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A Neurologist Makes the Case for the Video Game Model as a Learning Tool

by Judy Willis MD

The popularity of video games is not the enemy of education, but rather a model for best teaching strategies. Games insert players at *their achievable challenge level* and reward player effort and practice with acknowledgement of *incremental goal progress*, not just final product. The fuel for this process is the pleasure experience related to the release of *dopamine*.

Dopamine Motivation

The human brain, much like that of most mammals, has hardwired physiological responses that had survival value at some point in evolutionary progression. The dopamine-reward system is fueled by the brain's recognition of making a successful prediction, choice, or behavioral response.

Dopamine is a neurotransmitter that, when released in higher than usual amounts, goes beyond the synapse and flows to other regions of the brain producing a powerful pleasure response. This is a deep satisfaction, such as quenching a long thirst. After making a prediction, choice, or action, and receiving feedback that it was correct, the reward from the release of dopamine prompts the brain seek future opportunities to repeat the action. For animal survival, this promotes life or species-sustaining choices and behaviors, such as following a new scent that leads to a mate or a meal and remembering that scent the next time it is present.

No Pain, No Gain

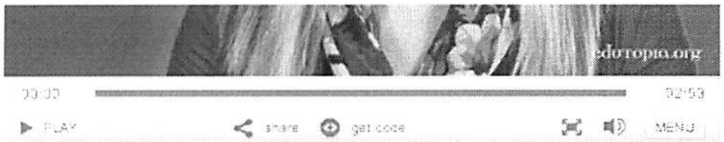
The survival benefit of the dopamine-reward system is *building* skills and adaptive responses. The system is only activated and available to promote, sustain, or repeat some mental or physical effort when the outcome is not assured. If there is no risk, there is no reward. If there is no challenge, such as adding single digit numbers by a student who has achieved mastery in adding double-digit numbers, there is activation of the dopamine-reward network.

In humans, the dopamine reward response that promotes pleasure and motivation also requires that they are *aware* that they solved a problem, figured out a puzzle, correctly answered a challenging question, or achieved the sequence of movements needed to play a song on the piano or swing a baseball bat to hit a home run. This is why students need to use what they learn in authentic ways that allow them to recognize their progress as clearly as they see it when playing video games.

Awareness of Incremental Goal Progress

In a sequential, multilevel video game, feedback of progress is often ongoing, such as accumulating points, visual tokens, or celebratory sound effects, but the real jolt of dopamine reward is in response to the player achieving the challenge, solution, sequence, etc. needed to progress to the next and more challenging level of the game. When the brain receives that feedback that this progress has been made, it reinforces the networks used to succeed. Through a feedback system, that neuronal circuit becomes stronger and more durable. In other words, memory of the mental or physical response used to achieve the dopamine reward is reinforced.

It may seem counter intuitive to think that children would consider harder work a reward for doing well on a homework problem, test, or physical skill to which they devoted considerable physical or mental energy. Yet, that is just what the video playing brain seeks after experiencing the pleasure of reaching a higher level in the game. A computer game doesn't hand out cash, toys, or even hugs. The motivation to persevere is the brain seeking another surge of dopamine -- the fuel of *intrinsic reinforcement*.



Individualized Achievable Challenge

Individualized achievable challenge level is one where a task, action, or choice is not so easy as to be essentially automatic or 100% successful. When that is the case the brain is not alert for feedback and there is no activation of the dopamine reward response system. The task must also not be perceived as so difficult that there is no chance of success. It is only when the brain perceives a reasonable possibility of success for achieving a desirable goal that it invests the energy and activates the dopamine reward circuit.

fMRI and cognitive studies reveal that the brain "evaluates" the probability of effort resulting in success before expending the cognitive effort in solving mental problems. If the challenge seems too high, or students have a fixed mindset related past failures that they will not succeed in a subject or topic, the brain is not likely to expend the effort needed to achieve the challenge.

Brain effort is costly because this three-pound organ needs 20% of the body's supply of oxygen and glucose to keep its cells alive. The brain operates to conserve its resources unless the energy cost is low or the expectation of reward is high. In the classroom, that is the ideal level of instructional challenge for student motivation.

When learners have opportunities to participate in learning challenges at their individualized achievable challenge level, their brains invest more effort to the task and are more responsive to feedback. Students working toward clear, desirable goals within their range of perceived achievable challenge, reach levels of engagement much like the focus and perseverance we see when they play their video games.

Feedback or scaffolding may be needed to support students' perception that the challenge is achievable, but the levels of mastery are rarely the same for every student in the class. This is when we need to provide opportunities for differentiating and individualizing. These interventions range from clearly scaled rubrics, to small flexible groups for "as needed" support, or collaborative groups through which students can "enter" from their strengths. Descriptions of these strategies, beyond the scope of this article, are found in differentiated instruction literature.

Game Entry Point is a Perfect Fit Through Pre-assessment and Feedback

The best on-line learning programs for building students' missing foundational knowledge use student responses to structure learning at individualized achievable challenge levels. These programs also provide timely corrective and progress-acknowledging feedback that allows the students to correct mistakes, build understanding progressively, and recognize their incremental progress.

The classroom model can follow suit. Video games with levels of play allow the player to progress quickly through early levels if the gamer already has the skill needed. Gamers reportedly make errors 80% of the time, but the most compelling games give hints, cues, and other feedback so players' brains have enough expectation of dopamine reward to persevere. The games require practice for the specific skills the player needs to master, without the off-putting requirement to repeat tasks already mastered. This type of game keeps the brain engaged because the dopamine surge is perceived to be within reach if effort and practice are sustained.

Good games give players opportunities for experiencing intrinsic reward at frequent intervals, when they apply the effort and practice the specific skills they need to get to the next level. The games do not require mastery of all tasks and the completion of the whole game before giving the brain the feedback for dopamine boosts of satisfaction. The dopamine release comes each time the game provides feedback that the player's actions or responses are correct. The player gains points or tokens for small incremental progress and ultimately the powerful feedback of the success of progressing to the next level. This is when players seek "harder work". To keep the pleasure of intrinsic satisfaction going, the brain needs a higher level of challenge, because staying at a level once mastery is achieved doesn't release the dopamine.

Bringing Incremental Progress Recognition to the Classroom... and Beyond

In the classroom, the video model can be achieved with timely, corrective feedback so students recognize incorrect foundational knowledge and then have opportunities to strengthen the correct new memory circuits through practice and application. However, individualized instruction, assignments, and feedback, that allow students to consistently work at their individualized achievable challenge levels, are time-consuming processes not possible for teachers to consistently provide all students.

What we can do is be aware of the reason the brain is so responsive to video game play and keep achievable challenge and incremental progress feedback in mind when planning units of instruction. One way to help each student sustain motivation and effort is to shift progress recognition to students themselves. This can be done by having students use a variety of methods of recording their own progress toward individualized goals. Through brief conferences, goals can be mutually agreed upon, such as number of pages read a week (with comprehension accountability), progression to the next level of the multiplication tables, or achievement of a higher level on a rubric for writing an essay. Free bar graphs downloaded from the Internet can be filled in by students as they record and see evidence of their incremental goal progress. In contrast to the system of recognition delayed until a final product is completed, graphing reveals the incremental progress evidence throughout the learning process. I've found that for students who have lost confidence to the point of not wanting to risk more failure, it is helpful to start the effort-to-progress record keeping and graphing with something they enjoy, such as shooting foul shots or computer keyboarding speed and accuracy.

Immediate Gratification or Long-term Goal Pursuit?

Compared to an adult brain, a young brain needs more frequent dopamine boosts to sustain effort, persevere through challenges and setbacks, and build the trait of resilience. The brain's prefrontal cortex, with its *executive functions* (judgment, analysis, delay of immediate gratification, prioritizing, planning, etc.) will be the subject of a future blog. In relation to the video game model, it is important to plan instruction keeping in mind that the executive function circuits are late to mature – well into the twenties. The visible evidence seen on their graphs or rubric progress evidence helps students develop the concept that effort toward a goal brings progress. This, in turn, builds their capacity to resist their young brain's strong drive for immediate gratification. As students use visible models to recognize their incremental goal progress, they build the executive function of goal-directed behavior.

Classroom instruction that provides opportunities for incremental progress feedback at students' achievable challenge levels pays off with increased focus, resilience, and willingness to revise and persevere toward achievement of goals. The development of students' awareness of their potentials to achieve success, through effort and response to feedback, extends far beyond the classroom walls. Your application of the video game model to instruction encourages the habits of mind through which your students can achieve their highest academic, social, and emotional potentials.

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