

Learning Newton While Crashing Cars



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Analysis

Purpose

What if there was a simple and cost effective way to “tweak” games so that players not only had fun, but learned something about physics? My research is an attempt to develop a design framework that subtly integrates formal content into informal video game contexts. In this first study I am looking at the game features kids attend to and interpret as velocity, acceleration, and momentum.

Research Questions

- What game design components cue a player’s intuitive concept of acceleration, velocity, and momentum?
- What *phenomenological primitives* are activated by these registrations?

Conceptual Framework

- Registrations: The design elements that become salient to the player during his interactions with the game and controller (Roschelle, 1991).
- diSessa’s (1993) *sense-of-mechanism* framework is used to identify *p-prims* activated by design components.

Method

- Ethnographic observation of three different kids playing *Mario Kart* on the Nintendo Wii and *Burnout Paradise* on the Xbox 360.
- Participants and the game screen were video taped, transcribed, and coded.
- Informal semi-clinical interviews were conducted during game play.

Children’s *p-prim*

- Being ahead implies having gone faster
- Getting to a goal first means having gone faster

Spatial Relationship

“I’m in first! That pretty much tells me I’m going fast!” (5/7/09, Transcript)

“You can tell like oh they’re going the speed limit and I’m going like 80 times faster than they are... See that guy all the way up there? And I just pass him like really quickly which proves that he was going really slow” (1/31/09, Transcript)



Mario Kart Wii

Children’s *p-prim*

- Passing means going faster



Burnout Paradise

Surroundings

“Like you can tell also from like stuff on the sidewalks and stuff on the streets like these stoplights.” (1/31/09, Transcript)

“by how fast the landscape is moving by.” (5/7/09, Transcript)

Vehicle Attribute

“This one has the best speed and acceleration” (5/7/09, Transcript)

“That’s why this car is so good. It’s so fast.” (5/7/09, Transcript)



Velocity and acceleration as car attributes

- Kids can define velocity and acceleration, but may not be able to identify differences
- Velocity and acceleration become *registrations* of attributes of the car.
- Related to controller use (“I never brake”).



Size

“Like if I hit a...it depends on the size of the car. Like if I hit a small car it’ll go flying but if I hit a huge car then I’ll go flying. [...] Cause my car is average size I guess.” (1/31/09, Transcript)

Ohm’s *p-prim*

- More effort yields more result

Conclusions

- 62% of the time players registered velocity using the spatial relationships noticed between vehicles. This registration likely activates the “being ahead implies having gone faster” *p-prim*.
- Players also attend to the movement of the surroundings in relation to their own car. The time it takes to pass trees, light posts, and buildings activates the “passing means going faster” *p-prim*.
- Players utilize *Ohm’s p-prim*, activated by visual vehicle size, to explain the concept of momentum as it plays out in the game.
- More work should be done to determine whether young players are able to distinguish velocity from acceleration during game play.

Selected References

diSessa, A.A. (1993). Toward an epistemology of physics. *Cognition and instruction*, 10(2 & 3), 105-225.

Roschelle, J. (1991). *Microanalysis of qualitative physics: Opening the black box*. Paper presented at the annual meeting of the AERA: Chicago, IL.

Gee, J. P. (2003). *What video games have to teach us about learning and literacy*. New York: Palgrave Macmillan.

Future Work

- By matching player’s *registrations* to established *p-prims* we can better identify possible design “tweaks” to move players from intuitive interpretations to expert-like thinking.
- In the next phase of my research, simulations will be used to isolate possible game designs. These simulations will allow us to test design tweaks to gain insight into possible frameworks that could help players to gain a qualitative understanding of concepts such as velocity and acceleration.

