RECENT DEVELOPMENTS IN PUZZLE DESIGN AND EDUCATIONAL SOFTWARE, AND A MODEL FOR CONVERGENCE

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Abstract

Since 2007 there have been several seminal computer games released that have completely changed the landscape of puzzle design. As will be discussed in this talk, their nature has huge implications for education. Titles including Portal, Miegakure, and Incredipede will be examined and demonstrated, and the subtle techniques they use to keep students ("players") engaged will be examined in the first half of the talk. Influenced by them, a novel approach to educational software was recently developed by Bret Victor: the "interactive essay", which will be introduced in the second half of the talk. Victor's proof-of-concept was a well-refined expression of the content of an important academic paper, so his format clearly has great expressive power. However, better expressive power may be attained by bringing the format even closer to using Portal-like puzzle design techniques. Work on some projects at the university of Warwick has attempted to do this, influenced by the Constructionism 2010 submission "Constructionism through construal by computer"[1]. These new pieces of educational software, along with Victor's model, will be demonstrated and discussed.

Keywords: educational games, educational software, maths, science, puzzles.

Educational video games have a history that has given them a deservedly bad reputation. Jacob Habgood, speaking about the design patterns often seen in educational games, coined the phrase "chocolate covered broccoli"[2]: the implication being that the "games" consisted of textbook content alternating with interludes of simplistic "fun" gameplay and story content (such as "math blaster", a game about combatting enemies that sometimes ask players maths questions).

This was the ugly history of educational games, and sadly the situation has not changed much. However, since 2007, the potential for a real paradigm shift has been shown. Portal (2007) can be thought of as a game that started a genre we may call the "expressive puzzle game"[3]; it is also very safe to call it one of the most beloved games of all time. In it, players navigate 3D puzzle rooms from a first-person viewpoint, trying to get themselves to an exit. They have the ability to create wormholes - pairs of doorways that act as a shortcut between the places they put them.

Portal's premise was hugely original, but its puzzle design was what made it revolutionary. Getting through the game's rooms requires the player to do a large number of varied, puzzle-like things - but these "puzzles" were not intended to be "puzzling"[4]. Using a number of non-verbal techniques informed by architecture and psychology, the game's designers attempted to make the puzzles as easy as possible - but this would be easy without compromising the interesting quality of the solution, and without resorting to verbally communicating to the player (because reading is often not as impactful as acting[5]). This made Portal something very new, and very fun: a game that was not about *challenge*, but about *engaging with varied "phenomena"*. The psychology and architecture at work will be discussed, and a brief video of Portal will be shown.

A few games related to Portal will be discussed, then the talk will move to a different place: a novel approach to educational software recently developed by Bret Victor[5], in which learners come at scientific information through a series of linked applet-like windows alternating with text. Victor's creations are very close to a methodology presented in the paper "constructionism through construal by a computer" presented at Constructionism 2010 by Meurig Beynon and Anthony Harfield. Victor's presentation "translated" a mathematics paper into an interactive form. The original paper[6], on "small world dynamics" was filled with inaccessible algebra; but Victor was able to visualize most of the concepts that were described, with some of the visualizations being made interactive. By alternating text with small (100x100 pixel) applets, he was able to express all the same information in the paper in a more direct and responsive way.

Victor was influenced on a philosophical level by Portal, though his work is quite different from it (it is partly verbal, and interactions are simpler). *Combining* the techniques of the two might be what leads to a format that is ideal for education: something with the specificity of Victor's presentation, and the fluidity of Portal. In this demonstration, projects of the author's own that aim for this Victor/Portal combination will be discussed and demonstrated. These projects combine verbal and visual/interactive learning, embed learning content directly into mechanics, and use Portal-like tools to lead users towards engaging with educational content.

References

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