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Telescope to Tablet

Using Real World Data to Design an Astronomy Game

Jennifer Dalsen (University of Wisconsin – Madison), Kurt Squire (University of Wisconsin - Madison), & Michael Beall (Learning Games Network)

Abstract

Undergraduate students enrolled in astronomy classes often seek to satisfy curiosities about outer space and fulfill a distribution requirement. However, they are rarely prepared to employ the mathematical thinking that is a natural part of the discipline. As a result, astronomy professors are challenged with communicating quantitatively laden subject matter in ways appropriate to their students and context. *At Play in the Cosmos* is an educational game designed to engage non-science majors by piquing their interest in our modern understanding of the Solar System, Stars, Galaxies and the Universe. It seeks to address this tension between qualitative and quantitative understandings, so that students begin with qualitative intuitions that are then formalized through quantitative representations (see Forbus, 2011). This paper provides a preliminary roadmap to how user feedback contributed to the design process.

Introduction

The majority of undergraduate students enrolled in ASTR 101 have no long-term plans to enter the astronomy field. These students expect to learn about galaxies and black holes, but do not anticipate the level of mathematical representation typically employed by the discipline. Models – from physical depictions to mathematical equations – are central to how we conceptualize astronomical phenomena. Astronomy professors introducing these representational systems (such as scientific notation) are also attempting to teach underlying phenomena. Indeed, the entangled nature between scientific inquiry and representation is at the heart of astronomy. As Frank (1999) writes:

"With mounds of data to sort through and hairy equations to solve, astronomers face issues that are anything but trivial. Some problems, however, are so frighteningly complex they are in a league of their own, problems such as the motions of gas inside stars or the evolution of the universe."

Norton Publishing, in partnership with the Learning Games Network (LGN) is exploring how a digital game, *At Play in the Cosmos*, might immerse learners in situations in which they think with scientific tools (e.g. scientific notation, Keppler's Law) while also leveraging games' capacity for real-time interactive 3D simulation.

Preliminary Structure

At Play in the Cosmos is a game designed to complement a collegiate astronomy textbook. The purpose of the game is to look beyond learned material and think critically about how evidence is applied to real world situations (Squire, 2011). Players are not expected to make any formal scientific calculations in the game itself. However, each scientific equation can be expanded or contracted in order to display what each part of the equation represents, thereby giving users a more in-depth look at the science behind their actions.

Play Testers

LGN facilitated two focus group rounds. The first focus group discussed expectations of an astronomy game. Questions examined game narrative, character development and artistic designs. A second focus group took place roughly six months later. By this point, developers had incorporated player feedback into the game's structure. The second round looked at engagement, game mechanics and scientific concepts. All participants were undergraduate students from a Midwestern university. A total of 68 undergraduate students participated in these sessions (46 males and 22 females). Only 2 participants identified as an astronomy major.

Design Outcomes

A roadmap of select design items, user feedback and resulting actions are displayed in Table 1.

	Feedback	Resulting Action
Narrative	Not Earth-bound Involve space exploration Include challenges Action storyline	Levels were modified to be missions that are also available as easily accessible tools for teaching.
Character	Ship captain Contractor Include artificial intelligence or robotic companion	A computer interface (C.O.R.I.) is an interactive guide and companion. C.O.R.I. narrates the storyline, alerts players to status updates and directions.
Presence of Scientific Equations	Participants want to see how equations are connected to digital models.	The option to expand or contract the "skeletal structure" of science equations was kept intact.
Navigational Tools	Initial controls were hard to identify and manipulate. Participants noticed their hands blocking the screen when navigating the controls.	Navigational controls were resituated to the corners of the screen and reverse thrusters modified to be more sensitive to touch.

Table 1. Feedback and resulting actions

Conclusion

At Play in the Cosmos is an interactive game created through the collaborative effort of astrophysics and game developers. Through user testing, developers identified key themes and game components to include in the final design. Play testing proved crucial to confirming what type of play and narrative would best engage non-science majors.

References

Forbus, K. (2011). Qualitative Modeling. WIRES: Cognitive Science. 2(4), pp 374-391, July/August

Frank, A. (1999). Virtual Astronomy. *Astronomy*. 27(8).

Squire, K. (2011). *Video Games and Learning: Teaching and Participatory Culture in the Digital Age. Technology, Education–Connections (the TEC Series)*. Teachers College Press. 1234 Amsterdam Avenue, New York, NY 10027.