The Fluid Ether: A physics simulation game

Kevin Miklasz, Iridescent, kevin@iridescentlearning.org

Abstract: We have created the first simulation game in a six game series based on various physics concepts. The *Ethers* series aims to bring the best parts of video games (goal-oriented play, open-ended challenges, a safe environment for failure, level editors, and performance before competence) to the world of physics education. The game comes with accompanying teacher resources for easy integration into the classroom. *The Fluid Ether* was created by a science education non-profit and is free and available for both computers and the ipad. The other five games, currently in development, will focus on gravity, momentum, projectile motion, electricity, and light.

Introduction

"*When we think of games, we think of fun. When we think of learning, we think of work. Games show us that this is wrong. They trigger deep learning that is itself part and parcel of the fun. It is what makes good games deep*." -James Gee 2007

Commercial games are effective learning tools, because they embody key learning features such as goal-oriented play, open-ended challenges, a safe environment for failure, and performance before competence. As a result, good games allow students to gain an intuitive understanding for a complex system through experiential play. Educational games that are appropriate for classroom settings rarely embody these features and fail to excite, as well as effectively teach, students. On the other hand, games that do embody these features are rarely classroom appropriate. Iridescent is developing six physics video games that embody the key learning features found in commercial games while focusing on classroom content and needs. The first game, *The Fluid Ether*, is complete and will be featured at the GLS Game Arcade.

For students, the game features two primary modes of engagement. First, students can engage in direct gameplay of the stock levels provided in the game. Second, students can create their own levels, adding to the content of the game and learning through creation. Teachers will also be provided with multiple resources to encourage adoption of the game in the classroom. First, teachers will be given an interface that tracks student progress and understanding as they engage with the game. Second, teachers will be give a sort of "lab manual" to structure classroom use of the game, including student homework prompts, discussion prompts and grading rubrics for student projects conducted through the level-editor. Third, Iridescent will provide professional development sessions for teachers to experience the game and create their own lessons surrounding the game.

Description of the game elements

"*Sometimes I was so involved with getting to the next level that I didn't realize what I was doing right, but as the game went on I saw the effect of manipulating water currents with jets.*" -Student tester of *The Fluid Ether*.

Open-ended sandbox style gameplay: A screenshot of the game is shown in figure 1. The game model is a physics simulator embedded in a sandbox style gameplay. Students manipulate the environment to move objects around and accomplish goals. For example players turn on and off jets to create fluid flow patterns that will move balls and accomplish tasks such as collecting coins and breaking blocks. Such gameplay encourages exploration of complex physics principles. For example by manipulating the fluid mechanics simulation, students learn that competing forces of drag and inertia increase disproportionately as ball size increases.

Deeper learning through challenge levels: The games will also feature challenge levels to test student knowledge. These levels will present one objective in a highly constrained format. Such levels will direct the student's attention to features they may have taken for granted, and it will subsequently test their understanding of those features. For example, in the "density" challenge level, a student will learn that balls of greater density have more inertia and take longer to accelerate. She will encounter a level with three balls of various densities, each ball in its own track and ready to be pushed forward by a jet with the tap of a finger. The goal is to make every ball hit the opposite side of the track at the same time. She will have to do this by turning on the jets in the tracks with high-density balls first, in the right order, and with correct timing.

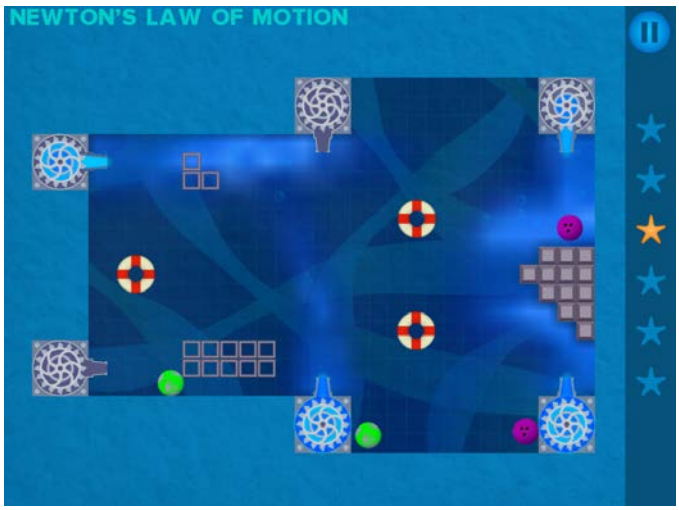

Figure 1: A screenshot of *The Fluid Ether*

In-game assessment: The game collects patterns of student play as they proceed through the game. When used in a classroom, this data can be pushed to a teacher's account, providing feedback on student progress to the teacher. In addition, such data acts as evidence of student performance and understanding. This can enable a transition towards in-game, evidence-based assessment, such that the act of doing functions both as learning, and as proof of learning. The data collection system is still being modified, and the author will share data collection methods with GLS attendees in the hope of developing a better understanding of what data to collect and how to collect it.

Co-creation through level editors: The game model will have a level-editor so that students can create their own levels, engaging them deeper in the physics and allowing them to engage in the design process. Students will be encouraged to customize the game to their liking and to add new challenges for other students to play. Teachers will be able to assign level-creation as a class project. A student-created level with an accompanying written or oral presentation will serve the same purpose in a science classroom that an essay serves in a reading classroom - a demonstration of understanding and synthesis of the topic.

References

Gee, J.P. (2007). *Good video games+ good learning: Collected essays on video games, learning, and literacy*. Vol. 27. Peter Lang Pub Incorporated.