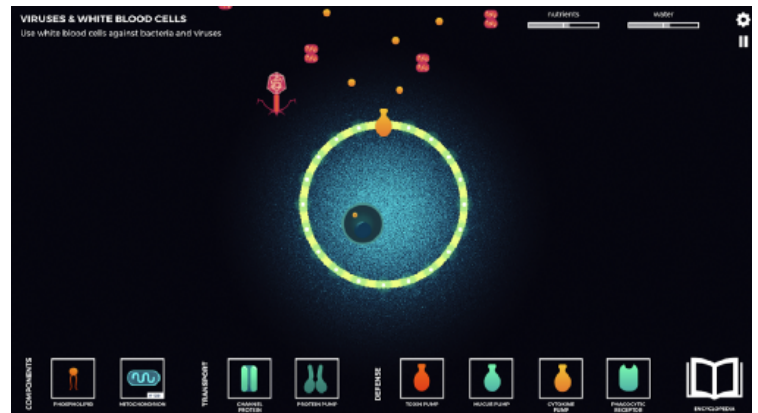
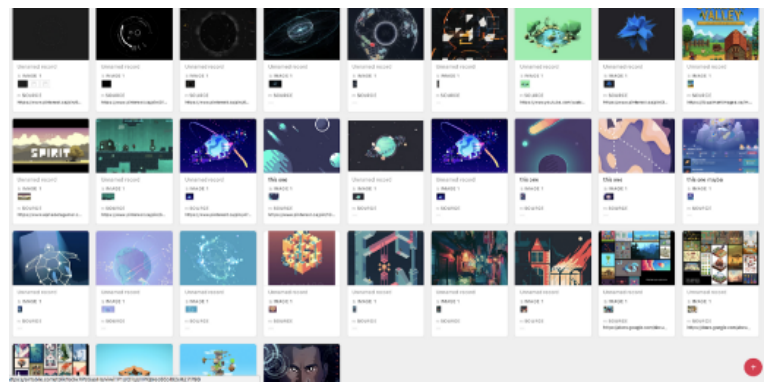
Imagining the game concept

Conceptualization and Evolution of Concept. The students took the initial concept and developed scenarios, levels, game mechanics and basic user interfaces (UI). At this stage, they mainly used paper and digital prototypes, which fostered discussions and greatly helped the development of the game concept.



Evolution of the concept

Students then started to refine user interface concepts and thinking about visual style. They also started to illustrate the different game components.



Evolution of interface and UI components

This led to the creation of the final visual style and interfaces that were chosen for the game.



Final interfaces

Develop

The computer science team then joined us to program the game and to build the prototype. This allowed the design team to precise some game mechanics and to adapt the game to unforeseen technological constraints. The students worked very hard (and succeeded) to build a working prototype for the game.





Meeting with Design and Computer Science team

We then had the opportunity to test the game with staff members, professors and biology students. Two design students helped us to take notes and to reflect on the test results. Overall, users were positive about the game. According to them, they mainly learned that the cell ecosystem is complex with many interconnected elements that maintain a fragile balance. They also gave us several insights on how to improve the prototype, mainly by adjusting the rhythm, balancing the levels and fixing some usability issues.

Discussion

Educational Video Games Are Often boring... Can Interaction Design Students Do Anything About This?

In short, yes. To be honest, we had very modest expectations starting this project. The whole design team had experience playing video games but not one of us had created a video game before. There are 4 key factors that helped us produce a strong game prototype in only two months.

- 1. A crash course in game design.** We all did a crash course in game design to learn key concepts and steps to creating effective games. Balancing fun and learning was the most difficult challenge in this respect.
- 2. Learning the content.** We were all committed to learning the content. This took many hours of textbook and supplemental reading plus several lectures by the biology professor.
- 3. Close student support and supervision.** Students were given close support and supervision to help manage the complexity of such a new and large project. This involves almost daily meetings, team coordination, concept refinement, critiques and workshops.

4. Variety of skill sets. We had a team that combined a variety of skill sets that allowed each person to work to their strengths. For example, if we didn't have a designer with strong illustration and animation skills, it would have been far more difficult to achieve something close to a professional product.

These four factors were critical to ensuring this project far exceeded our modest expectations and should form a minimal checklist for any designers planning to create a video game.

In which areas could undergraduate interaction design students be involved when designing an educational video game?

As noted above, one of the project's success factors was the makeup of the design team. Through the skills of individual students, the whole team worked on the following components of designing the video game:

- Game design
- Interaction and user interface design
- Illustration and animation
- User research and project assessment

Like with user experience designers in general, it is not common to find all four of these skill sets at a very high level in one designer. Therefore, it is recommended the design lead (typically a professor) seeks out and composes an undergraduate team of students that have complementary skills.

What unique learning experiences could be acquired by designing an educational video game?

Based on observing the students and exit interviews with them there were many useful and unique experiences they gained by designing a video game. First, they learned the importance of understanding the content before designing a product. This required the students become content experts, learning as much as they could about the subject material so they could teach it through a game. Second, students learned how to work in a multidisciplinary team. In the classroom, it is logistically difficult to create opportunities for designers and computing science students to work together. Research projects like this, provide this much needed learning opportunity to expose them to how almost all real-world projects operate. Third, the design students learned that their user interface design skills and interaction design principles were transferable to designing of video games. Fourth, students learned a great deal about what makes good video games — both through theory and practice. Within this topic, students learned that one of the most complicated aspects of video game design was to help the player reach a state of flow (Csikszentmihalyi, 2008) by balancing the game's difficulty level while still making it fun to play,

Educational game design as a learning experience for interaction design students?

While very challenging, designing an educational game was a positive experience for all of the designer's involved. It was an excellent way to introduce students to academic research — a first for all five of the students. This project was also their longest and largest design project they had ever worked on. This exposed them to details of the design process that are difficult to replicate in a classroom project. They learned the importance of good communication when working with other team members and, as we mentioned above, how understanding the content of a project means the difference between success and failure.

What are the challenges?

As mentioned this project was very challenging. We were able to address effectively most of the challenges as we encountered them, and with hindsight being 20/20, the others could be addressed with earlier intervention. We encountered mainly 4 main challenges:

1. A Complex Topic. Teaching University-level content takes significant specific knowledge about the content to teach, which is probably one of the major reasons why there are so few good educational video games for University-level topics. We reserved almost 20 hours for each designer on the team to read the textbook and supplementary materials in addition to 4 hours of lecturing by the Biological Sciences professor. He was also present during the whole process, which was critical to the success of the project.

2. The Right Level of Autonomy for the Students. Due to the complexity of the project, we learned quickly that simply touching base with our students once a week would not provide sufficient direction. We had to meet almost every second day, which ended up taking more time than we originally expected. Additionally, the professors had to take on some of the key tasks and provide considerable thought to high-level project goals and concept development. These tasks and decisions require many years of experience to get right and it isn't fair to expect undergraduate students to muddle their way through.

3. Managing the complexity of a video game. To produce something of high quality both conceptually and visually takes a long time. Only to complete our working prototype, the designer professors had to commit 160 hours and the design students required another 1,300 hours. To ensure time is used efficiently, we recommend that the team works together in the same space and at the same time. Time is at a premium for everyone involved and often team members can't wait 2–3 hours for an answer to a project question via email from someone working from home.

4. Communication Between Design and Computing Science Team. Communication is perhaps the most crucial challenge to address. Students need to already possess the skills or be guided in developing the skills to communicate their concerns to other team

members. Both set of students had never worked with other disciplines before so there was a culture shift on both sides. They all had to learn how priorities for the other team would be different and how this coloured discussion during meetings. Additionally, the computing science students had never been exposed to weekly presentations and critiques of their work which was challenging for them. A potential solution to better prepare everyone for this culture shock is to create a project charter that each new team member agrees to before joining. It would include roles and responsibilities along with a description of how meetings would be conducted and for what purpose. Introducing ice breaker exercises to help team members understand the roles of each team would also be a promising solution.

Conclusion: What Is Next?

Despite the challenges presented above, this new exploration was a successful endeavor overall. It gave students a good multidisciplinary work experience, was a promising way to introduce them to research and expanded their horizons regarding potential career paths interaction designers can pursue.

Our next steps are to refine and balance the game mechanics, improve the tutorials for new users, add more animations, levels, music and sound effects. This will involve a team from our University's Music Department as well from the English program. Our goal is to have a completed and tested game by the end of 2020.

Acknowledgements

We want to thank Stephanie Lumayno, Chanelle Paradis, Kia Valdez Bettcher, Matthew Satchwill, John Montague, Kelly Veillette, Isabela Lopez, David Cao, Kevin Ho, Brian Brookwell, Samuel Mugo, for their involvement in this project. Project funded by MacEwan Arts and Science Department, Faculty of Fine Arts and Communications and Research Services.

References

Csikszentmihalyi, M. (2008). *Flow: The Psychology of Optimal Experience*. New York: Harper Perennial Modern Classics.

Design Council (2015). The Design Process: What is the Double Diamond? Retrieved, from <http://www.designcouncil.org.uk/news-opinion/design-process-what-double-diamond>

Michael, D. & Chen S. (2005). Serious games: Games that educate, train, and inform.

Reece, D. (2015, April 27). Best Tower Defense Games of All Time. Retrieved from <https://gameranx.com/features/id/13529/article/best-tower-defense-games/>

Video of the Presentation



"Interaction Design and Educational Video Games" Isabelle Sperano and Robert Andruchow - Interaction19

from Interaction Design Association

23:22 |

About Isabelle



Dr. Sperano embraces a systemic, social and sustainable view of interaction design and information. This approach reveals itself in her teaching, notably by raising student awareness about the importance of taking user needs into account, developing a deep understanding of information behaviours and using holistic frameworks to elaborate sustainable solutions. In order to aid and support the decision-making process of the designers, Dr. Sperano also studies the development of innovative ways to visually describe information-rich ecosystems and interactions with their users. She focuses on finding common avenues of reflection for scientific research, teaching and practice in interaction design and information architecture. As she is constantly looking to widen her perspectives, she is invariably involved in interdisciplinary research teams with technical communication, education, information science, psychology and computer science researchers and practitioners.

About Robert

Robert plays a leadership role in the design community through his teaching, work and research. He is currently an assistant professor in and coordinator of the Design Studies

program at MacEwan University with a teaching focus in user experience design. Previous to his appointment at MacEwan, Robert taught part-time as a sessional instructor for 12 years at the University of Alberta, teaching a range of courses including design fundamentals, design research, design issues and interaction design. During this time, Robert worked for the federal government as a user experience designer until 2006 and since then has run his own design company, Big Pixel Creative working with government organizations and non-profits. Most recently, Robert was co-chair organizing UX Edmonton's annual conference, UX Camp. Robert's Masters and current research is about the philosophy of design, specifically, the role design theory plays in providing a strong foundation for design education and practice.

About Ross

Dr. Ross Shaw has experience working in marine biology, specifically fish disease and coral reef systems. He has worked with scientists from both coasts and maintains active connections with researchers at a various biological stations around the world. Our oceans are under increasing threat, and Dr. Shaw is passionate about learning what can be done to preserve these areas. Currently, he is involved in a large-scale project to bring a public aquarium to the greater Edmonton area.

[Interaction Design](#) [Education Summit](#) [Design Education](#) [Videogames](#)

[About](#) [Help](#) [Legal](#)

Get the Medium app

