Entry Title: *AdditionBlocks*

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Executive Summary

AdditionBlocks is a simple, fun, and challenging digital-learning video game to reinforce addition skills and improve recall speed and accuracy.

AdditionBlocks is currently a fully playable game written in *GameMaker 8.1*, and can be ported HTML5, Android or iOs platforms using *GameMaker Studio*. The game is playable and sustainable to all age groups with multiple game speed settings, difficulty levels, and the implementation of an achievement/reward system.

The game meets the *KIDS Ready to Learn Math Framework* by having players add digits to find sums up to 10 (Grade 1) and 20 (Grade 2). Additionally, the Common Core Standards requires children to add up to 20 (in Grades 1 & 2) and building fluency (Grade 2)[1]. Players will also find multiple combinations of digits that form the same sum, and mentally answering problems such as "What plus 5 equals 9?"

Sixty-eight percent of parents believe that game play provides mental stimulation or education; and playing games constitutes 87% of computer use by children between the ages of five and nine. However, as of January 30th 2012, the *PBS Kids Website* has not posted any addition-based video games for children of this age group.

Further development of ***AdditionBlocks*** includes completing the achievement system and re-designing the graphics for a more professional look/age-appropriate appeal. Additional play-testing is needed for the 6-8 age group to determine playability, regulate difficulty levels, and further assess the educational impact. Testing will also need to be completed on web browsers and mobile devices.

Concept Overview

AdditionBlocks is a simple, fun, and challenging digital-learning game to *reinforce* and *practice* basic addition skills and improve recall speed and accuracy (computational fluency). Players race against falling target sums to form sums using the digits 1 through 9. The game starts with the smaller digits and lower sums; as players progress through levels, the mid- and upper digits are introduced, and higher target sums are used. An achievement/reward system is used to keep the game playable and maintain student engagement.

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[1] "CCSI Math Standards", http://www.corestandards.org. Common Core State Standards Initiative. 8 Feb 2012. Web. n.d.

Computational Fluency is part of an essential foundation for more advanced performance.[2] In a research document from the makers of a digital-learning math program, the authors report:

> "Educators and cognitive scientists agree that the ability to recall basic math facts fluently is necessary for students to attain higher-order math skills... If a student constantly has to compute the answers to basic facts, less of that student's thinking capacity can be devoted to higher level concepts than a student who can effortlessly recall the answers to basic facts."

The authors consider basic math facts as computations with single-digit numbers.[3]

AdditionBlocks can be played in the classroom or at home to provide an electronic alternative to drill work required at this age level.[4] ***AdditionBlocks*** can improve recall speed and accuracy by reinforcing the memory "connections" and by forcing players to use more efficient adding methods (ie, NOT using fingers or counting), moving the child from constructing an answer to long-term memory retention.[5] Because of the time element used in the game, *AdditionBlocks is not designed to teach basic addition skills*.

AdditionBlocks provides children immediate feedback, allows failure, and encourages persistence, all of which are not provided in standard paper-and-pencil drill work. For example, when a child tries to use '5'and '2' to get 8, they will find that the digit blocks and target sum blocks are not being destroyed. When the student clicks on the '5' and '3', the digit blocks and target blocks are immediately destroyed with accompanying graphics and sound. There is little or no consequences for immediate failure, as students have time and multiple opportunities to find correct sums.

Sixty-eight percent of parents believe that game-play provides mental stimulation or education.[6] Interestingly, the *PBS KIDS Ready-to-learn-Math Framework* document does not list any first or second grade addition games.[7] Addition Blocks is a game that can begin to fill that hole.

The educational game genre does not require high quality, immersive 3D worlds to be fun and stimulating. ***AdditionBlocks*** uses simple 2D graphics. Additionally, in some digital-learning games, the educational value is not obvious, or the math content is forced and actually detracts from the game play. The game play of ***AdditionBlocks*** should be

[2] Korn, Angela. "Research Paper: Building Calculation Fluency". *http://eps.schoolspecialty.com/*. School Specialty: Literacy and Intervention. Jan. 2011. Web. 2 Feb 2011.
[3] "Research Foundation & Evidence of Effectiveness for FASTT Math". *http://www.scholastic.com*. Scholastic. n.d. Web. 2 Feb 2011.
[4] Ibid.
[5] Korn, Angela. "Research Paper: Building Calculation Fluency". *http://eps.schoolspecialty.com/*. School Specialty: Literacy and Intervention. Jan. 2011. Web. 2 Feb 2011.
[6] "Facts on Game Playing". *http://www.theesa.com/*. The Entertainment Software Association. n.d. Web. 2 Feb 2011.
[7] "Math Framework". http://pbskids.org/stemchallenge/. PBS Kids. n.d. Web. Jan 2011.

obvious to teachers and parents that the focus and object of the game is to practice addition.[8]

The educational impact of ***AdditionBlocks*** can be measured informally and formally. When my middle school students have played the game, students' comments overheard include "This is fun!" or "Can I keep playing?" Formally, teachers would use an untimed pre-test to determine a student's base-line abilities (however, recording the time is important). The game would be used several times a week for 5-10 minutes at a time. After a three month time span, teachers would re-test the students to compare correct answers, accuracy, and completion time.

KIDS Ready to Learn Math Framework

The game meets the PBS Kids Math Framework for Grade 1 & Grade 2 (6, 7, and 8 year-olds) by having the kids mentally add up to 10 (or 20 for grade 2). Addition Blocks also provides the opportunity for children find multiple combinations for the target sums. For example, a target sum of 9 can be computed as 5+4, 1+6+2, 4+1+1+3, etc. They also will solve addition sentences when clicking on a digit and then have to determine: "What plus 4 will equal 7?"

Playability

The right side of the screen displays the target sum on a slowly falling block. The rest of the screen has a 5 x 5 grid of blocks that contain a single digit. Players single-click on adjacent digit blocks to form the target sums. When a player's response equals the target sum, the digit blocks and the target sum block are 'destroyed', and the remaining digit blocks fall to fill in the empty space. (If an entire column is removed, digit blocks slide to the left). A new target sum is created and begins to fall from the top of the screen.

If the player does not find the sum by the time the target block falls to the bottom of the screen, the target blocks stack to form a wall. The game will end when the wall raises higher than the target line (10 uncompleted sums).

The level continues until the player clears the board of all blocks or if the remaining blocks cannot be used to calculate the current target sum. As the game progresses, the target sums will gradually increase in value and higher digits are used on the game board.

The game is sustainable and playable through gradually increasing difficulty and an achievement/reward system. Players earn medals when achieving multiplier bonuses, certain scores, or reach certain levels in the game. Medals unlock game extras, bonuses, and power-ups after earning medals.

[8] Klopfer, Eric, Osterweil, Scot, and Salen, Katie. "Moving Learning Games Forward". *http://education.mit.edu*. The Education Arcade. n.d. Web. Jan 2011.

Potential for Scale

The game is scalable to different age groups by changing the options for difficultly and speed. The game is also scalable other platforms since ***AdditionBlocks*** is written in *GameMaker 8.1*. **YoYo Games** will release *GameMaker Studio* this year (2012) to be able to port to HTML5 (to be played on web browsers), Android and iOs operating systems.

The access to the game will be widely available as well. The game executable will be posted on the YoYo Games website, (as a free download), available via hosted web site (Illuminations, CalculationNation, PBSKids, etc), and uploaded to Andriod and iOS stores for $.99.

Underserved Communities

The game has a small memory size footprint and simple graphics so download times are low and the game will start quickly. The game does not require a high-speed internet connection, powerful computer system, or high memory requirements, so basic computers with an updated web browser will be able to play the game. Any Android Smartphone, iPhone, iPad, or mobile device with an HTLM5 browser will also be able to play the game.

Next Steps

If ***AdditionBlocks*** wins the Grand Prize, the first step is to hire a graphic artist to update the sprites and graphics to have a more professional and age-appropriate look and feel. I would investigate the possibility of **YoYo Games** development team (producers of Andriod and iOs games written in GameMaker) to create the graphics.

In addition, I would need to purchase *GameMaker Studio* to port the game to HTML5, Android and iOS operating systems, as well as purchase an iPad and SmartPhone to test the application on those devices.

If awarded the opportunity to enhance AdditionBlocks, I would like to conduct additional play-testing, perform an action-research study on the impact of playing ***AdditionBlocks*** in the classroom, and write an article for NCTM and for the GCTM (Georgia Council of Teachers of Mathematics).

Lastly, I would investigate marketing the game to educational websites (Study Island, Illuminations, Calculation Nation, PBS Kids, etc) to add ***AdditionBlocks*** to their educational game offerings.