

“What infrastructure do we need for developing *a science of education?*”

Eradicating Polio (Bill and Melinda Gates:

<http://www.gatesfoundation.org/What-We-Do/Global-Development/Polio>);

Finding cure to all diseases (Mr. Zuckerberg and Dr. Chan:

<https://chanzuckerberg.com/>);

Space tourism (Richard Branson: <http://www.virgingalactic.com/>);

Space cargo (Jeff Bezos: <https://www.blueorigin.com/>);

Colonizing Mars (Elon Musk: <http://www.spacex.com/> or President Obama

<http://www.cnn.com/2016/10/11/opinions/america-will-take-giant-leap-to-mars-barack-obama/index.html>)

- what do all these goals have in common?

The tasks of achieving these goals are all ***doable!*** (a.k.a. **all these missions are *possible!***)

No doubt, achieving each goal requires an enormous amount of money, and effort, and R&D, and manpower, and intellectual breakthroughs, and organization, and logistics, and ... the list can go on and on.

But the process for achieving each goal has a well-defined structure, clear stages, manageable tasks such that when one task is finished it opens doors for the next one.

In the end, all these goals are achievable!

That is why all these goals have been proposed – because *businessmen do not set unachievable goals*. Businessmen do not “burn” money, neither literally, nor figuratively.

If businessmen do not see any realistic and positive (for them, for society) outcomes of a project, *they do not finance that project*.

Establishing this notion, we can conclude that businessmen do not see as feasible, or achievable such a goal as “eradicating stupidity/illiteracy/ignorance” - a slang and short version for “providing sufficient education to all”.

Giving here and there a couple of dozen of millions of dollars to support students and teachers in economically suppressed/underprivileged areas might help to ease some of the social issues like insufficient teacher preparation in local schools, or helping students with having textbooks, etc.

However, these actions look nothing like setting apart several billions of dollars to ... (please, read again the first paragraph).

It looks like for businessmen colonizing Mars, or eradicating all diseases seems easier to do than providing high quality education to all students. Isn't this strange?

One might ask, how do businessmen decide if a goal is achievable or not, if a mission is possible or not?

The answer is simple – **SCIENCE!**

All goals listed above are based on a solid science: physics, mathematics, engineering, biology, chemistry, medical science.

Science of education does *not* exist.

Subconsciously, all billionaires know this.

One cannot build a multibillion business without having a strong intuition about the things.

All billionaires intuitively know that currently there is no basis for an “Eradicating Stupidity” Project (evidently, building a city on Mars is just easier!).

But accepting the fact that *there is no such a thing as a science of education* could lead to stating an actually achievable goal –

investing into the development of infrastructure needed for the development of a science of education!

[This 6-minute video describes what can be done to achieve this goal.](#)

OR check below a presentation prepared for [Forbes UNDER 30 Summit in Boston](#)

OR [download a pdf file with the slides.](#)

1. Hello, I'm Dr. Valentin Voroshilov.

Be curious (and a curio)!
Be critical (including yourself)!
Reason! Doubt! Innovate!
Use your imagination!
No imagination =>
=> No success!



www.TeachOlogy.xyz

2. Billions of dollars have been spent to build research facilities to study



3. or to conquer the physical world.

ELON MUSK ANNOUNCES HIS PLAN TO COLONIZE MARS AND SAVE HUMANITY



Blue Origin, Jeff Bezos' Rocket Company,

By KENNETH CHANG OCT. 5, 2016



4. Billions of dollars are being spent for building research facilities to study biology, and medicine.



Biogen Idec's spending on research and development from 2006 to 2015 (in million U.S. dollars)

This statistic shows the spending on research and development by biotechnology company Biogen Inc. between 2006 and 2015. In 2008, the company spent around 1.07 billion U.S. dollars on research and development.



CDC—BUDGET REQUEST OVERVIEW

FY 2017 President's Budget Request | \$6.98 Billion

Mission

CDC works 24/7 to protect America from health and safety threats, both foreign and domestic. Whether diseases start at home or abroad, are chronic or acute, curable or preventable, due to human error or deliberate attack, CDC fights disease and supports communities and citizens to do the same. CDC is the nation's health protection agency—saving lives, protecting people from health threats, and saving money through prevention.

Why We're Here

- A disease threat anywhere can mean a public health threat everywhere; a safer world a safer America
- Each year, over 1 million illnesses and about 23,000 deaths are caused by antibiotic resistance
- More than 100,000 people die each day from overdoses from prescription drugs
- Chronic diseases afflict 117 million Americans
- More than 1.2 million Americans live with HIV infection, and 1 in 7 is unaware of his or her HIV status

\$6.98 billion

NewYork-Presbyterian

\$4.8 billion

CHOOSE A SERVICE

Find a Doctor
Our Services
Pay My Bill

About Us
Clinical Trials
Our Health Library

Total Revenues

\$4.8 billion

5. However, despite the fact that too many U.S. schools cannot provide sufficient education to too many graduates,

EdSource

Highlighting Strategies for Student Success

BILL & MELINDA
GATES foundation

Only 25 percent of U.S. public high school graduates have the skills needed to succeed academically in college, which is an important gateway to economic opportunity in the United States.

TOPICS COMMENTARIES PROJECTS STORYLINES DATA PUBLICATIONS ABOUT

CAREER PREPARATION

Survey: Most high school students feel unprepared for college

By Fermin Leal | July 30, 2015 | 12 Comments



Fewer than half of high school students across the country feel that college and careers, even though these remain top goals for students, to a survey released Thursday.

Results from a multi-year [College and Career Readiness survey](#) of high school students conducted by [YouthTruth](#), a San Francisco-based organization, found that 45 percent of students feel positive about their college readiness.

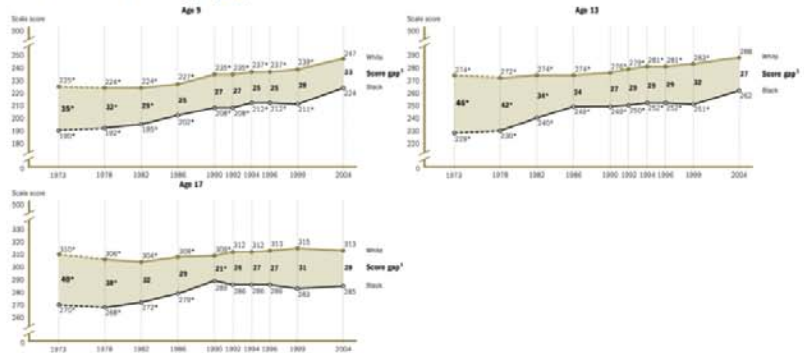
Evidence of the racial achievement gap: National Assessment of Educational Progress (United States) [edit]

Main article: National Assessment of Educational Progress

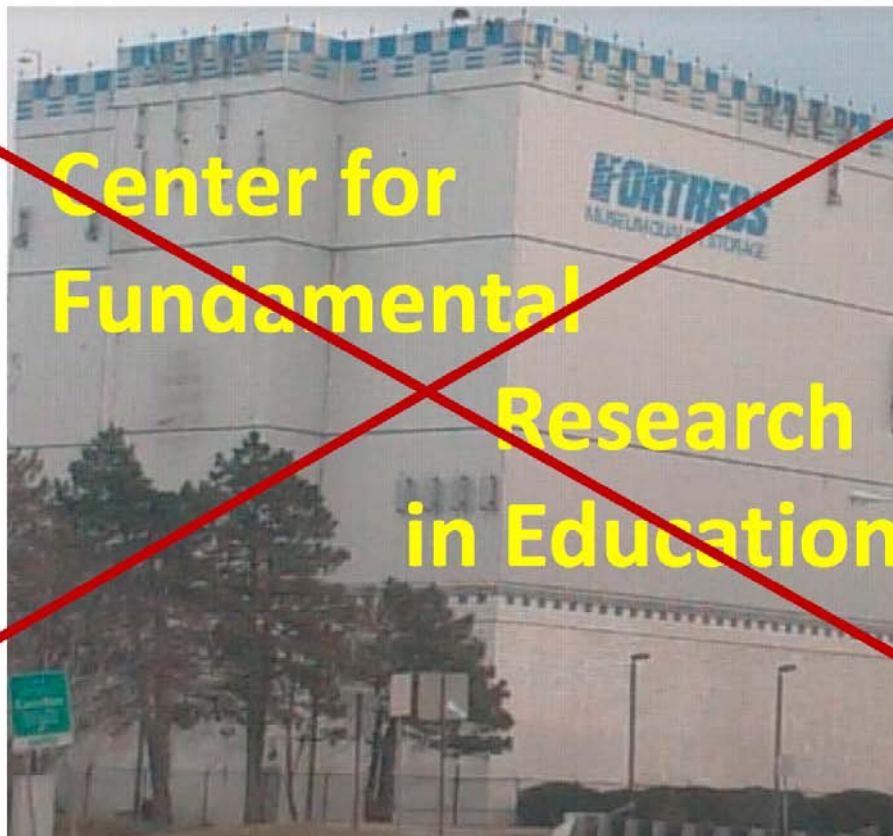
Evidence of the achievement gap can be found using various measures, but one assessment used nationwide is the National Assessment of Educational Progress (NAEP). The graphs below show the achievement gap on this assessment between black and white students and between Hispanic and white students in the U.S. over time. Although the gaps have generally narrowed in recent years according to this particular measure, there are clearly still large disparities between groups.

Math [edit]

Caucasian-African American gap [edit]



6. there are no investments in building research facilities designed specifically to studying learning and teaching processes.



7. The Government, the NSF, charitable and philanthropic organizations do finance various projects in the field, but the majority of the projects aim at solving social issues, like insufficient teacher preparation, adoption of new standards, bringing technologies in a classroom, and others.

We're investing in a new generation of courseware that adapts in sophisticated ways to students' learning needs. We're also supporting game-based learning that generates rich data about students' progress and challenges them with exactly what they need to learn next.



Blending face-to-face instruction with digital tools allows students to learn independently and at their own pace, freeing up time for teachers to give students more individualized attention and to focus on more complex tasks.

The Network Science project is a three year ITEST strategies project designed to engage 120 disadvantaged high school students (grades 10-11) and up to 30 high school STEM teachers from Boston and New York urban schools in a network science research based program, using cutting edge computer modeling research technology. Working with graduate student mentors, Network Science students and teachers will: (a) learn about the emerging discipline of network science, (b) construct and analyze science networks using computations and data visualizations



Boston-area Edtech Startups



Over 300 education technology and learning-oriented startups are currently based in the Boston area, drawing from its existing network of universities, learning companies, ecosystem, and technical talent. These companies have sprung up to solve challenges and take advantage of opportunities to support the growth and adoption of new products and methodologies within the education sector, which represents nearly 9% of the GDP.



McCarthy Dressman Education Foundation
Celebrating programs that engage, enrich and inspire learners

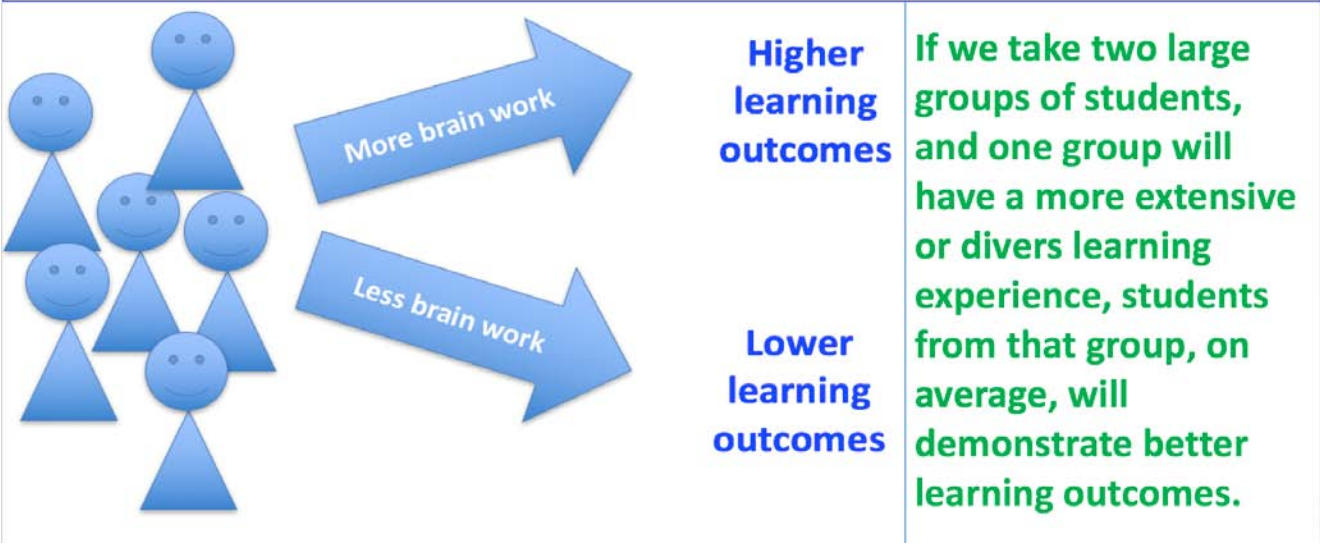
Login	Funding Opportunities	Funded Projects	About	Help
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Teacher Development Grants



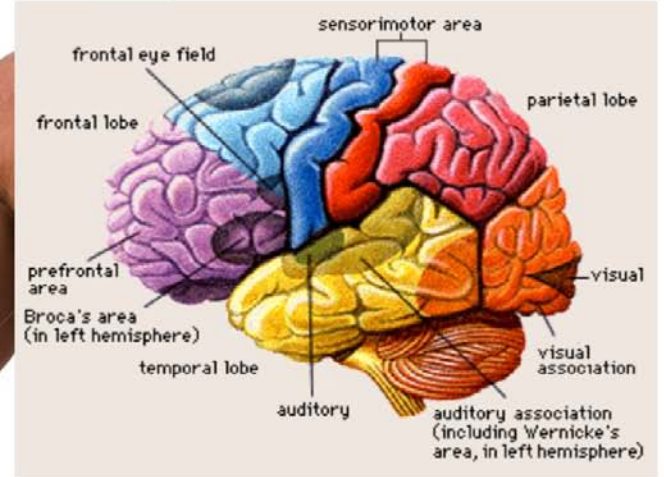
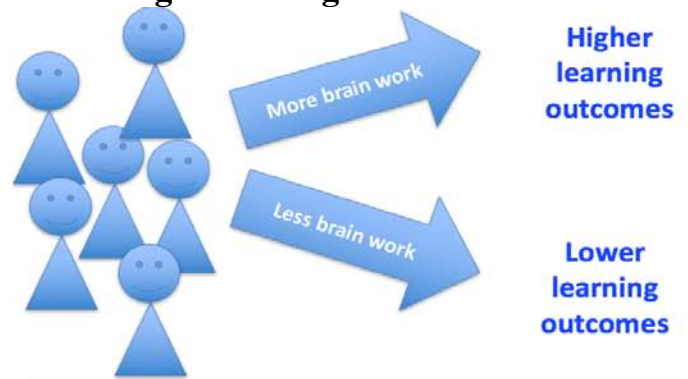
8. According to Dr. Kauffman and others, the research in the field is currently in a pre-science state. Most of the research conclusions can be summarized in a single statement: if we take two large groups of similar students, and one group of students will have a more extensive or divers learning experience (for example, more contact hours, or more time spent on certain exercises, or training through more, or more difficult, or different exercises) students from that group, on average, will demonstrate better learning outcomes than the students in a controlled group. Period.

“Today only a rare ... educator can point to scientific data supporting the method ... using or recommended.”
Dr. Kauffman “Toward a Science of Education”

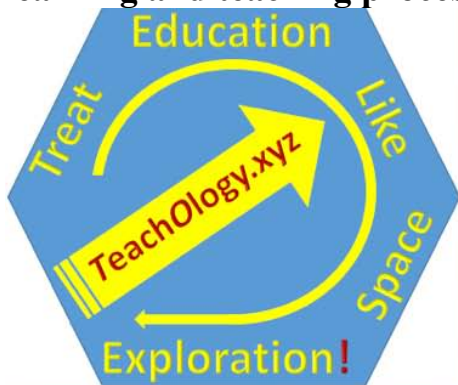


9. This conclusion does not really need special research; it becomes almost obvious if we employ the notion that a brain is basically a muscle, or a collection of muscles, the development of which strongly correlates with the variety and intensity of exercises it goes through.

This conclusion becomes almost obvious if we employ the notion that a brain is basically a muscle, or a collection of muscles, the development of which strongly correlates with the variety and intensity of exercises it goes through during its development.



10. In order to move beyond the obvious and to make a transition from a pre-science state (like alchemy) to becoming a true science (like chemistry) we have to treat education like space exploration, i.e. the field of education needs research facilities *designed* specifically to studying learning and teaching processes.



A research

facility for studying

learning and teaching processes.

11. But first, two questions have to be answered: What to study, and how to structure this facility?



12. I've been teaching math and physics for many years, and I know that *everyone can get an A*, but different people need a different path and a different time to achieve that. However, teaching today is like telling every marathon runner: "You have 2 hours to run, whoever runs the farthest – wins."

Ladies and gentlemen! You have 2 hours to run!



**Children! You have one year to learn!
Whoever learns the most – wins!**

13. Many words are said about differentiation in learning. Those words however are just proclamations not based on any solid data. Nowadays we know *only in general* how people learn. But we have *no idea* how much time would Ben Smith need to spend to learn “Breaking numbers apart by addition”.

“Breaking numbers apart by addition” (5th grade math skill)

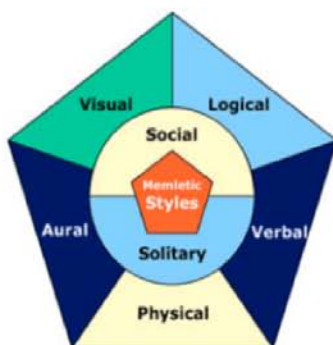
versus

An actual individual learning trajectory ???

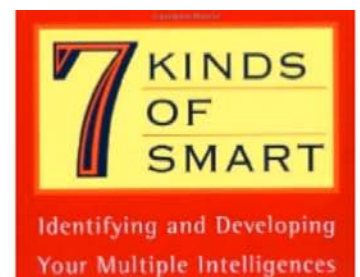
14. Yes, different people have different learning styles. We know that.

Overview of Learning Styles

Many people recognize that each person prefers different learning styles and techniques. Learning styles group common ways that people learn. Everyone has a mix of learning styles. Some people may find that they have a dominant style of learning, with far less use of the other styles. Others may find that they use different styles in different circumstances. There is no right mix. Nor are your styles fixed. You can develop ability in less dominant styles, as well as further develop styles that you already use well.



- **Linguistic intelligence** ("word smart")
- **Logical-mathematical intelligence** ("number/
- **Spatial intelligence** ("picture smart")
- **Bodily-Kinesthetic intelligence** ("body smart")
- **Musical intelligence** ("music smart")
- **Interpersonal intelligence** ("people smart")
- **Intrapersonal intelligence** ("self smart")
- **Naturalist intelligence** ("nature smart")



HOWARD GARDNER

Author of Frames of Mind



Multiple Intelligences

15. But how much time would it take to a child of a specific gender, race, socio-economic background, attention span, temperament, and other individual characteristics to master a given skill of a given subject? *That* we do not know.

gender

attention span



temperament

race

$$6 \square 3 = 9 \quad 8 \square 6 = 2$$

$$2 \square 5 = 7 \quad 3 \square 7 = 10$$

$$0 \square 4 = 6 \quad 9 \square 5 = 4$$

$$4 \square 1 = 5 \quad 8 \square 1 = 9$$

$$7 \square 3 = 4 \quad 5 \square 2 = 3$$

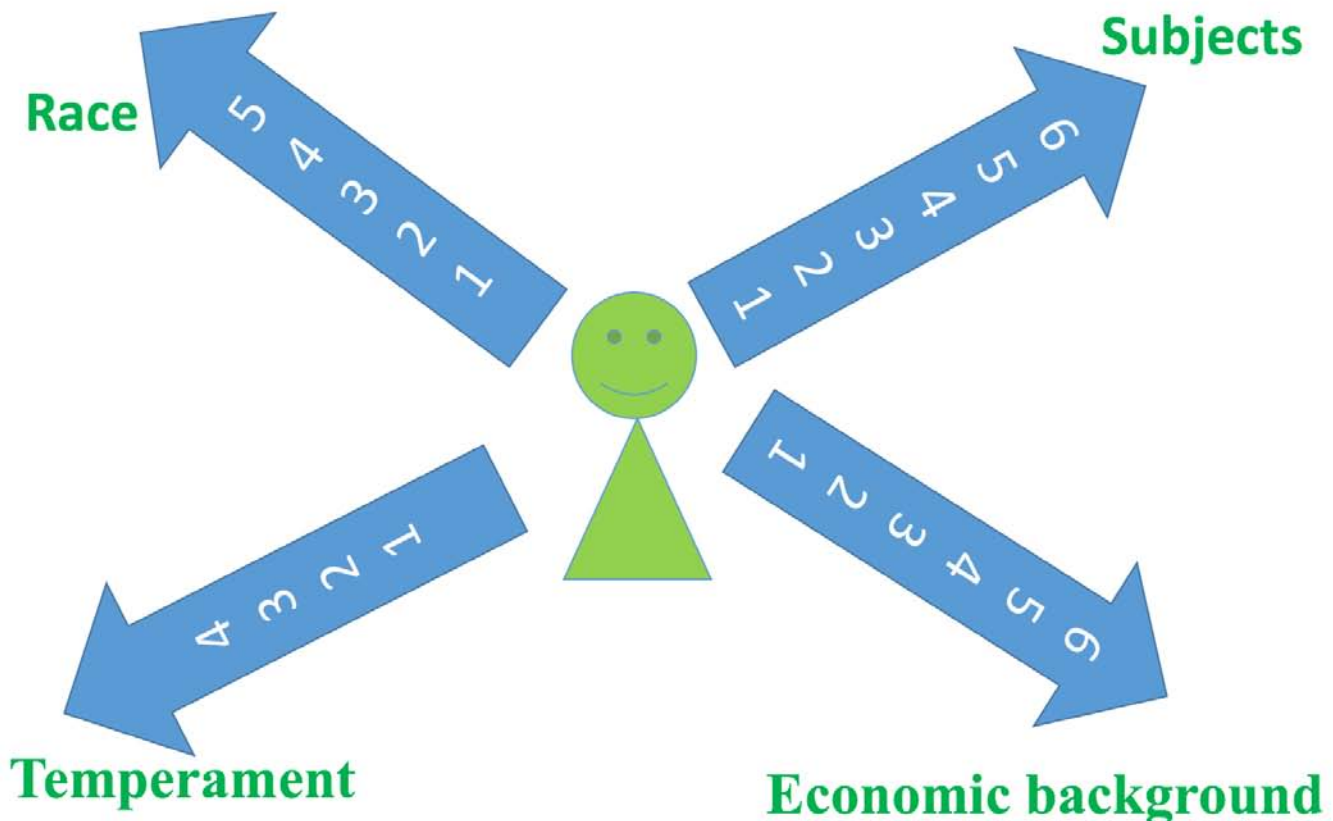
socio-economic background

A+!

An individual learning trajectory???



16. For every child, there is a finite number of individual characteristics describing his or her learning, behavioral, and social styles. There is a finite number of subjects to learn, and within each subject there is a finite volume of knowledge to learn, and a finite number of skills to master. It should take a finite amount of time to study all relevant correlations.



17. The research facility for conducting such a study must be developed around a specifically designed school, or a network of schools. Each school will be the nucleus of a facility where all students and professionals work together, with the whole world watching 24/7 ([click here for more info on the structure of the facility](#)).



18. It will generate data sufficient for promoting current educational research to a true science. The research will lead to development of new teaching tools and learning aids.



19. Two of the founders of the Breakthrough prize, Mark Zuckerberg and Yuri Milner, pledged to spend one hundred million dollars on the search for extraterrestrials. It did not occur to them, or to anybody else, that for many teachers their students do look like aliens.



Cornelia I. Bargmann, Chair



Anne Wojcicki



Mark Zuckerberg

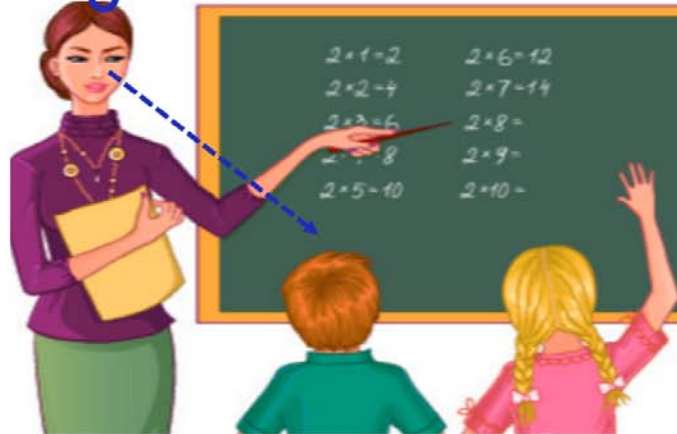


Jack Ma



Yuri Milner

\$100,000.00



20. Today I am calling on philanthropists to spend money on building research facilities designated specifically to studying learning and teaching processes, so in the coming decades every educator *could* point to scientific data supporting the method he or she uses, or recommends.



Cornelia I. Bargmann, Chair



Anne Wojcicki



Mark Zuckerberg



Jack Ma



Yuri Milner

\$100,000.00



"Today only a rare ... educator can point to scientific data supporting the method ... using or recommended."



21. Thank you. This would have been my presentation offered to the judges of 2016 Forbes Boston “30 under 30” Forum, if I would have been under 30.

Please, contact [Dr. Valentin Voroshilov](mailto:Dr.Valentin.Voroshilov@teachology.xyz) at teachology@teachology.xyz

Dr. Valentin Voroshilov



Teachology Consulting

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with achieving
their goals!

Teachology.xyz

617-657-9436



“Prof. Voroshilov, I’m at a loss for words to express my gratitude. In all of my years of school, from elementary, into high school, and through college, I have been blessed with top-notch teachers. But I’m pretty sure you take the cake. =>

click this link for *our publications*

000214387
[web counter](#) (started on Feb 14, 2015)

Areas of expertise:

- A) administrative practices related to running a unit of an administrative structure, such as a department, or an institution, including but not limited to:
1. strategic and tactical planning
 2. observing, guiding, coordinating, evaluating the performance of employees
 3. analyzing individual reports, preparing and presenting cumulative
 4. managing everyday workflow
- B) consulting on developing teaching practices at different levels (individual teachers, teams of teachers, schools, school districts)

SELECTED CONFERENCES AND PUBLICATIONS

- The excitation energy spectrum for a system with electron pairs tunneling in a two-leg ladder has a doping depended gap": <http://www.teachology.xyz/vv16.pdf> (Aug., 2016)
Presentation at 2016 PhysTech conference: <http://www.teachology.xyz/pr16.htm>
- Learning aides for students taking physics". Phys. Educ. 50 (2015) 694-698, <http://stacks.iop.org/0031-9120/50/694> (October, 2015; an unedited version is free at <http://www.teachology.xyz/lc.htm>)
- Education reform needs a new paradigm" // <http://www.teachology.xyz/np.htm> (Sept. 2015)
- Math self-test for students planning on taking a physics course" // <http://www.teachology.xyz/mst/mst.htm> (Sept. 2015)
- What does “thinking as a physicist” mean?" // <http://www.teachology.xyz/sp.htm> (Mar. 2015)
- A Map of Operationally Connected Categories as an instrument for classifying physics problems and a basis for developing a novel tool for measuring learning outcomes in physics." // <http://www.teachology.xyz/mocc.htm> (Mar. 2015)
- Why have hundreds of millions of dollars been spent on developing the common core math standards if content-wise they are not much different from the ones they replace?" // <http://www.teachology.xyz/3r.htm> (Mar. 2015)
- Critical reading of “Making sense of confusion” by Eric Mazur et al." // <http://www.teachology.xyz/msm.html> (Mar. 2015)

22. However, I can assure you, there is no-one under 30 who could have made this presentation, because it is based on both, wide and deep, and both, teaching and research experience, which in the field of education takes decades to grow. Thank you again.

Dr. Valentin Voroshilov

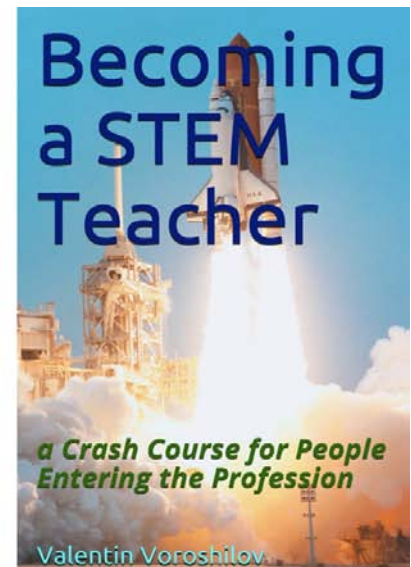
Professional experience and areas of expertise:

Teaching:

Algebra based physics
Calculus based physics
Physics for science teachers
Physics for students with
learning disabilities
Algebra
Geometry
Trigonometry
Methods for teaching physics

Consulting:

Individual teachers
School administrators
District administrators
School and district teams of
educators
on strategies and tactics for
advancing teaching practices
and improving learning
outcomes.



Teaching and researching on two continents.

[Click here \(and scroll down a page\) to see my application and what the judges said!](#)

Appendix I:

What is the difference between a science and a religion?

This is a heavily loaded question, which have been igniting many heated discussions.

If you read various publications on the matter you see that the most of the authors boil their views down to one statement: “A science is evidence based, and a religion is faith based.”

For example, the following quote represents an example of a very common sentiment on the difference between a science and a religion:

“The important difference between science and religion is that religion comes with ABSOLUTE statements, that neither can be proved or disproved, and science evolves from relative truths and statements, that can be testified and proven false (which means: science has to develop, in order to replace (partly) untrue theories, and replace them with better ones). Science does not claim it has absolute knowledge on anything. Religion claims it has.” (Reference <https://www.physicsforums.com/threads/difference-between-science-and-religion.2248/>)

This statement is not incorrect, but it is missing a very important part of any science.

Every science is also based on absolute statements, i.e. on the statements in which every scientist deeply believes without really having them logically derived from indisputable evidence.

In other words, every scientist has a faith.

Every scientist has a faith in that:

- * The world (a.k.a. the universe, a.k.a. the nature) exists.
- * The existence of the world does not require human presence.
- * The functioning of the world has certain patterns (under similar circumstances objects undergo similar processes). Those patterns do not depend on the existence of intelligent species.
- * Humans are intelligent enough to uncover and understand the patterns governing the world (a.k.a. laws).
- * I – a scientist – am intelligent enough to uncover and understand the patterns governing the world (otherwise why would I be going into doing a science?)

Diving into a specific science, like mathematics, or physics, or chemistry, shows that all those sciences are also based on a set of absolute statements, although in a science those statements called postulates or axioms, not commandments.

Those postulates cannot be logically derived from certain observations or experiments. Yes, they are related to certain observations or experiments, and during the search for those postulates some reasoning, of course, have been used. However, the final formulation of a postulate is usually a result of an insight. Then, after the postulates had been formulated, scientists use logical procedures to

derive various consequences/predications, and if those predictions are consistent with observations and experiments that gives us the confidence in the truthfulness of the postulates.

There are many good books on a logical structure of science (just run an Internet search on “structure of science). Here I would only point at one of my favorite examples, namely, Albert Einstein’s postulates of The Special Relativity Theory.

In conclusion, we cannot say that a science does not include any faith at all: there is a faith in a science, but just different one from a faith in a religion.

If the difference between a science and a religion is not based on the presence of absence of a faith, then what does make them different? The answer is – people.

A science and a religion are just two of many human practices.

The most important difference is between the people practicing those practices.

A person who practices a science – a scientist – does not claim that his knowledge is absolute and cannot be changed. A scientist is not the one who knows everything and is always right. A scientist knows that his/her knowledge is limited, can and most probably will be changed in the future (even the postulates!), and because of that a scientist is always ready to be wrong.

People practicing religion will never accept any possibility for their postulates to be wrong, they practice a dogmatic thinking.

To be fair, some people who call themselves scientists also practice a dogmatic thinking.

Maybe this is why Max Plank said, that “A new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it.”

Appendix II:

If you check what the judges said about my proposal, you will see that their opinions were very much opposite. Interestingly, the similar case happened when two judges evaluated one of my papers (<http://www.teachology.xyz/msm.html>). If you read my official student evaluations, you do not find many neutral views like "He was OK", but the most of the opinions are either "great"-like or "sucked"-like (and ratemyprofessor.com shows a similar pattern). Evidently, one way or another, I touch most of the people I meet - like I am a "Donald-Trump/Hillary-Clinton type of person - love me or hate me. I want to add that I have no intention making people feel that why about me, I just have noticed the pattern.