PETER H. DIAMANDIS

CHRONICLES OF EDUCATION

Reinventing how we teach our kids

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INTRODUCTION

Most elementary schools haven't changed in decades. As someone who studies the future of exponential technologies, I began asking myself what I'd want my kids to learn, and how I'd reinvent elementary school during an exponential era.

This whitepaper covers five subjects related to elementary school education:

1. **FIVE ISSUES WITH TODAY'S ELEMENTARY SCHOOLS**
2. **FIVE GUIDING PRINCIPLES FOR FUTURE EDUCATION**
3. **AN ELEMENTARY SCHOOL CURRICULUM FOR THE FUTURE**
4. **EXPONENTIAL TECHNOLOGIES IN OUR CLASSROOM**
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FIVE ISSUES WITH TODAY'S ELEMENTARY SCHOOLS

Today's traditional elementary schools are plagued with a variety of issues, but here are some of the most bothersome:

1 | **GRADING.** In the traditional education system, you start at an "A," and every time you get something wrong, your score gets lower and lower. At best it's demotivating, and at worst it has nothing to do with the world you occupy as an adult. In the gaming world (e.g. Angry Birds), it's just the opposite. You start with zero and every time you come up with something right, your score gets higher and higher.

2 | **SAGE ON THE STAGE.** Most classrooms have a teacher up in front of class lecturing to a classroom of students, half of whom are bored and half of whom are lost. The one-teacher-fits-all model comes from an era of scarcity where great teachers and schools were rare.

3 | **RELEVANCE.** When I think back to elementary and secondary school, I realize how much of what I learned was never actually useful later in life, and how many of my critical lessons for success I had to pick up on my own. (I don't know about you, but I haven't ever actually had to factor a polynomial in my adult life.)

4 | **IMAGINATION - COLORING INSIDE THE LINES.** Probably of greatest concern to me is the factory-worker, industrial-era origin of today's schools -- programs so structured with rote memorization that it squashes the originality from most children. I'm reminded that "the day before something is truly a breakthrough, it's a crazy idea."

Where do we pursue crazy ideas in our schools? Where do we foster imagination?

5 | **BORING.** If learning in school is a chore, boring or emotionless, then the most important driver of human learning, passion, is disengaged. Having our children memorize facts and figures, sit passively in class and take mundane standardized tests completely defeats the purpose.

An average of 7,200 students drop out of high school each day, totaling 1.3 million each year. This means only 69% of students who start high school finish four years later. And over 50% of these high school dropouts name boredom as the No. 1 reason they left.

FIVE GUIDING PRINCIPLES FOR FUTURE EDUCATION

What if elementary schools strengthened capabilities like these?

1 | **PASSION.** You'd be amazed at how many people don't have a mission in life. A calling — something to jolt them out of bed every morning. The most valuable resource for humanity is the persistent and passionate human mind, so creating a future of passionate kids is essential.

For my 5-year-old boys, I want to support them in finding their passion or purpose... something that is uniquely theirs, in the same way that the Apollo program and Star Trek drove my early love for all things space, and that passion drove me to learn and do.

2 | **CURIOSITY.** Curiosity is something innate in kids, yet it's lost by most adults during the course of their life. Why?

In a world of Google, robots and AI, raising a kid that is constantly asking questions and running "what if" experiments can be extremely valuable. In an age of machine learning, massive data and a trillion sensors, it will be the quality of your questions that will be most important.

3 | **IMAGINATION.** Entrepreneurs and visionaries imagine the world (and the future) they want to live in, and then they create it. Kids happen to be some of the most imaginative humans around. It's critical that they know how important and liberating imagination can be.

4 | **CRITICAL THINKING.** In a world flooded with often-conflicting ideas, baseless claims, misleading headlines, negative news and misinformation, learning the skill of critical thinking helps find the signal in the noise. This principle is perhaps the most difficult to teach kids.

5 | **GRIT.** Grit is defined as "passion and perseverance in pursuit of long-term goals," and it has recently been widely acknowledged as one of the most important predictors of and contributors to success.

Teaching your kids not to give up, to keep trying, and to keep trying new ideas for something that they are truly passionate about achieving is extremely critical. Much of my personal success has come from such stubbornness. I joke that both XPRIZE and the Zero Gravity Corporation were "overnight successes after 10 years of hard work."

So given those five basic principles, what would an elementary curriculum look like?

Let's take a look...

CHRONICLES OF EDUCATION

AN ELEMENTARY SCHOOL CURRICULUM FOR THE FUTURE

Over the last 30 years, I've had the pleasure of starting two universities, International Space University (1987) and Singularity University (2007). My favorite part of cofounding both institutions was designing and implementing the curriculum. Along those lines, the following is my first shot at the type of curriculum I'd love my own boys to be learning.

I'd love your thoughts. CLICK HERE to tell me what you think.

For the purpose of illustration, I'll speak about 'courses' or 'modules,' but in reality these are just elements that would ultimately be woven together throughout the course of K-6 education.

MODULE 1

STORYTELLING / COMMUNICATIONS

When I think about the skill that has served me best in life, it's been my ability to present my ideas in the most compelling fashion possible, to get others onboard, and support birth and growth in an innovative direction. In my adult life, as an entrepreneur and a CEO, it's been my ability to communicate clearly and tell compelling stories that has allowed me to create the future. I don't think this lesson can start too early in life.

So imagine a module, year after year, where our kids learn the art and practice of formulating and pitching their ideas. The best of oration and storytelling. Perhaps children in this class would watch TED presentations, or maybe they'd put together their own TEDx for kids. Ultimately, it's about practice and getting comfortable with putting yourself and your ideas out there and overcoming any fears of public speaking.

MODULE 2

PASSIONS

A modern school should help our children find and explore their passion(s). Passion is the greatest gift of self-discovery. It is a source of interest and excitement, and is unique to each child.

The key to finding passion is exposure. Allowing kids to experience as many adventures, careers and passionate adults as possible. Historically, this was limited by the reality of geography and cost, implemented by having local moms and dads presenting in class about their careers. "Hi, I'm Alan, Billy's dad, and I'm an accountant. Accountants are people who..."

But in a world of YouTube and virtual reality, the ability for our children to explore 500 different possible careers or passions during their K-6 education becomes not only possible but compelling. I imagine a module where children share their newest passion each month, sharing videos (or VR experiences) and explaining what they love and what they've learned.

MODULE 3

CURIOSITY + EXPERIMENTATION

Einstein famously said, "I have no special talent. I am only passionately curious." Curiosity is innate in children, and many times lost later in life. Arguably, it can be said that curiosity is responsible for all major scientific and technological advances -- the desire of an individual to know the truth.

Coupled with curiosity is the process of experimentation and discovery. The process of asking questions, creating and testing a hypothesis, and repeated experimentation until the truth is found. As I've studied the most successful entrepreneurs and entrepreneurial companies, from Google and Amazon to Uber, their success is significantly due to their relentless use of experimentation to define their products and services.

Here I imagine a module which instills in children the importance of curiosity and gives them permission to say, "I don't know, let's find out."

Further, a monthly module that teaches children how to design and execute valid and meaningful experiments. Imagine children who learn the skill of asking a question, proposing a hypothesis, designing an experiment, gathering the data and then reaching a conclusion.

MODULE 4

PERSISTENCE / GRIT

Doing anything big, bold and significant in life is hard work. You can't just give up when the going gets rough. The mindset of persistence, of grit, is a learned behavior and I believe can be taught at an early age, especially when it's tied to pursuing a child's passion.

I imagine a curriculum that, each week, studies the career of a great entrepreneur and highlights their story of persistence. It would highlight the individuals and companies that stuck with it, iterated and ultimately succeeded.

Further, I imagine a module that combines persistence and experimentation in gameplay such as that found in Dean Kamen's FIRST LEGO league, where 4th graders (and up) research a real-world problem such as food safety, recycling, energy and so on, and are challenged to develop a solution. They also must design, build and program a robot using LEGO MINDSTORMS®, then compete on a tabletop playing field.

MODULE 5
TECHNOLOGY EXPOSURE

In a world of rapidly accelerating technology, understanding how technologies work, what they do and their potential for benefiting society is, in my humble opinion, critical to a child's future. Technology and coding (more on this below) are the new "lingua franca" of tomorrow.

In this module, I imagine teaching (age appropriate) kids through play and demonstration. Giving them an overview of exponential technologies such as computation, sensors, networks, artificial intelligence, digital manufacturing, genetic engineering, augmented/virtual reality and robotics, to name a few. This module is not about making a child an expert in any technology, it's more about giving them the language of these new tools, and conceptually an overview of how they might use such a technology in the future. The goal here is to get them excited, give them demonstrations that make the concepts stick, and then to let their imaginations run.

MODULE 6
EMPATHY

Empathy, defined as "the ability to understand and share the feelings of another," has been recognized as one of the most critical skills for our children today. And while there has been much written, and great practices for instilling this at home and in school, today's new tools accelerate this.

Virtual reality isn't just about video games anymore. Artists, activists and journalists now see the technology's potential to be an empathy engine, one that can shine spotlights on everything from the Ebola epidemic to what it's like to live in Gaza. And Jeremy Bailenson has been at the vanguard of investigating VR's power for good.

For more than a decade, Bailenson's lab at Stanford has been studying how VR can make us better people. Through the power of VR, volunteers at the lab have felt what it is like to be Superman (to see if it makes them more helpful), a cow (to reduce meat consumption) and even a coral (to learn about ocean acidification).

Silly as they might seem, these sorts of VR scenarios could be more effective than the traditional public service ad at making people behave. Afterwards, they waste less paper. They save more money for retirement. They're nicer to the people around them. And this could have consequences in terms of how we teach and train everyone from cliquey teenagers to high court judges

MODULE 7
ETHICS / MORAL DILEMMAS

Related to empathy, and equally important, is the goal of Infusing kids with a moral compass. Recently I toured a special school created by Elon Musk (the Ad Astra school) for his five boys (age 8 to 13). One element that is persistent in that small school of 31 kids is the conversation about ethics and morals, a conversation manifested by debating real-world scenarios that our kids may one day face.

Here's an example of the sort of gameplay/roleplay that I heard about at Ad Astra, that might be implemented in a module on morals and ethics. Imagine a small town on a lake, in which the majority of the town is employed by a single factory. But that factory has been polluting the lake and killing all the life. What do you do? It's posed that shutting down the factory would mean that everyone loses their jobs. On the other hand, keeping the factory open means the lake is destroyed and the lake dies. This kind of regular and routine conversation/gameplay allows the children to see the world in a critically important fashion.

MODULE 8
THE 3R BASICS: Reading, wRiting & aRithmetic

There's no question that young children entering kindergarten need the basics of reading, writing and math. The only question is what's the best way for them to get it? We all grew up in the classic mode of a teacher at the chalkboard, books and homework at night. But I would argue that such teaching approaches are long outdated, now replaced with apps, gameplay and the concept of the flip classroom.

Pioneered by high school teachers Jonathan Bergman and Aaron Sams in 2007, the flipped classroom reverses the sequence of events from that of the traditional classroom.

Students view lecture materials, usually in the form of video lectures, as homework prior to coming to class. In-class time is reserved for activities such as interactive discussions or collaborative work -- all performed under the guidance of the teacher.

The benefits are clear:

1. Students can consume lectures at their own pace, viewing the video again and again until they get the concept, or fast-forwarding if the information is obvious.
2. The teacher is present while students apply new knowledge. Doing the homework into class time gives teachers insight into which concepts, if any, that their students are struggling with and helps them adjust the class accordingly.
3. The flipped classroom produces tangible results: 71% of teachers who flipped their classes noticed improved grades. 80% reported improved attitudes as a result.

MODULE 9
CREATIVE EXPRESSION & IMPROVISATION

Every single one of us is creative. It's human nature to be creative... the thing is that we each might have different ways of expressing our creativity.

We must encourage kids to discover and to develop their creative outlets early. In this module, imagine showing kids the many different ways creativity is expressed -- from art to engineering to music to math -- and then guiding them as they choose the area (or areas) they are most interested in. Critically, teachers (or parents) can then develop unique lessons for each child based on their interests, thanks to open education resources like YouTube and the Khan Academy. If my child is interested in painting and robots, a teacher or AI could scour the Web and put together a custom lesson set from videos/articles where the best painters and roboticists in the world share their skills.

Adapting to change is critical for success, especially in our constantly changing world today. Improvisation is a skill that can be learned, and we need to be teaching it early.

In most collegiate "improv" classes, the core of great improvisation is the "Yes, And..." mindset. When acting out a scene, one actor might introduce a new character or idea, completely changing the context of the scene. It's critical that the other actors in the scene say "Yes, and..." accept the new reality, then add something new of their own.

Imagine playing similar role-play games in elementary schools, where a teacher gives the students a scene/context and constantly changes variables, forcing them to adapt and play.

MODULE 10
CODING

Computer science opens more doors for students than any other discipline in today's world. Learning even the basics will help students in virtually any career, from architecture to zoology.

Coding is an important tool for computer science, in the way that arithmetic is a tool for doing mathematics and words are a tool for English. Coding creates software, but computer science is a broad field encompassing deep concepts that go well beyond coding.

Every 21st century student should also have a chance to learn about algorithms, how to make an app or how the Internet works. Computational thinking allows preschoolers to grasp concepts like algorithms, recursion and heuristics -- even if they don't understand the terms, they'll learn the basic concepts.

There are more than 500,000 open jobs in computing right now, representing the No. 1 source of new wages in the United States, and these jobs are projected to grow at twice the rate of all other jobs.

Coding is fun! Beyond the practical reasons for learning how to code, there's the fact that creating a game or animation can be really fun for kids.

MODULE 11
ENTREPRENEURSHIP & SALES

At its core, entrepreneurship is about identifying a problem (an opportunity), developing a vision on how to solve it, and working with a team to turn that vision into reality. I mentioned Elon's school, Ad Astra: here, again, entrepreneurship is a core discipline where students create and actually sell products and services to each other and the school community.

You could recreate this basic exercise with a group of kids in lots of fun ways to teach them the basic lessons of entrepreneurship.

Related to entrepreneurship is sales. In my opinion, we need to be teaching sales to every child at an early age. Being able to "sell" an idea (again related to storytelling) has been a critical skill in my career, and it is a competency that many people simply never learned.

The lemonade stand has been a classic, though somewhat meager, lesson in sales from past generations, where a child sits on a street corner and tries to sell homemade lemonade for $0.50 to people passing by. I'd suggest we step the game up and take a more active approach in gamifying sales, and maybe having the classroom create a Kickstarter, Indiegogo or GoFundMe campaign. The experience of creating a product or service and successfully selling it will create an indelible memory and give students the tools to change the world.

MODULE 12
LANGUAGE

I just returned from a week in China meeting with parents whose focus on kids' education is extraordinary. One of the areas I found fascinating is how some of the most advanced parents are teaching their kids new languages: through games. On the tablet, the kids are allowed to play games, but only in French. A child's desire to win fully engages them and drives their learning rapidly.

Beyond games, there's virtual reality. We know that full immersion is what it takes to become fluent (at least later in life). A semester abroad in France or Italy, and you've got a great handle on the language and the culture. But what about for an 8-year-old?

Imagine a module where for an hour each day, the children spend their time walking around Italy in a VR world, hanging out with AI-driven game characters who teach them, engage them, and share the culture and the language in the most personalized and compelling fashion possible.

EXPONENTIAL TECHNOLOGIES FOR OUR CLASSROOMS

If you've attended Abundance 360 or Singularity University, or followed my blogs, you'll probably agree with me that the way our children will learn is going to fundamentally transform over the next decade.

Here's an overview of the top five technologies that will reshape the future of education:

TECH 1 | **VIRTUAL REALITY.** Virtual Reality (VR) can make learning truly immersive. Research has shown that we remember 20% of what we hear, 30% of what we see, and up to 90% of what we do or simulate. Virtual reality yields the latter scenario impeccably. VR enables students to simulate flying through the bloodstream while learning about different cells they encounter, or travel to Mars to inspect the surface for life. To make this a reality, Google Cardboard just launched its Pioneer Expeditions product. Under this program, thousands of schools around the world have gotten a kit containing everything a teacher needs to take his or her class on a virtual trip. While data on VR use in K-12 schools and colleges have yet to be gathered, the steady growth of the market is reflected in the surge of companies (including zSpace, Alchemy VR and Immersive VR Education) solely dedicated to providing schools with packaged education curriculum and content.

Add to VR a related technology called augmented reality (AR), and experiential education really comes alive. Imagine wearing an AR headset that is able to superimpose educational lessons on top of real-world experiences. Interested in botany? As you walk through a garden, the AR headset superimposes the name and details of every plant you see.

TECH 2 | 3D PRINTING. 3D Printing is allowing students to bring their ideas to life. Never mind the computer on every desktop (or a tablet for every student), that's a given. In the near future, teachers and students will want or have a 3D printer on the desk to help them learn core science, technology, engineering and mathematics (STEM) principles. Bre Pettis, of MakerBot Industries, in a grand but practical vision, sees a 3D printer on every school desk in America. "Imagine if you had a 3D printer instead of a LEGO set when you were a kid; what would life be like now?" asks Mr. Pettis. You could print your own mini-figures, your own blocks, and you could iterate on new designs as quickly as your imagination would allow. MakerBots are now in over 5,000 K-12 schools across the United States.

Taking this one step further, you could imagine having a 3D file for most entries in Wikipedia, allowing you to print out and study an object you can only read about or visualize in VR.

TECH 3 | SENSORS & NETWORKS. Sensors & Networks. An explosion of sensors and networks are going to connect everyone at gigabit speeds, making access to rich video available at all times. At the same time, sensors continue to miniaturize and reduce in power, becoming embedded in everything. One benefit will be the connection of sensor data with machine learning and AI (below), such that knowledge of a child's attention drifting, or confusion, can be easily measured and communicated. The result would be a representation of the information through an alternate modality or at a different speed.

TECH 4 | MACHINE LEARNING. Machine Learning is making learning adaptive and personalized. No two students are identical — they have different modes of learning (by reading, seeing, hearing, doing), come from different educational backgrounds, and have different intellectual capabilities and attention spans. Advances in machine learning and the surging adaptive learning movement are seeking to solve this problem. Companies like Knewton and Dreambox have over 15 million students on their respective adaptive learning platforms. Soon, every education application will be adaptive, learning how to personalize the lesson for a specific student. There will be adaptive quizzing apps, flashcard apps, textbook apps, simulation apps and many more.

TECH 5 | ARTIFICIAL INTELLIGENCE or an "AI TEACHING COMPANION." Neil Stephenson's book "The Diamond Age" presents a fascinating piece of educational technology called "A Young Lady's Illustrated Primer."

As described by Beat Schwendimann,

> The primer is an interactive book that can answer a learner's questions (spoken in natural language), teach through allegories that incorporate elements of the learner's environment, and presents contextual just-in-time information.
>
> The primer includes sensors that monitor the learner's actions and provide feedback. The learner is in a cognitive apprenticeship with the book: The primer models a certain skill (through allegorical fairy tale characters), which the learner then imitates in real life.
>
> The primer follows a learning progression with increasingly more complex tasks. The educational goals of the primer are humanist: To support the learner to become a strong and independently thinking person.

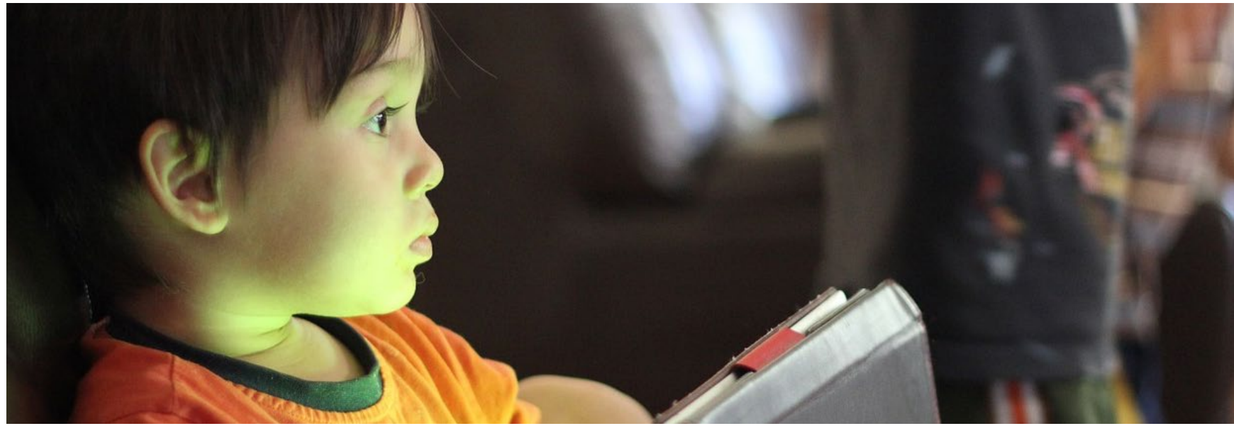
The primer, an individualized AI teaching companion is the result of technological convergence and is beautifully described by YouTuber CGP Grey in his video: Digital Aristotle: Thoughts on the Future of Education.

Your AI companion will have unlimited access to information on the cloud and will deliver it at the optimal speed to each student in an engaging, fun way. This AI will demonetize and democratize education, be available to everyone for free (just like Google), and offering the best education to the wealthiest and poorest children on the planet equally.

This AI companion is not a tutor who spouts facts, figures and answers, but a player on the side of the student, there to help him or her learn, and in so doing, learn how to learn better. The AI is always alert, watching for signs of frustration and boredom that may precede quitting, for signs of curiosity or interest that tend to indicate active exploration, and for signs of enjoyment and mastery, which might indicate a successful learning experience.

Ultimately, we're heading towards a vastly more educated world. We are truly living during the most exciting time to be alive.

NOTE: At this very moment, the XPRIZE Foundation is operating a $15M Global Learning XPRIZE in which >100 teams are building Android-based software designed to take an illiterate student in the middle of Tanzania and get them to basic reading, writing and numeracy in 18 months.

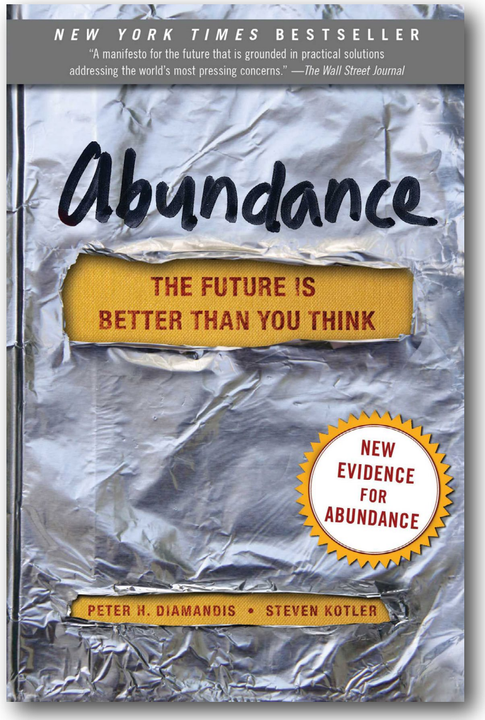


MINDSETS FOR THE 21ST CENTURY

How we think about the future colors how we learn and what we do. I've written extensively about the importance of an abundance and exponential mindset for entrepreneurs and CEOs. I also think that attention to mindset in our elementary schools, when a child is shaping the mental "operating system" for the rest of their life, is even more important.

As such, I would recommend that a school adopt a set of principles that teach and promote a number of mindsets in the fabric of their programs.

Many "mindsets" are important to promote. Here are a couple to consider:



Abundance: The Future is Better Than You Think
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NURTURING OPTIMISM AND AN ABUNDANCE MINDSET

We live in a competitive world, and kids experience a significant amount of pressure to perform. When they fall short, they feel deflated. We all fail at times -- that's part of life. If we want to raise "can-do" kids who can work through failure and come out stronger for it, it's wise to nurture optimism. Optimistic kids are more willing to take healthy risks, are better problem-solvers and experience positive relationships. You can nurture optimism in your school by starting each day by focusing on gratitude (what each child is grateful for), or a "positive focus" in which each student takes 30 seconds to talk about what they are most excited about, or what recent event was positively impactful to them. (NOTE: I start every meeting inside my PHD Ventures team with a positive focus.)

Finally, helping students understand (through data and graphs) that the world is in fact getting better (see my first book: Abundance: The Future is Better Than You Think) will help them counter the continuous flow of negative news flowing through our news media.

When kids feel confident in their abilities and excited about the world, they are willing to work harder and be more creative.

TOLERANCE FOR FAILURE

Tolerating failure is a difficult lesson to learn and a difficult lesson to teach. But it is critically important to succeeding in life.

Astro Teller, who runs Google's innovation branch "X," talks a lot about encouraging failure. At X, they regularly try to "kill" their ideas. If they are successful in killing an idea, and thus "failing," they save lots of time, money and resources. The ideas they can't kill survive and develop into billion-dollar businesses. The key is that each time an idea is killed, Astro rewards the team -- literally, with cash bonuses. Their failure is celebrated and they become a hero.

This should be reproduced in the classroom: kids should try to be critical of their best ideas (learn critical thinking), then they should be celebrated for 'successfully failing' -- perhaps with cake, balloons, confetti and lots of Silly String.

Dr. Peter H. Diamandis is an international pioneer in the fields of innovation, incentive competitions and commercial space. In 2014 he was named one of "The World's 50 Greatest Leaders" – by Fortune Magazine. In the field of Innovation, Diamandis is Founder and Executive Chairman of the XPRIZE Foundation, best known for its $10 million Ansari XPRIZE for private spaceflight. Diamandis is also the Co-Founder and Vice-Chairman of Human Longevity Inc. (HLI), a genomics and cell therapy-based diagnostic and therapeutic company focused on extending the healthy human lifespan. He is also the Co-Founder and Executive Chairman of Singularity University, a graduate-level Silicon Valley institution that studies exponentially growing technologies, their ability to transform industries and solve humanity's grand challenges. In the field of commercial space, Diamandis is Co-Founder/Co-Chairman of Planetary Resources, a company designing spacecraft to enable the detection and prospecting of asteroid for precious materials. He is also the Co-Founder of Space Adventures and Zero-Gravity Corporation. Diamandis is the New York Times Bestselling author of Abundance – The Future Is Better Than You Think and BOLD – How to go Big, Create Wealth & Impact the World. He earned an undergraduate degree in Molecular Genetics and a graduate degree in Aerospace Engineering from MIT, and received his M.D. from Harvard Medical School.

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