http://teachology.xyz/1p.html

1. Hello. I'm Dr. Valentin Voroshilov. This presentation summarizes all my current projects, which are four. First of all, I am a teacher.

My best recommendations come from my students (please, check the link at the bottom). My resume, my experience, and philosophy are also available online.

Dr. Valentin Voroshilov

=> GoMars.xyz

Professional experience and areas of expertise:

Teaching:

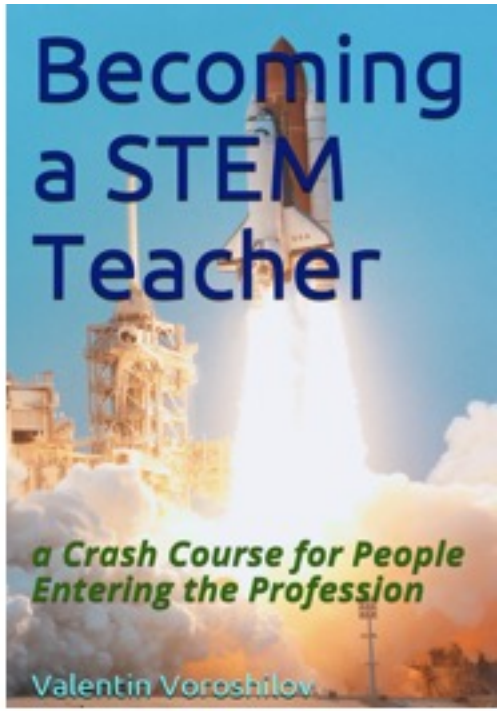
Algebra based physics
Calculus based physics
Physics for science teachers
Physics for students with learning disabilities
Algebra
Geometry
Trigonometry
Methods for teaching physics

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.

The voices of my students: http://www.teachology.xyz/evvv.html



2. STEM education has become a priority for our government and for the business community. Today I invite everyone to get involved into 4 critical educational projects.

1. Physics as an entry in STEM education.
2. A universal standard for measuring content knowledge.
3. Propelling a science of education by developing facilities for studying learning and teaching.
4. Reforming educational reform by inviting teachers into active forms of professional development.

Championing STEM Education in Massachusetts:

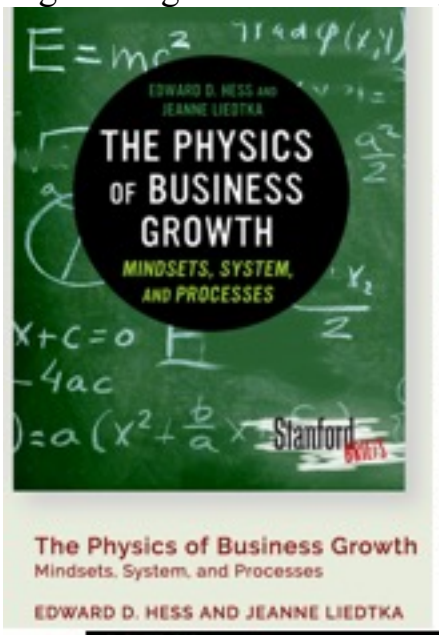
1. Physics as an entry in STEM.

2. A universal scale for measuring content knowledge in physics (as a primer for all STEM subjects).

3. Developing research facilities specifically designed to study learning and teaching processes.

4. Transforming on a large scale teacher professional development from passive into active form ("growing by doing").

3. What is so special about Physics? Not many people realize that nowadays physics has entered many fields beyond just physics or engineering. First to mention, of course, is applications of computational physics to business. There are books, articles, conferences.



1. Physics as an entry in STEM.

Physics for Business Applications

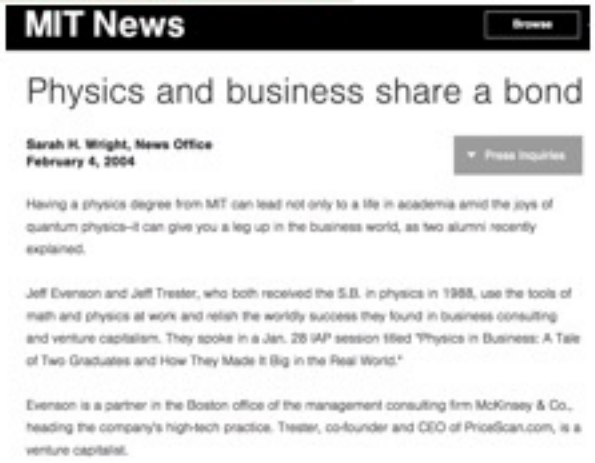
Due to the persistent efforts of our former Chair, Professor Hans Bozler, the University of Southern California has been funded by the Alfred P. Sloan Foundation to create four new professional master's degrees in the sciences.

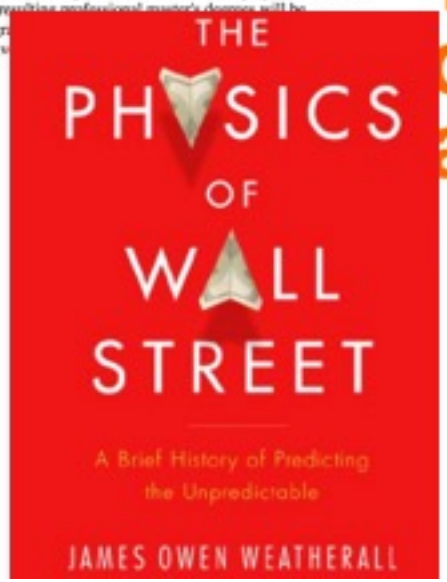
One of these four new programs is Physics for Business Applications which is designed for the physical sciences, mathematics, or engineering graduate who wants to pursue a career in management, consulting, and finance, rather than follow the traditional path of research and teaching. "We expect the physics-plus degree to be comparable to MBA and law degrees, but grounded in the tools and techniques of advanced technology," says Hans Bozler.

After first consulting and holding conferences with potential employers who have shown an interest in the hiring of our future Physics for Business Applications graduates, our department has designed a program which is interdisciplinary, hands-on (an internship is required), and designed to meet the demands of graduate students and employers. Professor Bozler explains, "We expect that the resulting professional master's degrees will be 'high-valued' and will attract recent gr... government, and industry who perceiv...

Organizational Physics

The Science of Growing a Business





4. Many people majoring or minoring in physics have become successful businessmen.

What's a Physicist Doing on Wall Street?

Over a year ago by EMANUEL DERMAN

I think having a background as a physicist is kind of fortuitously good for people who work on Wall Street because there are a lot of fields that use mathematics, but physics is sort of the field *par excellence*. It has made the best use of mathematics. And I think physicists understand what's a really good theory and what's accurate and they also, in their every day life, work on models which are like approximations that give you some idea of the way something behaves. And they have a good sense for what's a good theory and what's a good model and where the boundary lies between them.

In recent years, many physics graduates have been recruited by the financial services sector; 18.3% of physics graduates who entered employment after leaving university in 2008 found work in the business and financial professions, more than any other sector. However, only 37.9% were picking up pay cheques six months after graduating, far below the average for other graduates. This is a reflection of the fact that more than a third of physics graduates went on to further study - again, above average.

What jobs can you do?

"There are a number of physics-based careers - medical physicist, research scientist, scientific laboratory technician, radiation protection adviser, the armed forces and defence industry," says Margaret Holbrough, careers adviser at Graduate Prospects. Physics graduates also find employment in academic institutions, and government research organisations as well as industries such as aerospace, engineering, manufacturing, oil and gas, space exploration and telecommunications.

When Elon Musk was an undergraduate at the University of Pennsylvania, he pursued a dual degree in business and physics.

"It was an unusual combination," he told Physics World in 2007, "and I enjoyed the physics more. I'm not sure I would study business again if I could replay things."

The interest in physics was long in the making for Musk. He's said that he grew up in a "technical" household in South Africa, thanks

Elon Musk. Bill Pugliano / Getty

October 18, 2013 1:12 pm

Physicists and the financial markets

By Stephen Foley

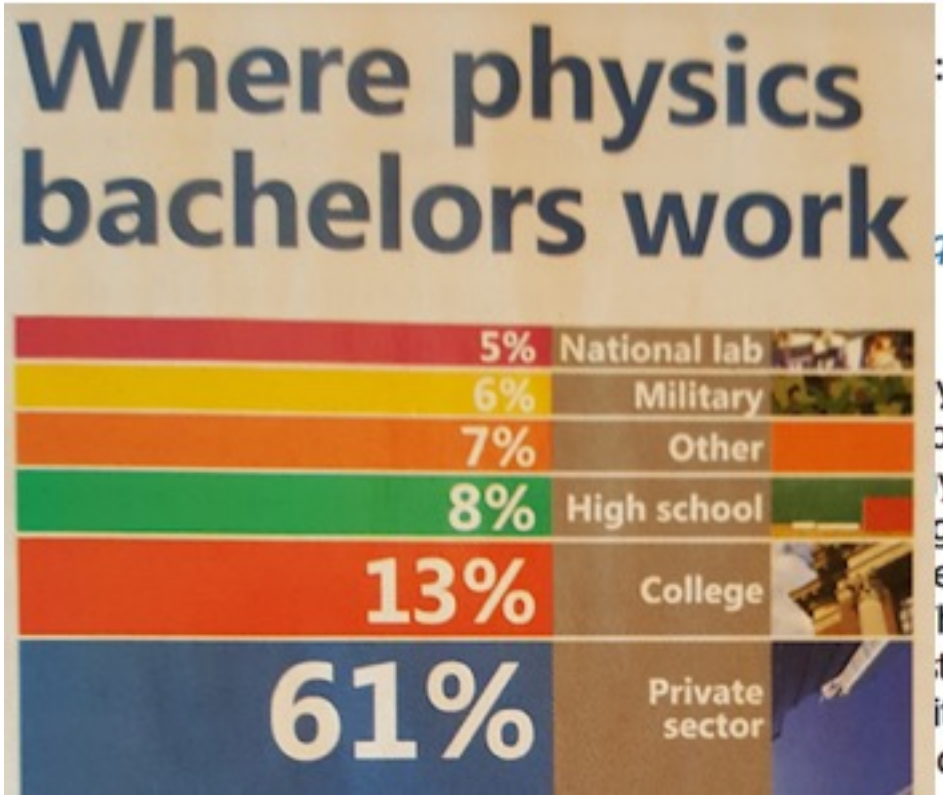
Share Author alerts Print Clip Comments

Physicists have been lured into the financial market for decades, prized for their insights and data-crunching skills. But in a time of turbulence, flash crashes and high-frequency trading, can they really spot things that others miss?

5. And physics is changing many other human practices:

Breaking the Myth of the "Non-Traditional" Physicist" The Real Story about Employment for Physics Graduates

Speaker: Crystal Bailey, Careers Program Manager, American Physical Society



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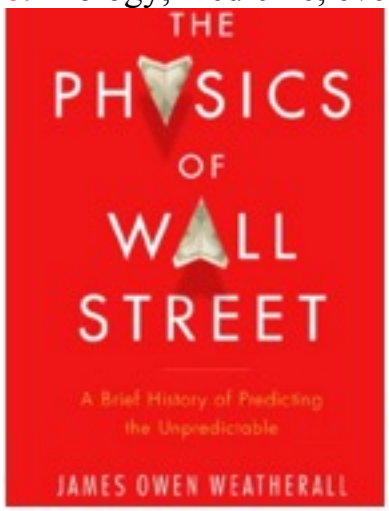
degrees.

6. Biology, medicine, even sport.

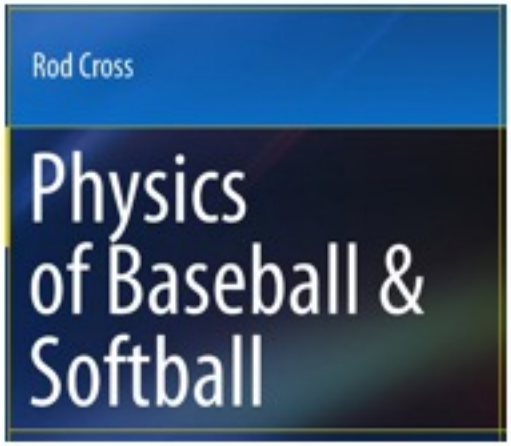


Biology

Medical physics (also called **biomedical physics**, **medical biophysics** or **applied physics in medicine**) is, generally speaking, the application of physics concepts, theories and methods to medicine or healthcare. Medical physics departments may be found in hospitals or universities.

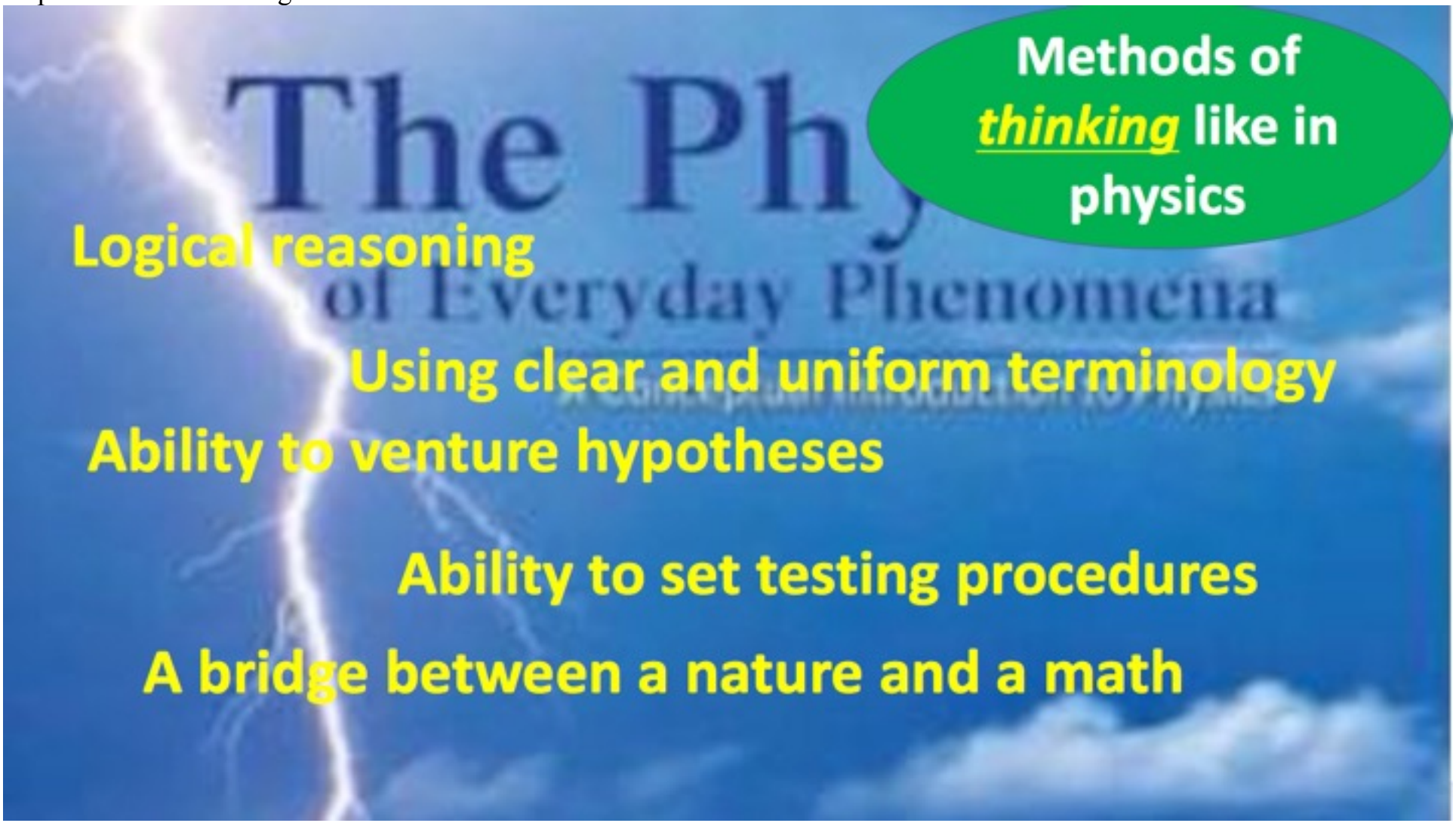
Medicine

Methods of physics



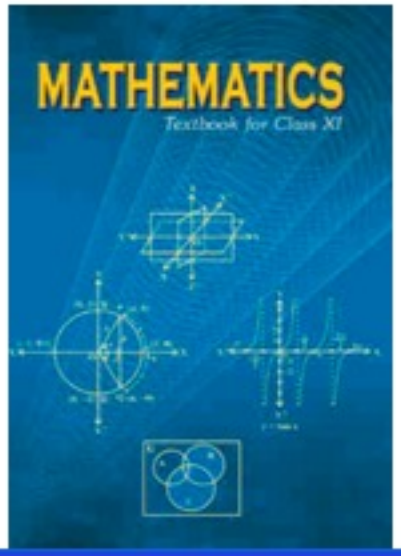
SPORT

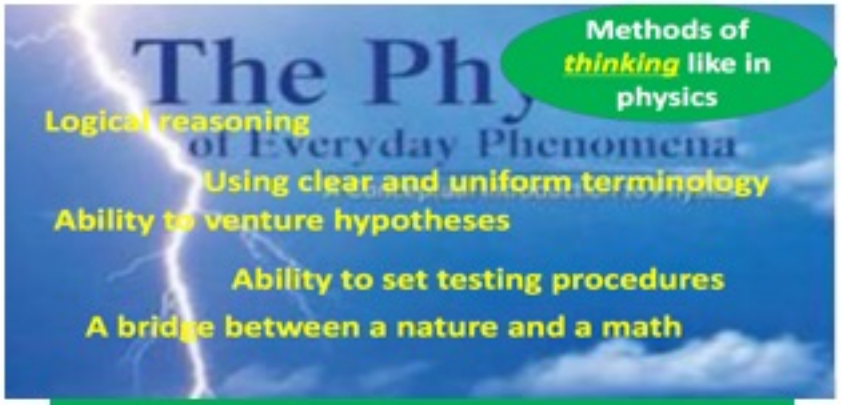
7. But the true importance of physics is not in the computational methods developed in it and ready to be deployed in other fields. The true importance of physics is in enhancing reasoning abilities of every single person taking physics course. By the way: there is NO single TV show helping with developing reasoning abilities. There are a lot of shows on remembering simple facts. But only physics helps to enhance thinking skills.



8. Physics is more powerful tool for advancing reasoning abilities than mathematics or computer coding! Learning physics means understanding how to bridge the abstract world of mathematics and the world of actual phenomena happening around us.

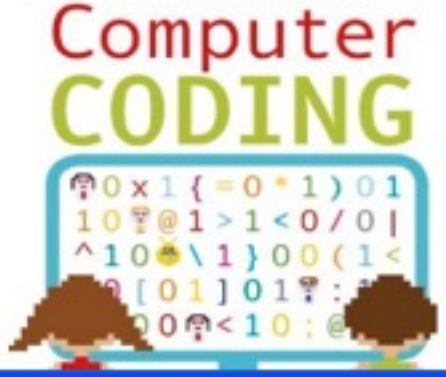
Everyone who learns physics can learn coding. The opposite ???





FACT SHEET: President Obama Announces Computer Science For All Initiative

"In the coming years, we should build on that progress, by ... offering every student the hands-on computer science and math classes that make them job-ready on day one."



Physics = Reasoning

+ Mathematics

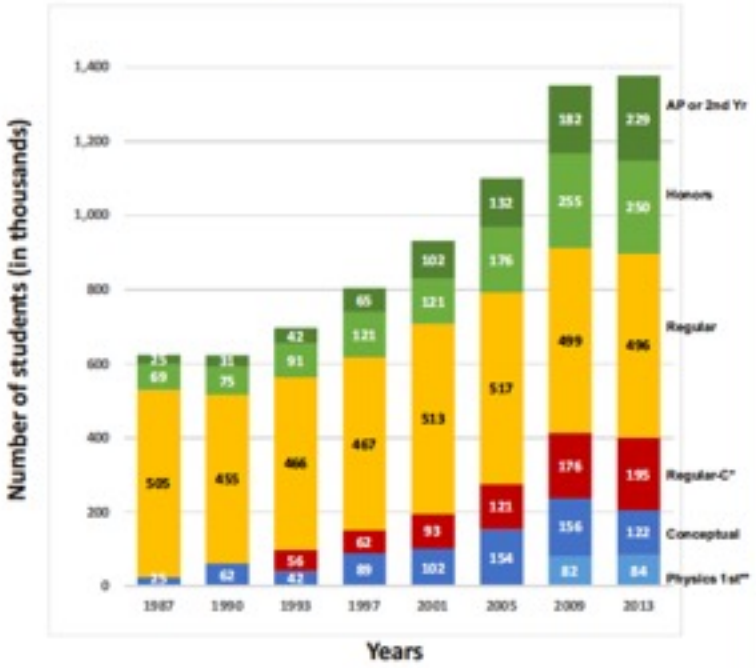
1

2 **Coding = algorithmization (reasoning) + programming language (memorizing)** 2

9. Unfortunately, currently less than a half of high school students taking physics class.

American Institute of Physics

High School Physics Enrollments 1987-2013

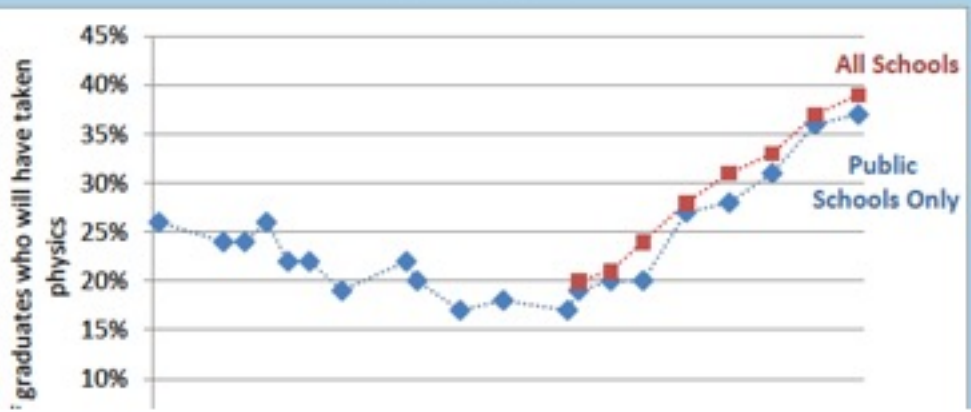


Four Graduates in Ten Take High School Physics

The proportion of high school graduates who will have taken at least one physics course prior to graduation continues to grow. When we began this study in 1987, the "physics-taking rate" (the proportion of high school graduates who will have taken at least one high school physics course) was 20%. Based on data from our most recent survey (which includes both public and private high schools in the U.S.) during the 2012-2013 school year, we estimate that 39% of the class of 2013 took high school physics before graduating. Figure 1 provides a historical perspective.

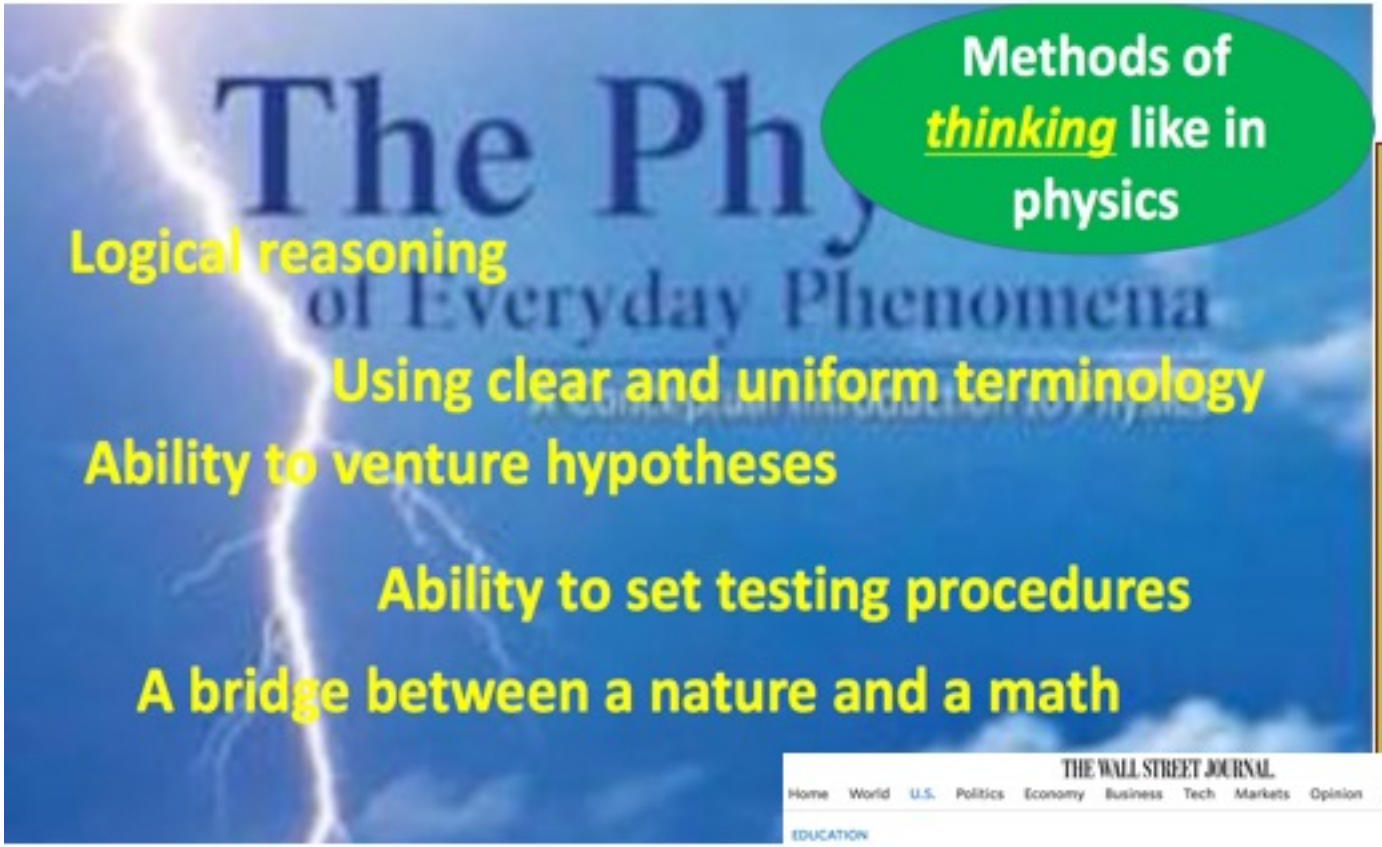
Figure 1

Physics-Taking Rate in U.S. High Schools 1948 – 2013



10. This means that 60 % of current high school graduates are not ready for the demands of the contemporary job market.

Four Graduates in Ten Take High School Physics



Only four Graduates in Ten **are ready to enter contemporary job market.**


THE WALL STREET JOURNAL.

Home World U.S. Politics Economy Business Tech Markets Opinion Arts Life Real Estate

EDUCATION

Obama Calls for Two Years of Free Community College for All Students

Proposal Will Face an Uphill Climb in Congress

11. That is why I am asking everyone to join forces and to petition all school district and other government officials to develop a plan with the goal of having all high school students taking physics course by the year of 2020.

Physics course for every student!

Physics into every school!

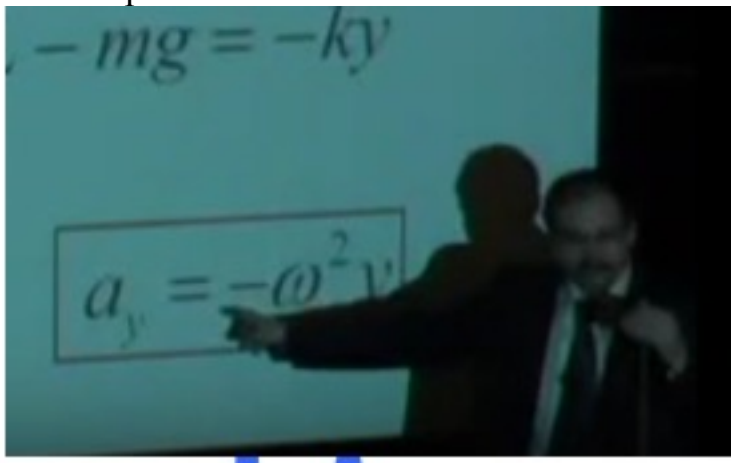
A petition to all school district and other government officials to develop a plan with the goal of having all high school students taking physics course by the year of 2020.

12. The goal of the next project is to develop a device, which all physics teachers could use to compare very accurately what students have learned in a physics course.

2. A universal scale for measuring content knowledge in physics (as a primer for all STEM subjects).

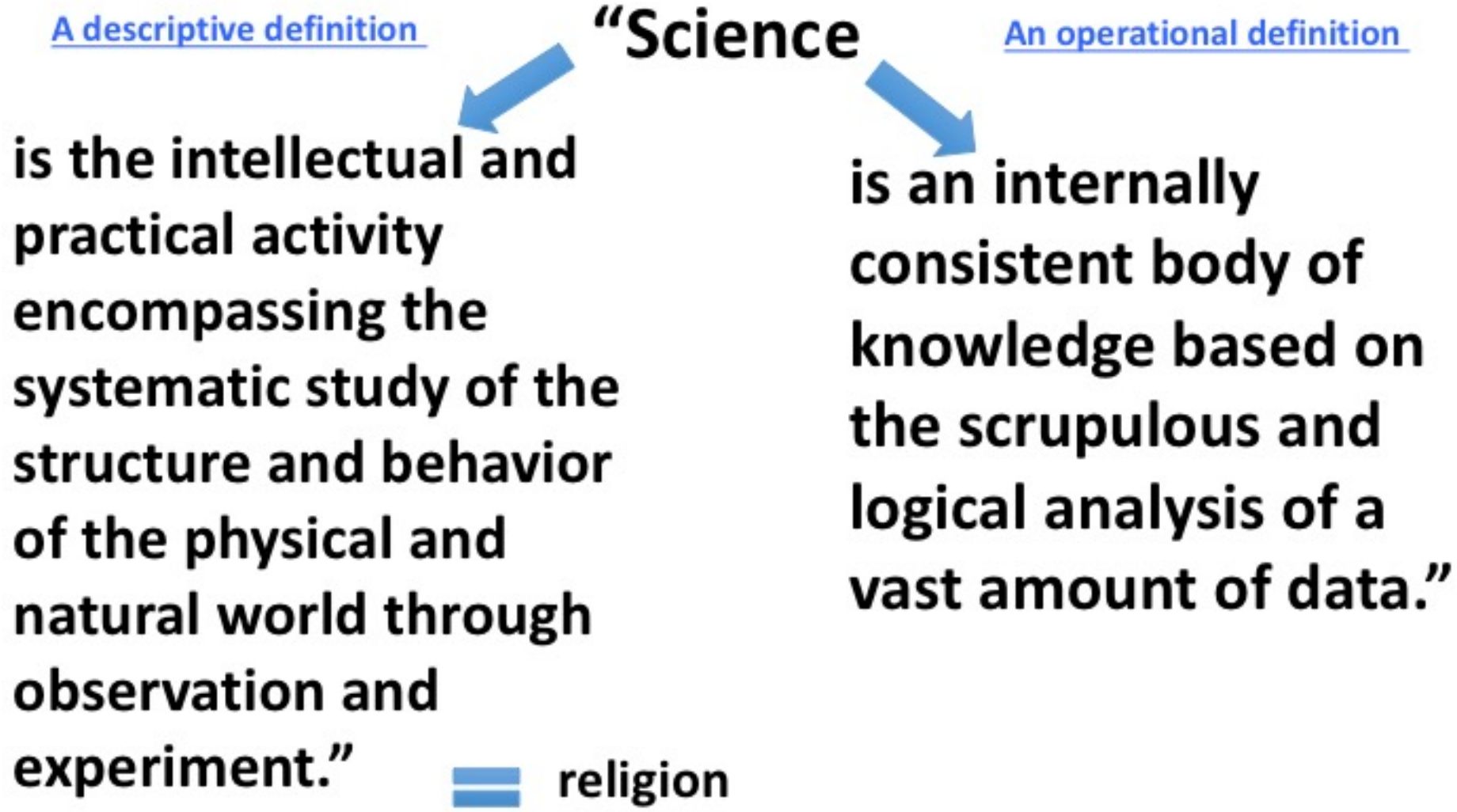
13. We all know this. Physics is a science. Teaching physics is not. At least, if we use a procedural definition of a “science”.

Physics is a science.

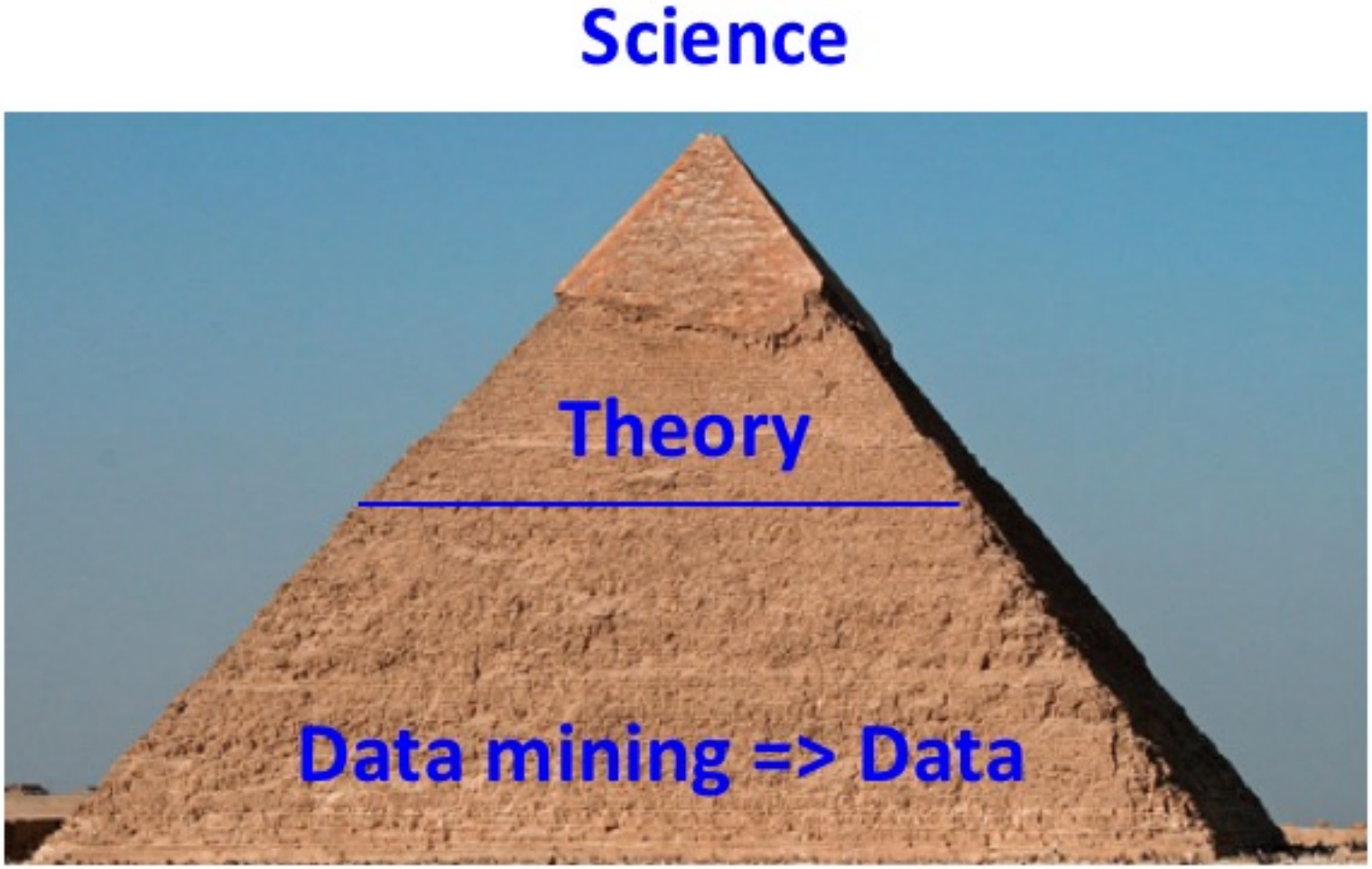


Teaching physics is *not*.

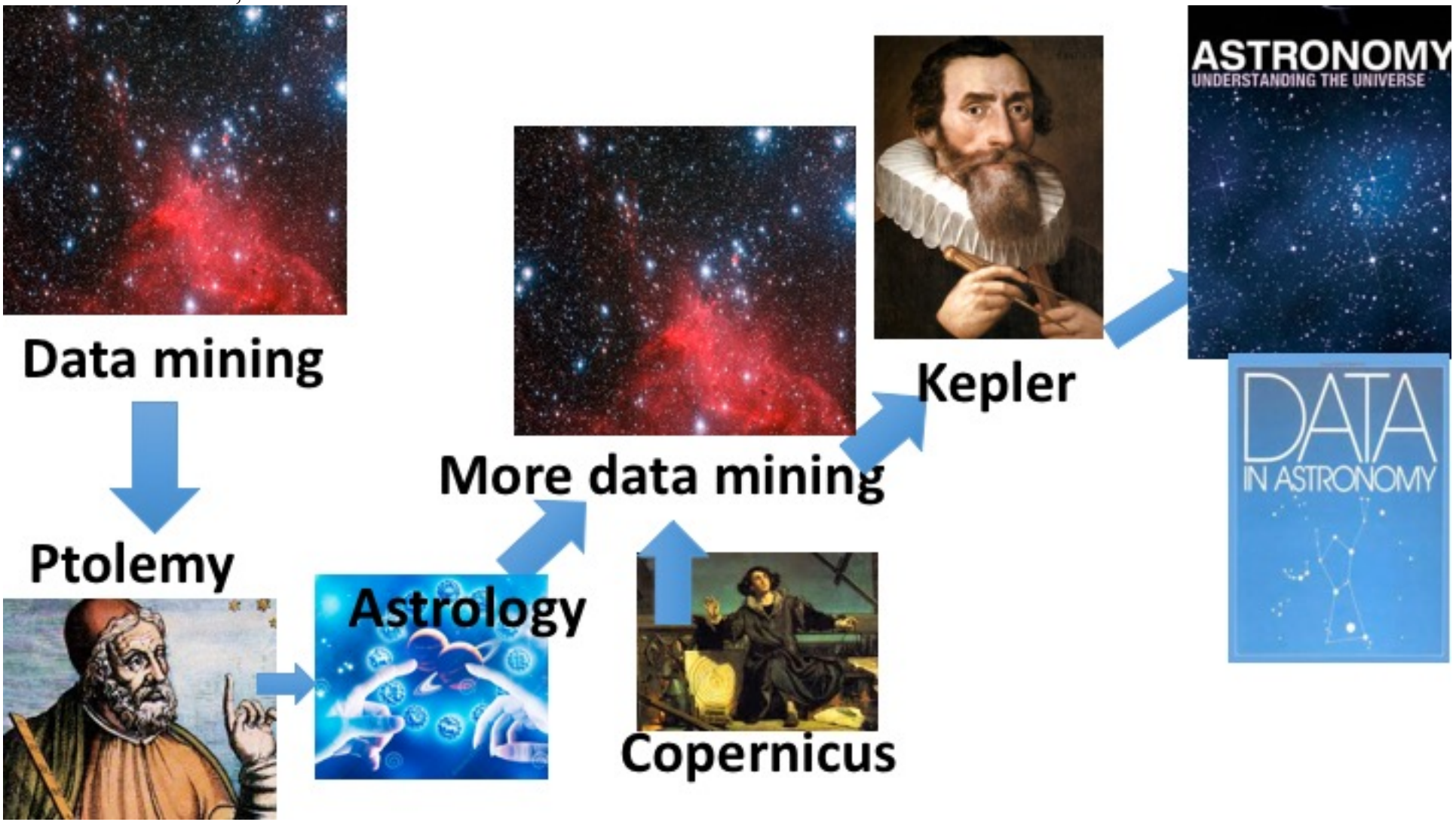
14. Personally, I do not like descriptive definitions like “science is the intellectual and practical activity encompassing the systematic study of the structure and behavior of the physical and natural world through observation and experiment” (this is the top Google search result for “definition of science”). In fact, such a definition does not allow to distinguish a science from a religion. I prefer a procedural or operational definition, like “A science is an internally consistent body of knowledge based on the scrupulous and logical analysis of a vast amount of data”. In particular, this definition allows us to see when a school of thoughts becomes a science.



15. Every science is based on a solid foundation of the results of intensive data mining.



16. For example, Astronomy dropped Astrology and became a science when Kepler finished his analysis of huge amount of data collected before him, and wrote his famous laws.



17. Educational data mining is a young field. It starts producing a large amount of data.

International **Educational Data Mining** Society

Home JEDM Proceedings Resources Related Orgs Mailing

Educational Data Mining is an emerging discipline, concerned with developing methods for exploring the unique and increasingly large-scale data that come from educational settings, and using those methods to better understand students, and the settings which they learn in.

Not yet an IEDMS member?

Join or Renew Now!

Recent News

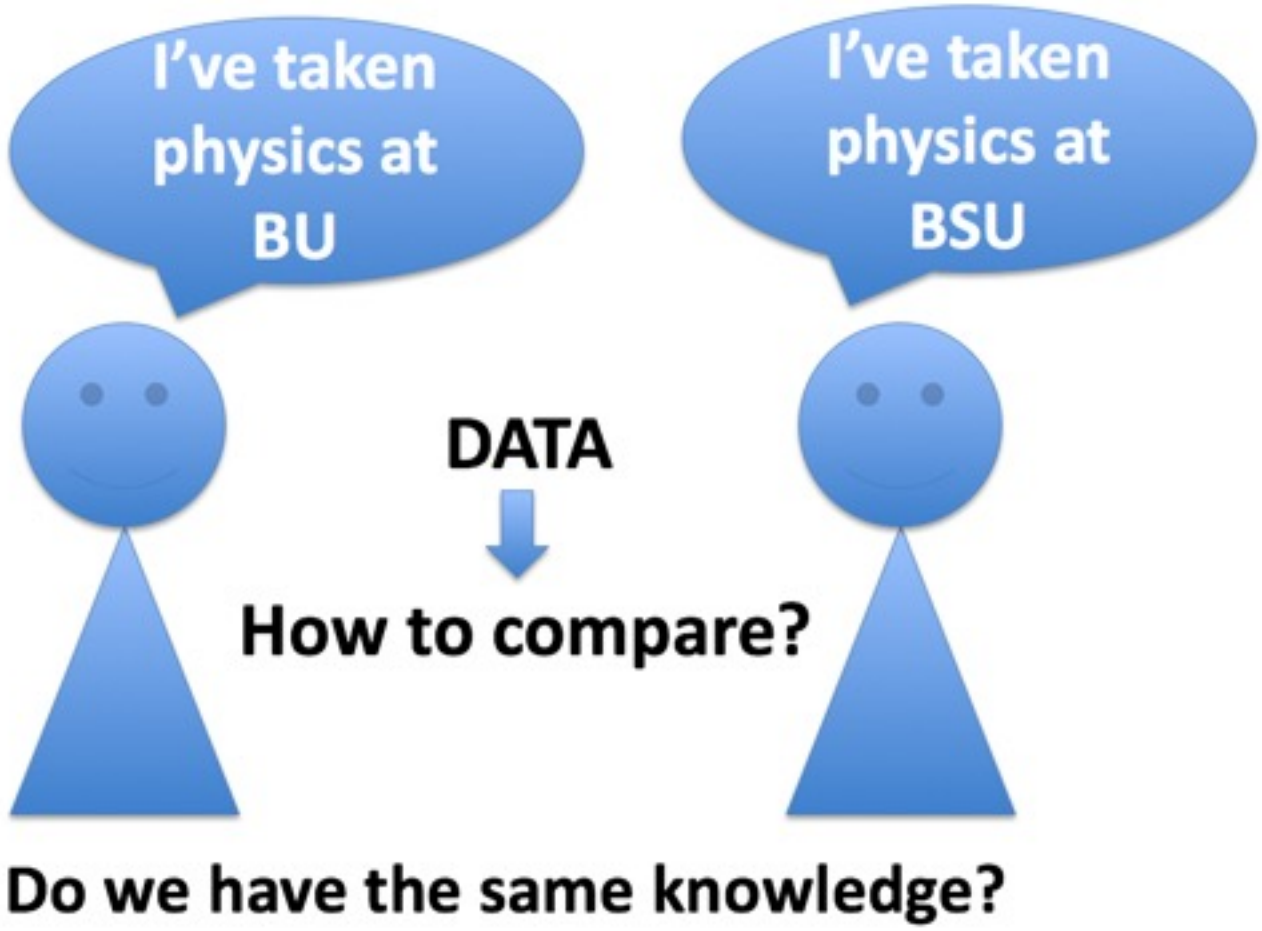
Proceedings of the Eighth International Conference on Educational Data Mining now available here.

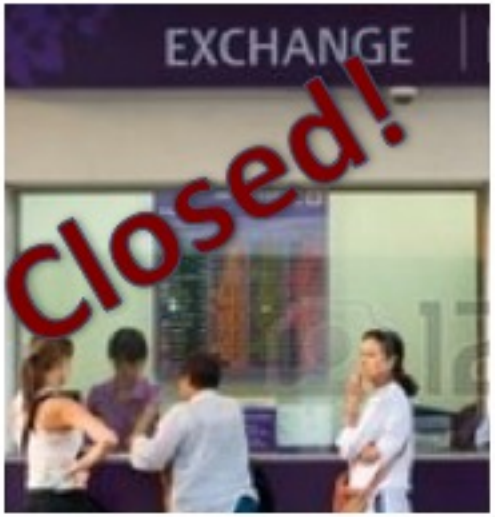
Journal of Educational Data Mining issue 7(2) now available here.

Upcoming Conferences

Ninth International Conference on Educational

18. However, having a lot of data without being able to make a comparison is like using different currencies without establishing exchange rates.



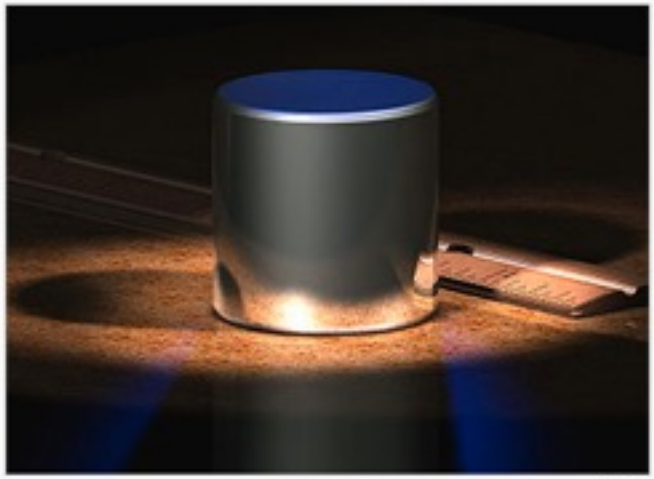


19. The history of physics shows us a means for establishing the comparability we need – such means are called standards.

Standard (metrology)

From Wikipedia, the free encyclopedia

In metrology (the science of measurement), a **standard** (or **etalon**) is an object, system, or experiment that bears a defined relationship to a unit of measurement of a physical quantity.[1] Standards are the fundamental reference for a system of weights and measures, against which all other measuring devices are compared. Historical standards for length, volume, and mass were defined by many different authorities, which resulted in confusion and inaccuracy of measurements. Modern measurements are defined in relationship to internationally-standardized reference objects, which are used under carefully controlled laboratory conditions to define the units of length, mass, electrical potential, and other physical quantities.



The International Prototype Kilogram (IPK) is an artifact standard or prototype that is defined to be exactly one kilogram mass.

20. We would have never had a hadron collider built in Geneva if after an almost hundred-year long journey physicists would not agree on a set of common standards.

KING HENRY DIED DRINKING CHOCOLATE MILK

Mnemonic	King	Henry	Died	Base Unit	Drinking	Chocolate	Milk
Length: Abbreviation:	Kilometer km	Hectometer hm	Decameter dam	Meter m	Decimeter dm	Centimeter cm	Millimeter mm
Weight: Abbreviation:	Kilogram kg	Hectogram hg	Decagram dag	Gram g	Decigram dg	Centigram cg	Milligram mg
Volume: Abbreviation:	Kiloliter kL	Hectoliter hL	Decaliter daL	Liter L	Deciliter dL	Centiliter cL	Milliliter mL
How many are in **1** meter/gram/liter	.001	.01	.1	1	10	100	1000
How many meters/grams/liters are in this unit?	1000	100	10	1	.1	.01	.001
	⇦	BIGGER			SMALLER	⇨	

Standard (metrology)

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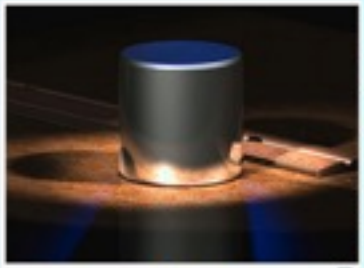
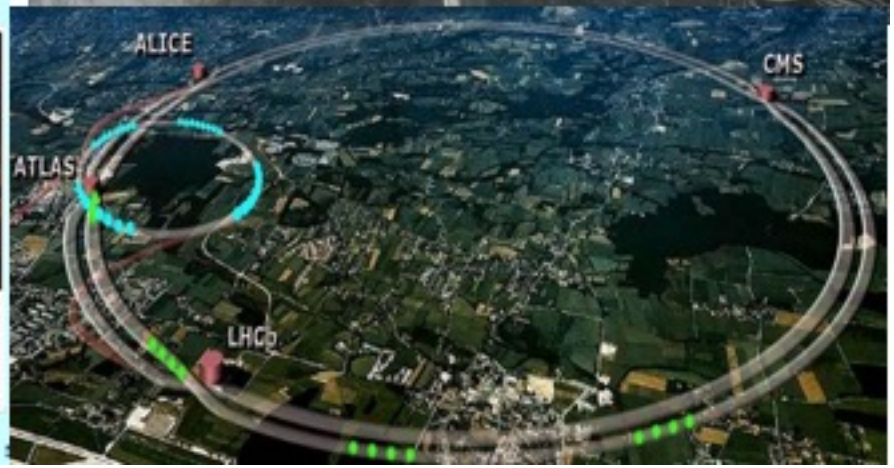
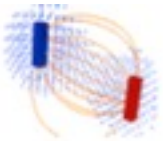


The International Prototype Kilogram (IPK) is an artifact standard or prototype that is defined to be exactly one kilogram mass.



21. There are standards in education, too. But when an educator says “a standard”, he or she means something very different from what it meant in physics. In education, a standard is a description of “the learning goals for what students should know and be able to do at each grade level”. However, people using the same educational standards still can use different measuring procedures leading to incomparable results.

PHYSICS STANDARDS



Motion and Forces

1. Newton's laws predict the motion of most objects. As a basis for understanding this concept:

a. *Students know* how to solve problems that involve constant speed and average speed.

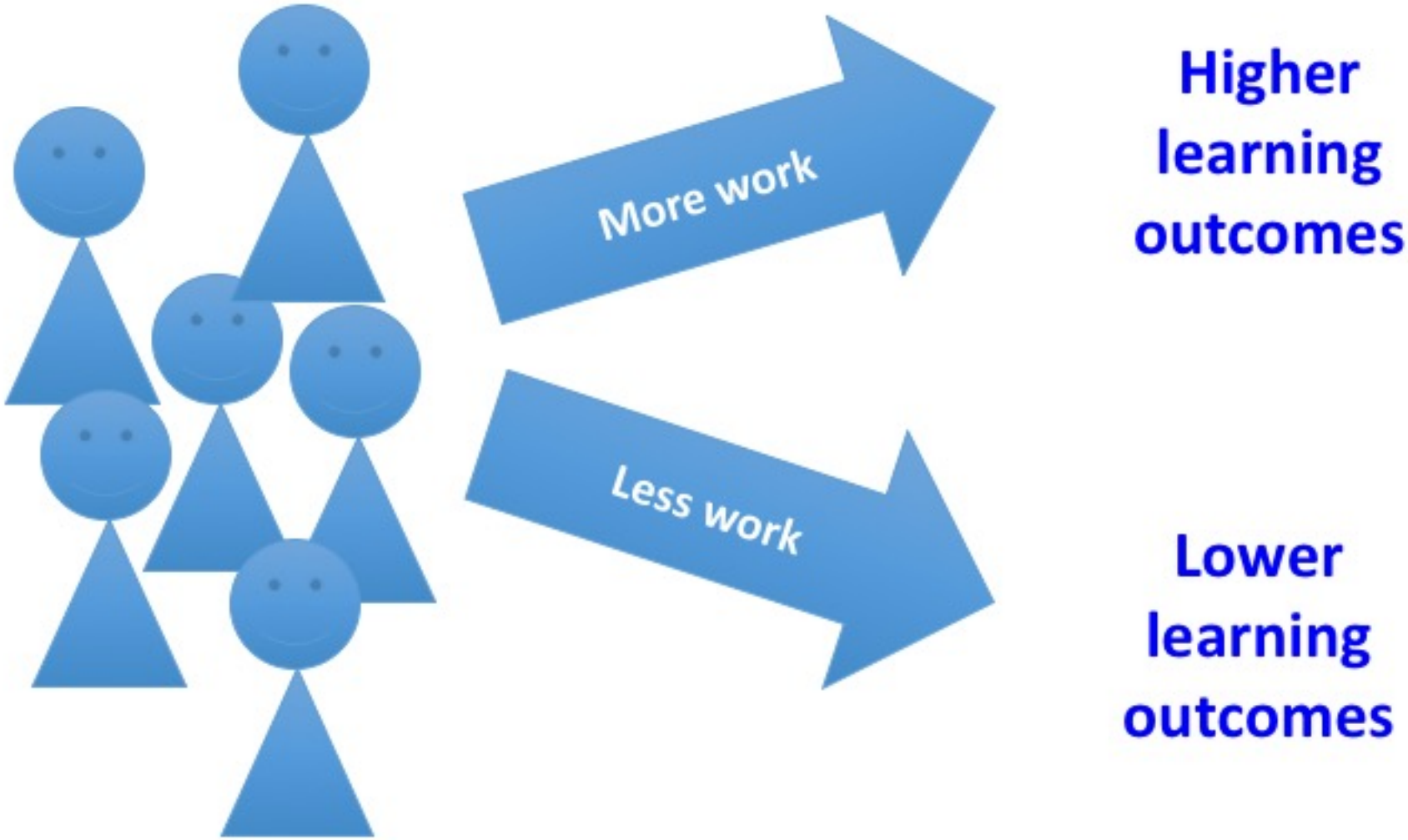
b. *Students know* that when forces are balanced, no acceleration occurs; thus an object continues to move at a constant speed or stays at rest (Newton's first law).

c. *Students know* how to apply the law *F=ma* to solve one-dimensional motion problems that involve constant forces (Newton's second law).

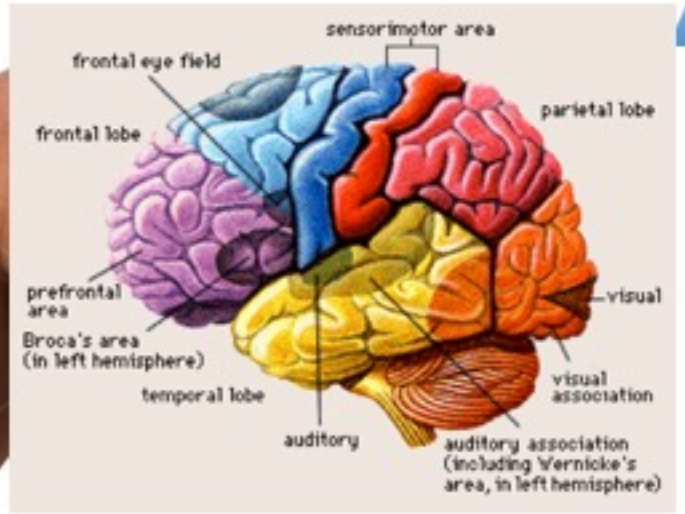
d. *Students know* that when one object exerts a force on a second object, the second object always exerts a force of equal magnitude and in the opposite direction. (Newton's third law).

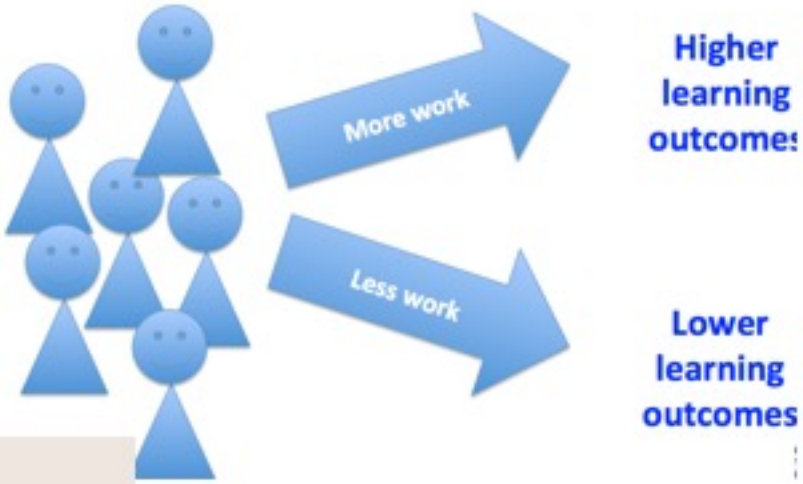
Do we use the same measuring procedure?

22. Based on current data all we can conclude so far is that: 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 different exercises, etc.) students from that group, on average, will demonstrate better learning outcomes than the students in a controlled group.



23. 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.





24. In order to move beyond the obvious we need to adapt to teaching physics the same approach which had been adopted to doing physics.

In order to move beyond the obvious we need to adapt to *teaching* physics the same approach which had been adopted to *doing* physics. And, as in physics, we need a "standardized" standard/prototype which, like in physics, is an actual object, or a feature of an object, accompanied by a specific procedure which allows comparing similar features carried by other objects with the one of the standard.

Building a Science of Teaching Physics

Edward F. Redish
University of Maryland, College Park

*Published July, 1999, in **The American Journal of Physics**.*

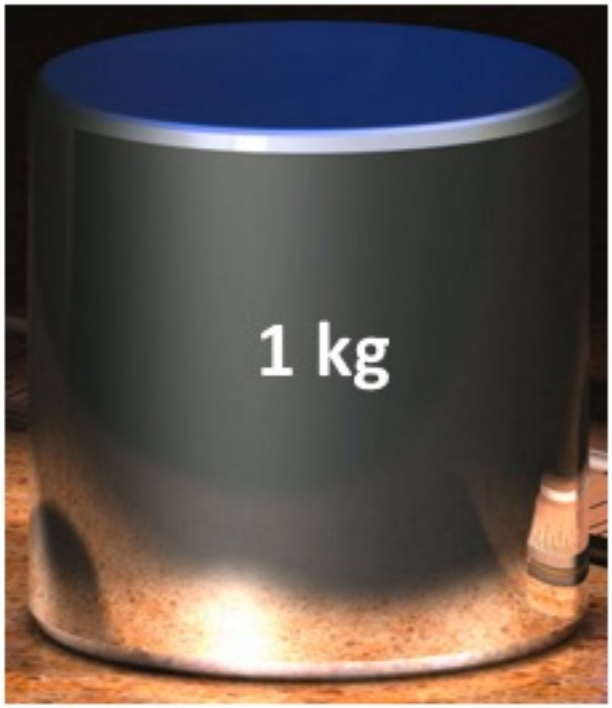
Back to overview of research

This work was supported in part by NSF grants DUE 945 5561 and DUE 965 2877.

http://www.physics.umd.edu/rgroups/ripe/perg/qm/qmcourse/NewModel/research/millikan/index.htm

25. We need a standard which, like in physics, is an actual object, or a feature of an object, accompanied by a specific procedure which allows comparing similar features carried by other objects with the one of the standard (that is why "a standard" is also called "a prototype", or "an etalon"). For example, a standard of mass is an actual cylinder. A verbal description such as: "A standard of mass looks like a cylinder "with diameter and height of about 39 mm, and is made of an alloy of 90 % platinum and 10 % iridium" would not work as a standard, because it is impossible to compare the mass of an object with a sentence.

A standard is an object, or a feature of an object, accompanied by a specific procedure which allows comparing similar features carried by other objects with the one of the standard.



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"A standard of mass looks like a cylinder "with diameter and height of about 39 mm, and is made of an alloy of 90 % platinum and 10 % iridium"

http://www.physics.umd.edu/rgroups/ripe/perg/qm/qmcourse/NewModel/research/millikan/index.htm

26. I propose that, following physics, "a standard" for measuring learning outcomes must satisfy the following five conditions:

(a) Every aspect of the development and the use of the standard has to be open to public and be able to be examined by *anyone*.

(b) The use of the standard must lead to gradable information on student's skills and knowledge.

(c) The use of the standard must lead to gradable information on student's skills and knowledge, AND must not depend on any specific features of teaching or learning processes.

(d) The use of the standard must lead to gradable information on student's skills and knowledge, and must not depend on any specific features of teaching or learning processes, AND must allow to compare on a uniform basis the learning outcomes of any and all students using the standard.

(e) Any institution adopting the standard should automatically become an active member of the community utilizing the standard and can propose possible alternations to the standard to accommodate changes in the understanding of what students should know and be able to do.

27. I have developed a specific approach which will lead to designing such a standard. The approach is based on using MOCCs (MOCC stands for "a map of operationally connected categories"); the link on the screen leads to a detailed description of what MOCC is and whys to use it (http://teachology.xyz/mocc.htm).

A Map of Operationally Connected Categories as an instrument for classifying physics problems and a basis for developing a universal standard for measuring learning outcomes of students taking physics courses (a novel tool for measuring learning outcomes in physics).

By Valentin Voroshilov

http://teachology.xyz/mocc.htm

Abstract

Currently there is no tool for measuring learning outcomes of students, which would be broadly accepted by teachers, schools and district officials, by parents, policymakers. Educational standards cannot provide a basis for such a tool, since for an educator "a standard" means a verbal description of skills and knowledge which students should be able to demonstrate but not an actual object, or a feature of an object, accompanied by a specific procedure which allows comparing similar features carried by other objects with the standard one (like in physics). There is however an approach to standardization of measurement of physics knowledge similar to standardization of measurements in physics. This approach is based on a specific technique used for classification physics problems. At the core of such classification is the use of graphs, such that 1. every quantity represented by a vertex/node of a graph must have a numerical representation, i.e.

28. I believe that the time has come to create a coalition of individuals and institutions who would see as an achievable goal developing the universal standard for measuring learning outcomes in physics (and then to apply the same approach to other STEM subjects).

An association for developing objective standards for measuring knowledge and skills in STEM subjects

29. The methodology or framework for the deployment of such a standard is following “a driving exam” approach: instead of using a verbal description of what students should know and be able to do (a.k.a. “educational standards”), making them to demonstrate what they should know and be able to do using a “standardized” collection of exercises and actions (a.k.a. “physics standards”).

30. This methodology is based on four fundamental principles.

1. In physics every component of student's knowledge and every element of his/her skill set can be probed by offering to a student to solve a specific theoretical (or practical) problem (to probe rote knowledge a student can be asked a question like "what is ...").

31. For a given level of learning physics there is *always* a set of problems, which can be used to probe student's knowledge and skills. For a given level of learning physics a set of problems, which can be used to probe student's knowledge and skills, has a finite number of items.

2. For a given level of learning physics there is *always* a set of problems, which can be used to probe student's knowledge and skills.

3. For a given level of learning physics a set of problems, which can be used to probe student's knowledge and skills, has a finite number of items.

32. The most important principle says

based (a) on the *minimal* set of the physical quantities, (b) on the *minimal* set of the physical relationships necessary for constricting the solution of a problem , and (c) on the structure of the connections between quantities (a) provided by relationships (b)

33. Using the fourth principle (and new terminology), we can classify all problems based on the structure of the internal connections between the quantities involved in constructing their solution.

All problems which can be solved by applying the exactly same sets of quantities (a) and expressions (b) and using the same sequence of steps (c) are *congruent* to each other. Problems which use the same set of quantities (a) and expressions (b) but differ by sequence (c) are *analogous* problems. Two problems for which set of physics quantities (a) differ by one quantity are *similar*.

34. For example, here are samples of problems which are congruent or similar to each other.

E.G. **Problem A.** A plain needs to reach speed of 100 m/s. Engines provide acceleration of 8.33 m/s^2. Find the time for the plain to reach the takeoff speed.

Problem B. For a takeoff a plain needs to reach speed of 100 m/s. It travels 600 m to reach this speed. Find acceleration of the plain during its running on the ground. (B is *similar* to A)

Problem C. A car reaches the speed of 18 m/s, moving with a constant acceleration of 6 m/s^2 (starting from rest). Find the time it takes for the car to reach the speed. (C is *congruent* to A)

35. It is very important, that

All analogous, similar and congruent problems can be restated using a *general language* which does *not* depend on the actual situation described in a problem => *root problems.*

36. For the three previous problems, the root problem sounds like the one at the bottom of the screen.

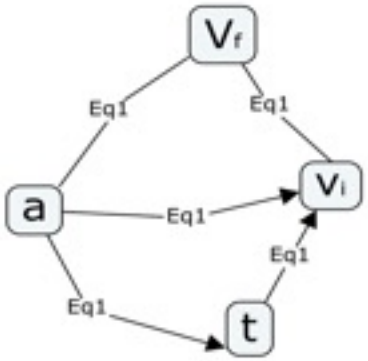
E.G. **Problem A.** For a takeoff a plain needs to reach speed of 100 m/s. The engines provide acceleration of 8.33 m/s^2. Find the time it takes for the plain to reach the speed.

Problem B. For a takeoff a plain needs to reach speed of 100 m/s. It travels 600 m to reach this speed. Find acceleration of the plain during its running on the ground. (B is *similar* to A)

Problem C. A car starts from rest and reaches the speed of 18 m/s, moving with the constant acceleration of 6 m/s^2. Find the time it takes for the car to reach the speed. (C is *congruent* to A)

Root problem. An object starts moving from rest keeping constant acceleration. How much time does it need to reach the given speed or to travel the given distance?

37. To help us to classify all root problems we can use the so-called MOCCs (a map of operationally connected categories).



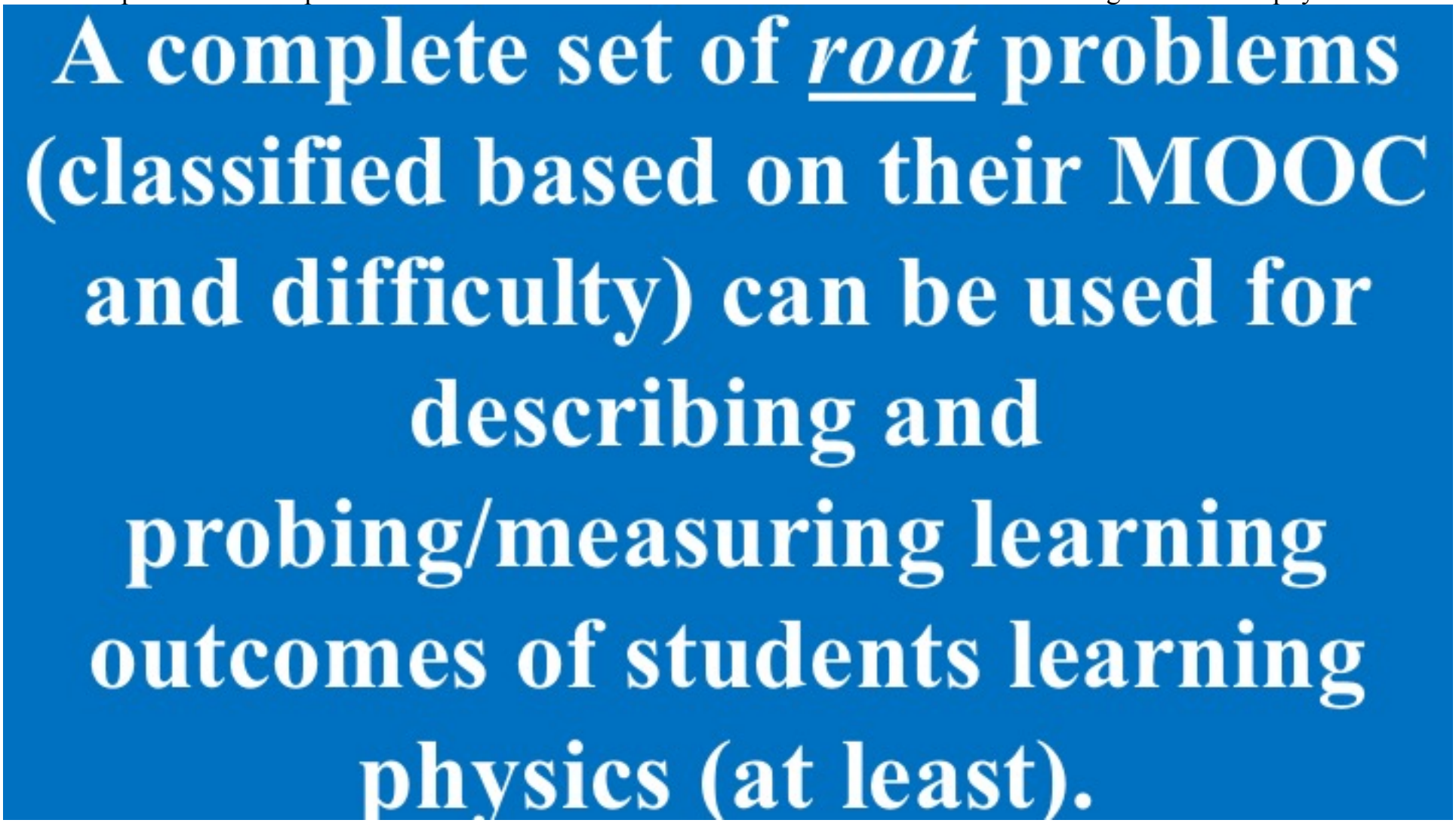
For each root problem => visual representation

Each MOCC represents a specific example of a knowledge mapping, but must satisfy *two specific conditions:*

1. every quantity represented by a vertex of a graph must have a numerical representation, i.e. has to be measurable (capable of being measured, i.e. there has to be a procedure leading g to a numerical value of the quantity represented by a vertex).

2. every link between any to vertices must have an operational representation: i.e. for any quantity represented by a vertex, if its value is getting changed, and the values of all but one other quantities represented by other vertices connected to the changing one are being kept constant, the quantity represented by the remaining vertex linked to the changing one must change its value.

38. A complete set of root problems can be used to describe desired and different levels of learning outcomes of physics students.



39. The first step toward the association would be agreeing on the set of root problems (classifying them based on the difficulty).

An association for developing objective standards for measuring knowledge and skills in STEM subjects

The first step toward the development of a ***universal content standard*** would be agreeing on the set of root problems (classified based on the difficulty).

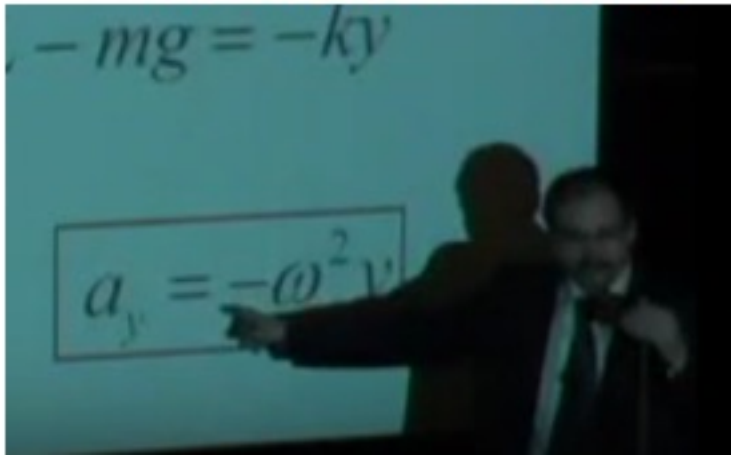
40. The third project is a continuation of the previous project.

3. Developing research facilities specifically designed to study learning and teaching processes.

41. Today there is NO science of education.

Physics, mathematics, chemistry, biology, medicine, engineering is a science.

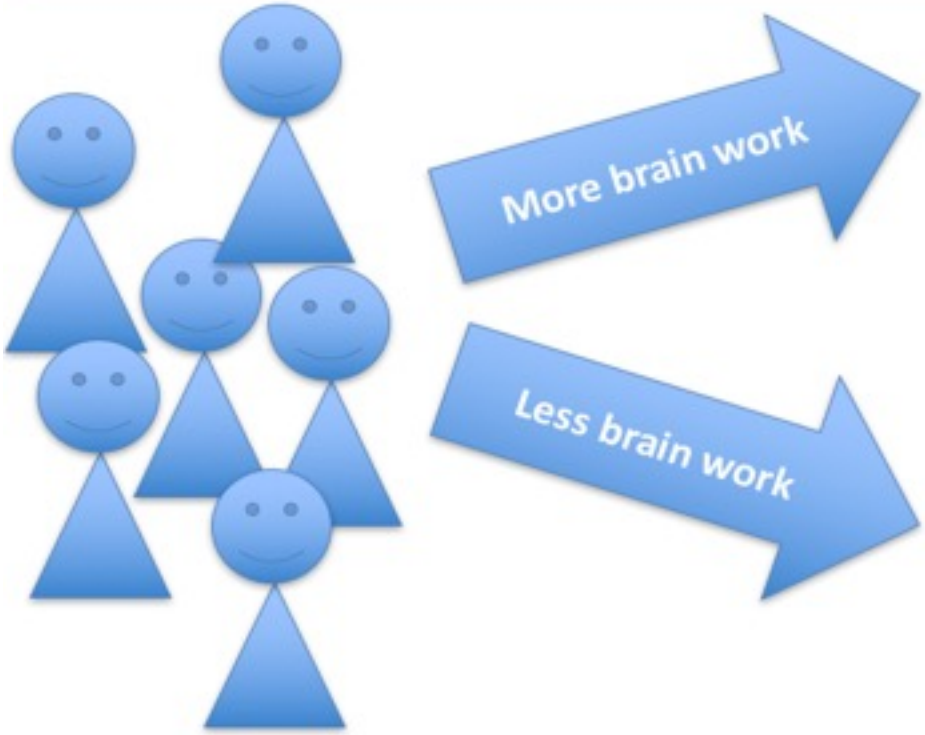
Teaching physics, mathematics, chemistry, biology, medicine, engineering is *not*.



42. Scientific activities in education are in a pre-science stage. We have so far "the alchemy" of education. 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"



Higher learning outcomes

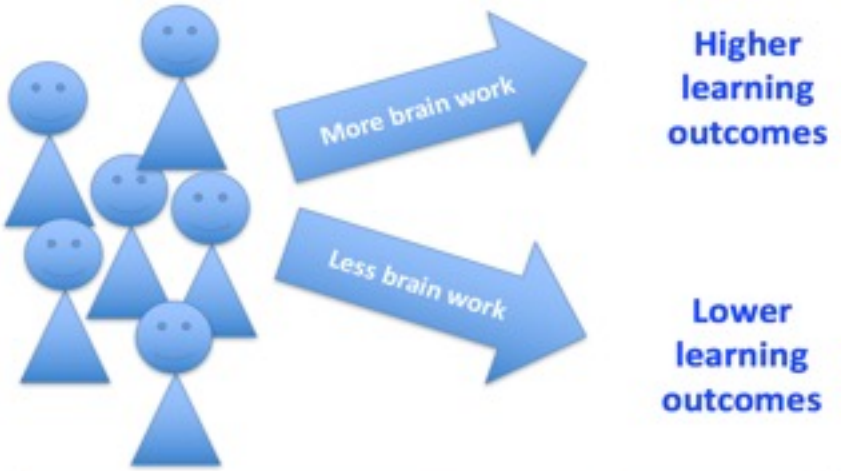
Lower learning outcomes

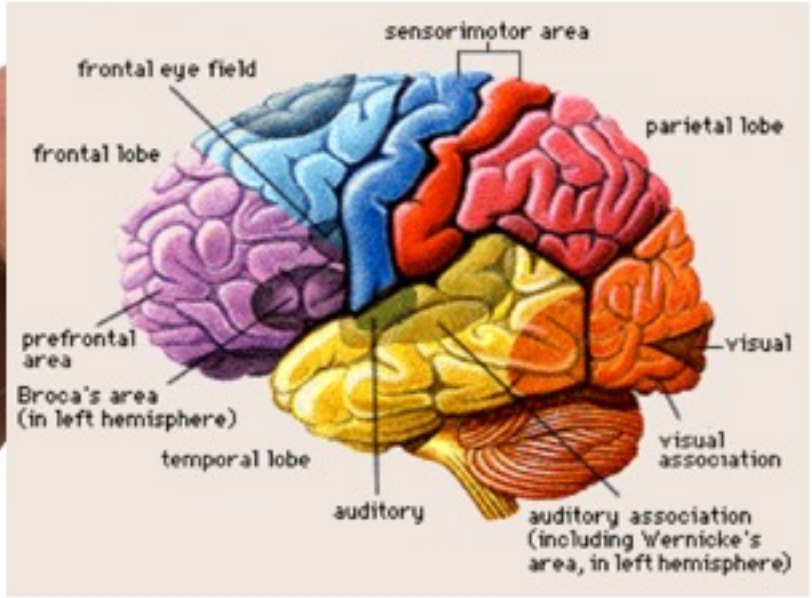
If we take two large groups of students, and one group will have a more extensive or divers learning experience, students from that group, on average, will demonstrate better learning outcomes.

43. This conclusion becomes almost obvious if we employ the notion that a brain is basically a collection of muscles.

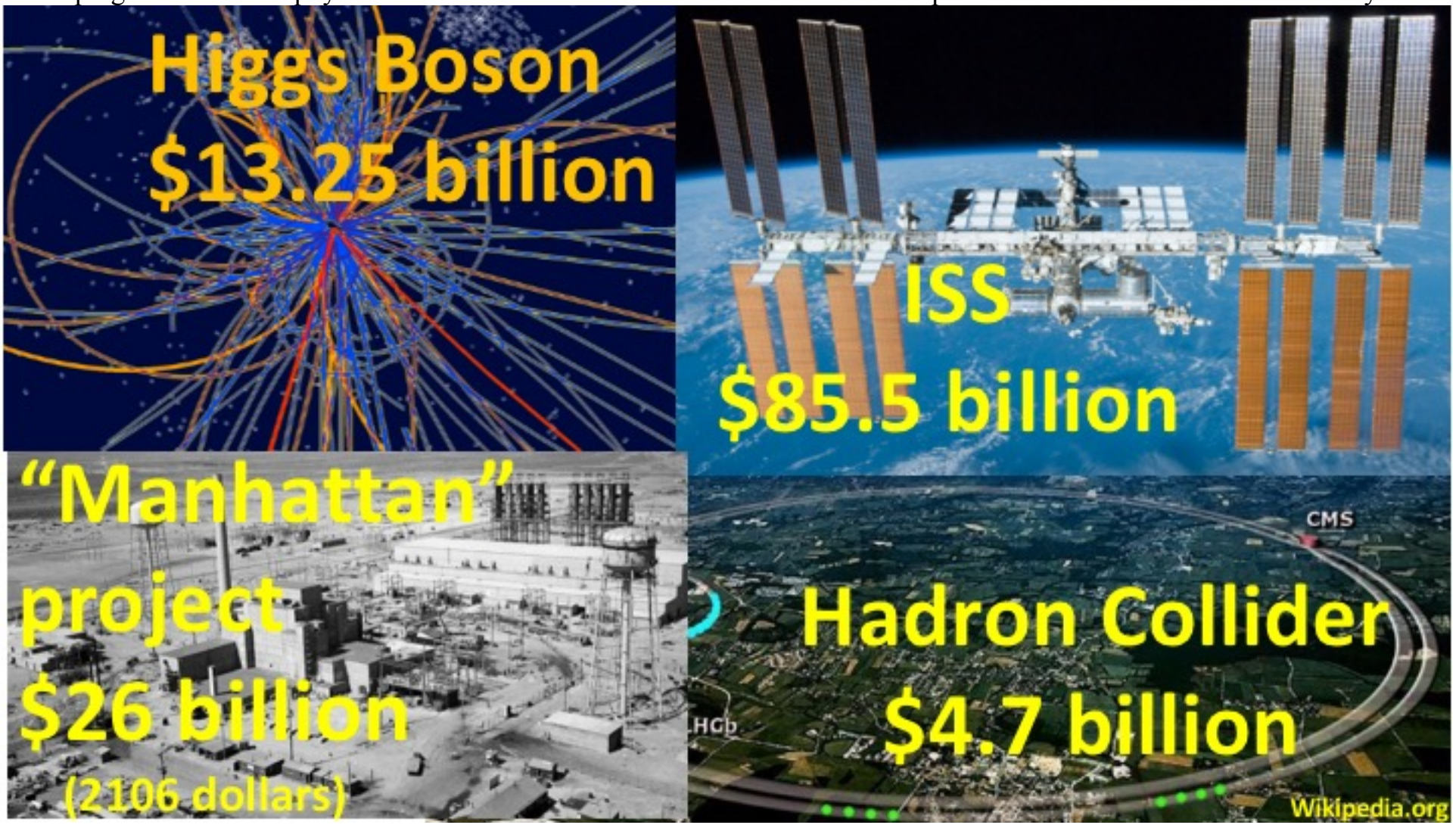
This conclusion becomes almost obvious if we employ the notion that a brain is basically a muscle, or a collection of muscles,

the development of which strongly correlates with the *variety* and *intensity* of exercises it goes through during its development.





44. To propel a science of education to a true science we don't need to reinvent a wheel. We just have to follow the strategy used in developing the science of physics. We all know that billions of dollars have been spent to build research facilities to study

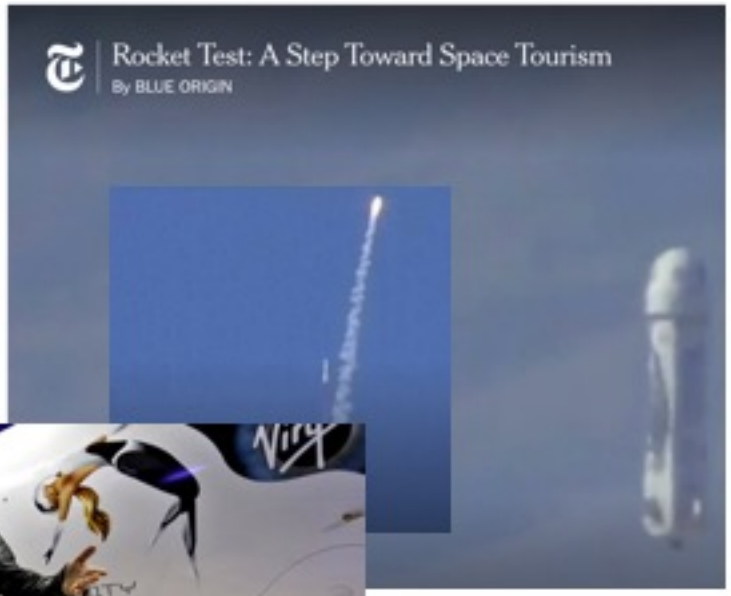


45. or even to conquer the physical world.

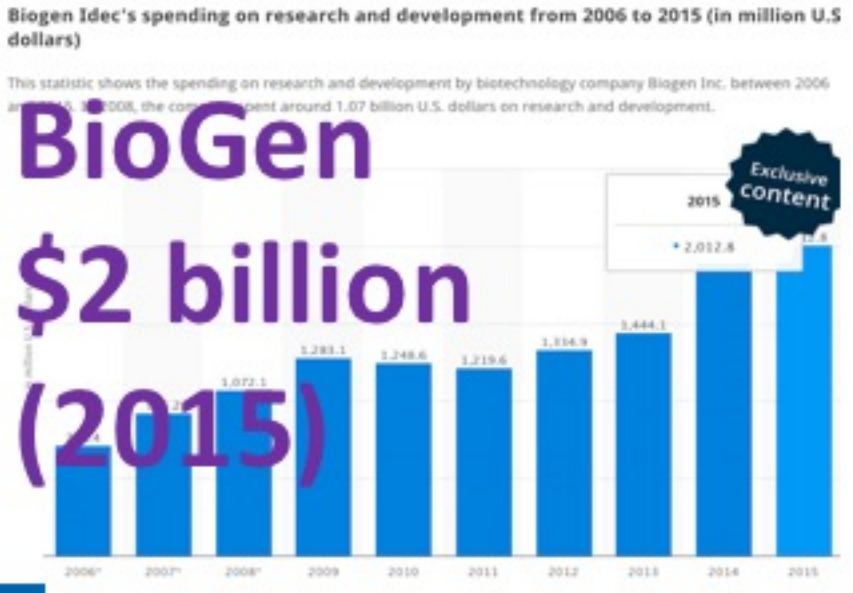
ELON MUSK ANNOUNCES HIS PLAN TO COLONIZE MARS AND SAVE HUMANITY

Blue Origin, Jeff Bezos' Rocket Company, .

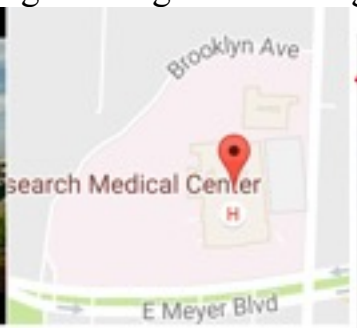
By KENNETH CHANG OCT. 5, 2016



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



47. We have hundreds of research hospitals, but ZERO research schools. And there is ZERO investment into building research facilities designed specifically to studying learning and teaching processes.



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Hospital and Emergency Room in Kansas City, MO with an additional location in the Brookside neighborhood and a separate psychiatric clinic providing ...

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St. Jude is a leading children's hospital pioneering research and treatments for kids with cancer and other life-threatening diseases. Your donation matters.
Donate to St Jude · Careers · Research at St. Jude · Ways to Give

Careers - St. Jude Children's Research Hospital
https://www.stjude.org/jobs.html ▾
St. Jude is a world-class research hospital seeking a diverse staff of faculty, researchers, clinicians, fundraisers and more. Find a job and help save lives.

48. 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.

Boston-area Edtech Startups

LearnLaunch

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.

National Science Foundation
WHERE DISCOVERIES BEGIN

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

M D E F

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Teacher Development Grants

49. To make a transition from a pre-science state (like alchemy) to becoming a true science (like chemistry) we have to treat education as space exploration. The field of education needs research facilities *designated* specifically to studying learning and teaching processes.

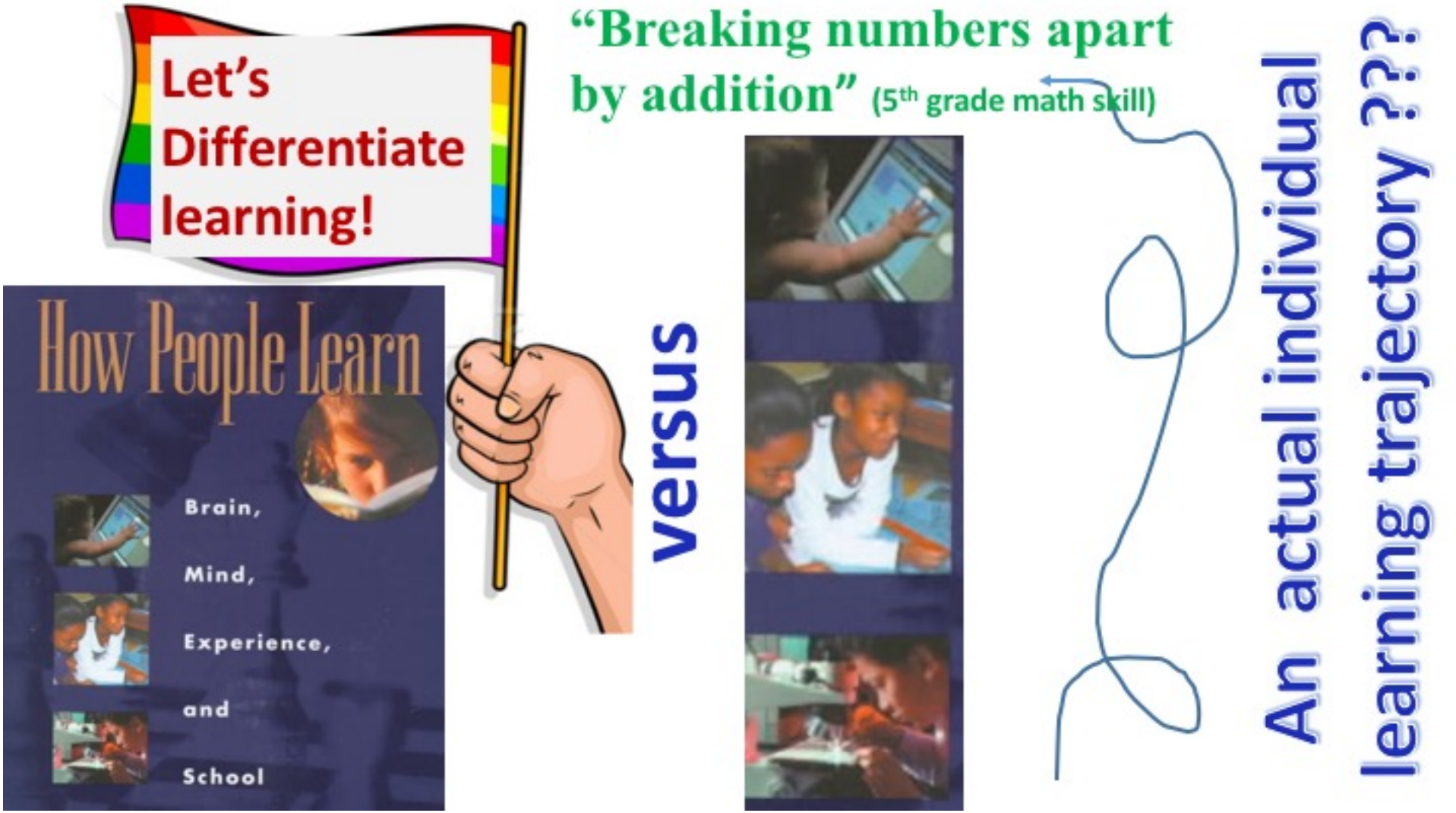
50. We have to start from two questions. What to study, and how to structure this facility?

51. 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!

52. 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".

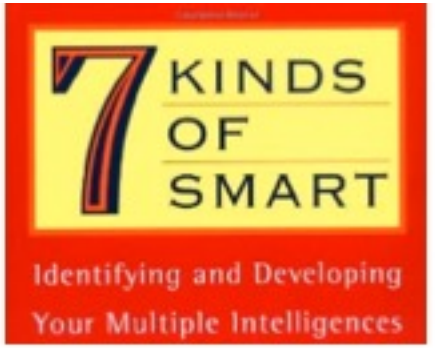


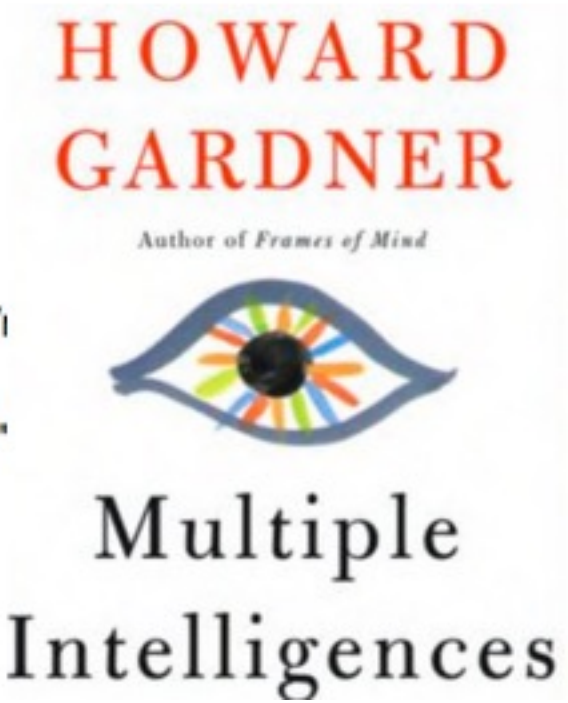
53. Yes, different people have different learning styles. We know that.

Overview of Learning Styles

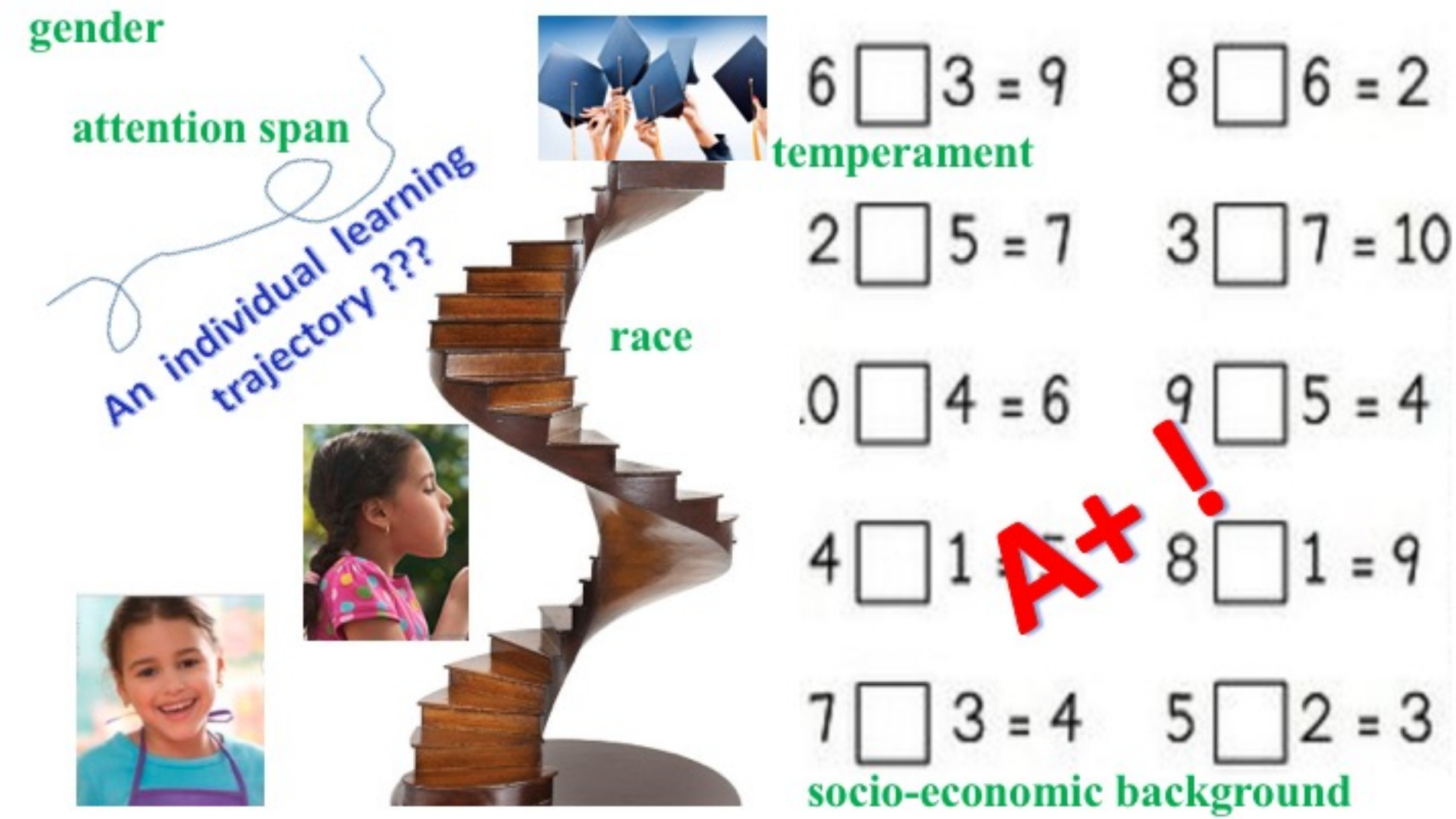
Many people recognize that each person prefers different learning styles and techniques. Learning styles group common ways that people learn. Everyone has a mix of learning styles. Some people may find that they have a dominant style of learning, with far less use of the other styles. Others may find 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")

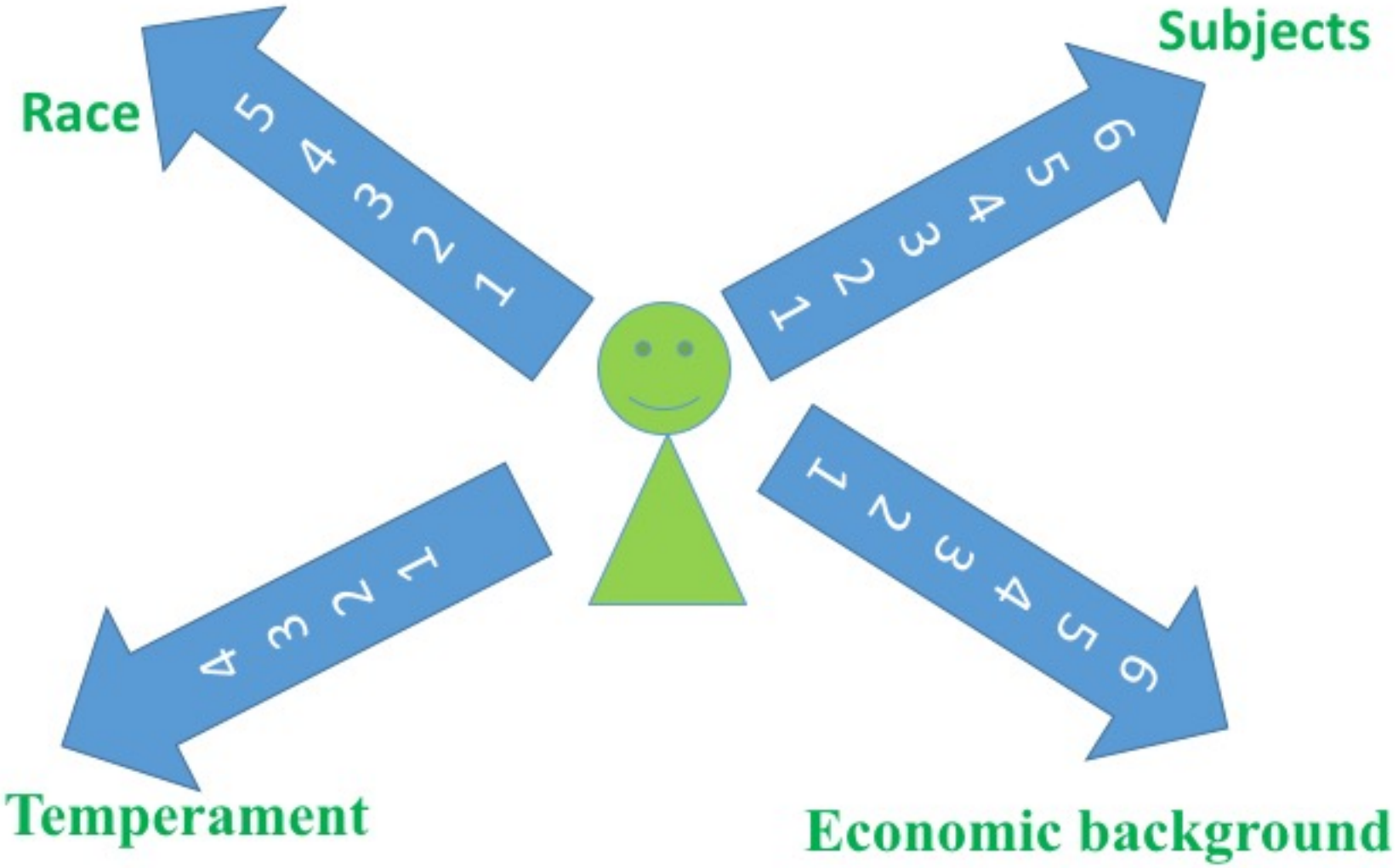




54. But how much time would it take to a child of a specific gender, race, socio-economic background, attention span, temperament, and other individual characteristics to master a given skill of a given subject? *That* we do not know.

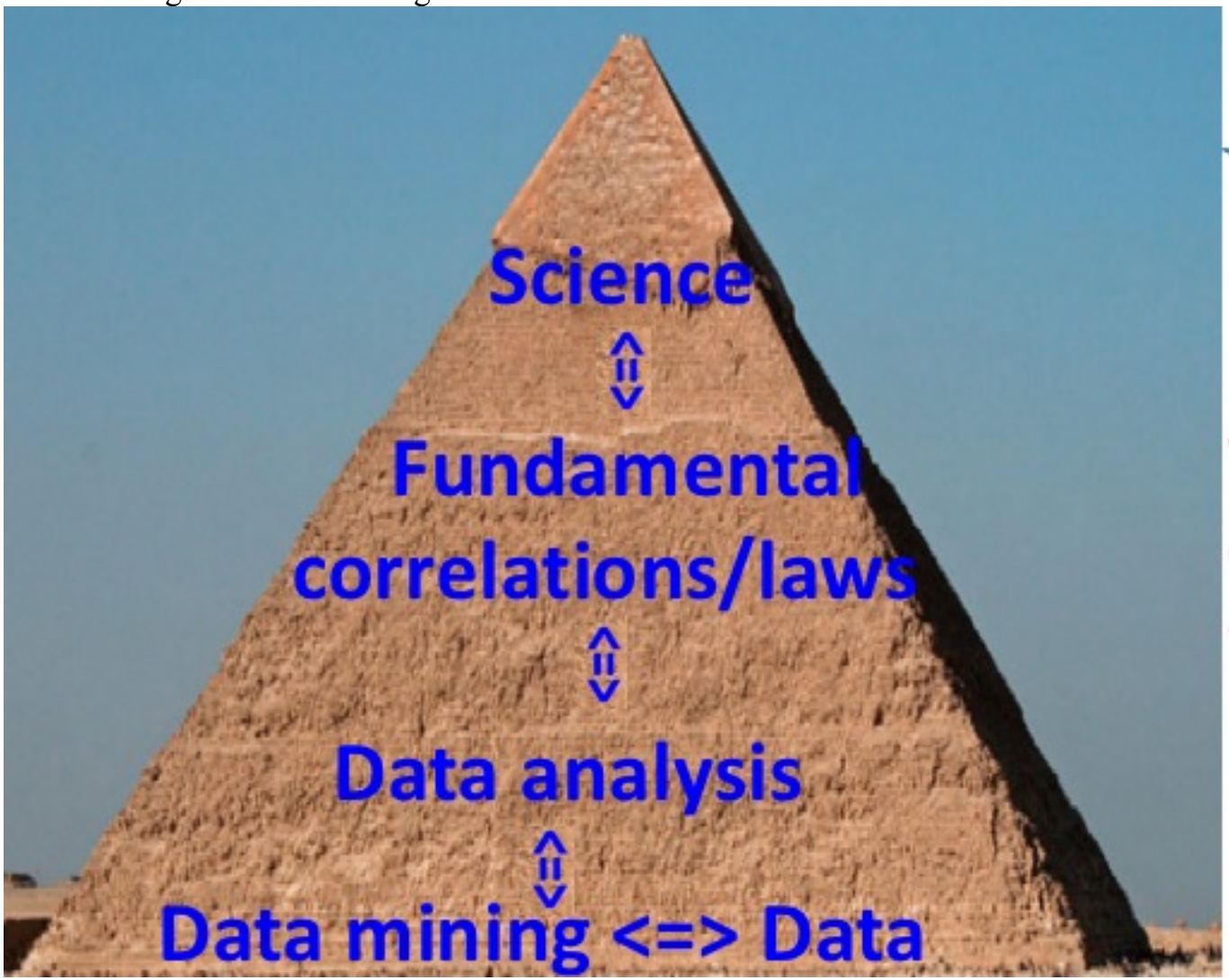


55. For every child, there is a finite number of individual characteristics describing his or her learning, behavioral, and social styles. There is a finite number of subjects to learn, and within each subject there is a finite volume of knowledge to learn, and a finite number of skills to master. It should take a finite amount of time to study all relevant correlations. We need to study those elementary learning acts which different children need to enact to learn a given skill.



56. 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.

57. 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.



R&D

Recommendation
Textbooks
Assessments
Apps
Gadgets
...
???
No way to predict!

58. 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.

59. 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.

60. The last project recognizes the most important role teachers play in education. The quality of education is directly related to the quality of teaching, which is directly related to the quality of teacher professional development

"Professional Designing" as a "Project-oriented form of teacher professional development for pre-service and in-service physics teachers".

http://www.teachology.xyz/np.htm

http://www.teachology.xyz/pd.htm

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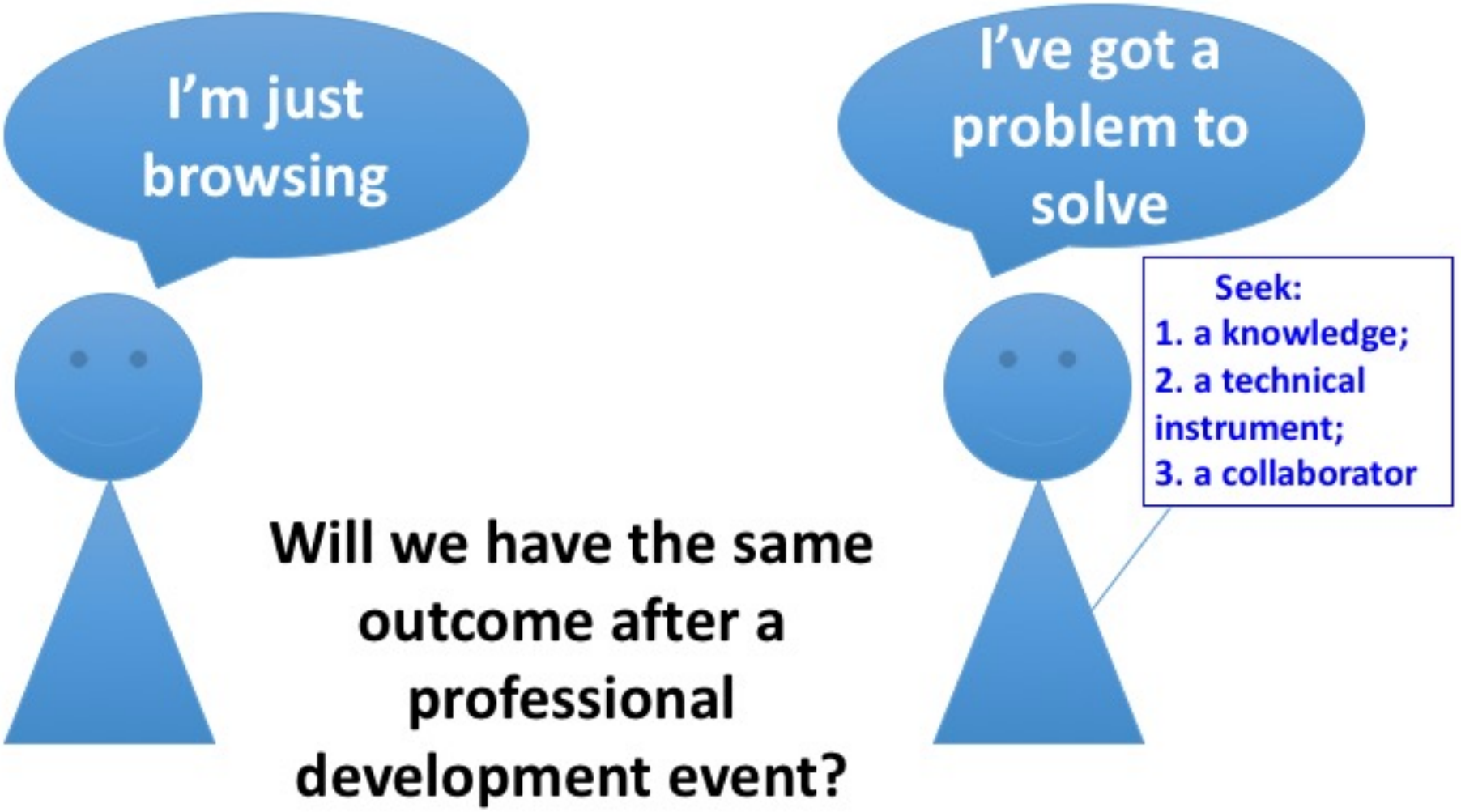
61. This project is based on a specific version of the Activity Theory described in Chapter 16 of the book: “Facilitating In-Service Teacher Training for Professional Development”

“Facilitating In-Service Teacher Training for Professional Development”

Chapter 16: “Professional Designing as One of Key Competencies of Modern Teacher: an Ability Which Every Teacher Needs to Have”

http://www.igi-global.com/book/facilitating-service-teacher-training-professional/164920

62. When attending a professional development event, a teacher can take a passive position (“I am just looking for something new and interesting”). Or, the teacher can take an active position (“I have a problem and I need to find a means to solve it”).



63. The latter position significantly increases chances that after the event the teacher will be making some changes in his or her teaching practice. And that is what we all want from a professional development event.

The outcome and effectiveness of a teacher professional development event is viewed via changes in the teaching practice made by the participant (attendee) after the event, and focusing on making advancement in the teaching practice by solving specific problems and overcoming specific obstacles.

64. “When I started my career, I did not have a say in the menu of courses that my district taught. We logged into a training system and chose, based on what was being provided. The problem was that *none of the provided sessions applied to what I needed*, and when district requirements were that a certain number of hours be earned through in-district training, it meant that *a large majority of teachers were taking courses just to earn the hours*. That was more than 10 years ago, and sadly, in many school districts, this is still the case.” This is a quote from a book by Rafranz Davis, “The Missing Voices in EdTech”, 2015 (CORWIN)

“When I started my career, I did not have a say in the menu of courses that my district taught. We logged into a training system and chose, based on what was being provided. The problem was that *none of the provided sessions applied to what I needed,* and when district requirements were that a certain number of hours be earned through in-district training, it meant that *a large majority of teachers were taking courses just to earn the hours*. That was more than 10 years ago, and sadly, in many school districts, this is still the case.”

From a book by Rafranz Davis, “The Missing Voices in EdTech”, 2015 (CORWIN)

65. Various researchers have been looking for methods to ensure that after attending a professional development workshop a teacher will bring into his or her practice new knowledge presented at the workshop. One of the practices which proved to be efficient is based on the activity theory, and called “Professional Designing”.

66. Professional Designing helps to ignite and maintain a process of transformative development of an individual or an institutional educational practice.
The theoretical foundation of this branch of the research can be found in publications of G.P. Shchedrovitsky (1964, 1966, 1971, 1977, 1981), and his colleagues, such as N.G. Alekseev (1992) and followers such as A.P. Zinchenko (2014).

Center for Activity Theory and Developmental Work Research

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Activity theory

Lev Vygotsky

From Wikipedia, the free encyclopedia

Lev Semyonovich Vygotsky (Russian: Лев Семёнович Выготский or Выготский, born Лев Симхович Выгодский [Lev Simkhovich Vygodskiy], November 17 [O.S. November 5] 1896 – June 11, 1934) was a Soviet psychologist, the founder of a theory of human cultural and bio-social development commonly referred to as cultural-historical psychology, and leader of the Vygotsky Circle.

Vygotsky's main work was in developmental psychology, and he proposed a theory of the development of higher cognitive functions in children that saw reasoning as emerging through practical activity in a social environment. During the earlier period of his career he argued that the development of reasoning was mediated

Lev Vygotsky

The Moscow Methodological Circle

Moscow Methodological Circle (MMC) is the philosophical and methodological intellectual and practical school established by George Petrovich Shchedrovitsky (or, GP, as many of his pupils nicknamed him)

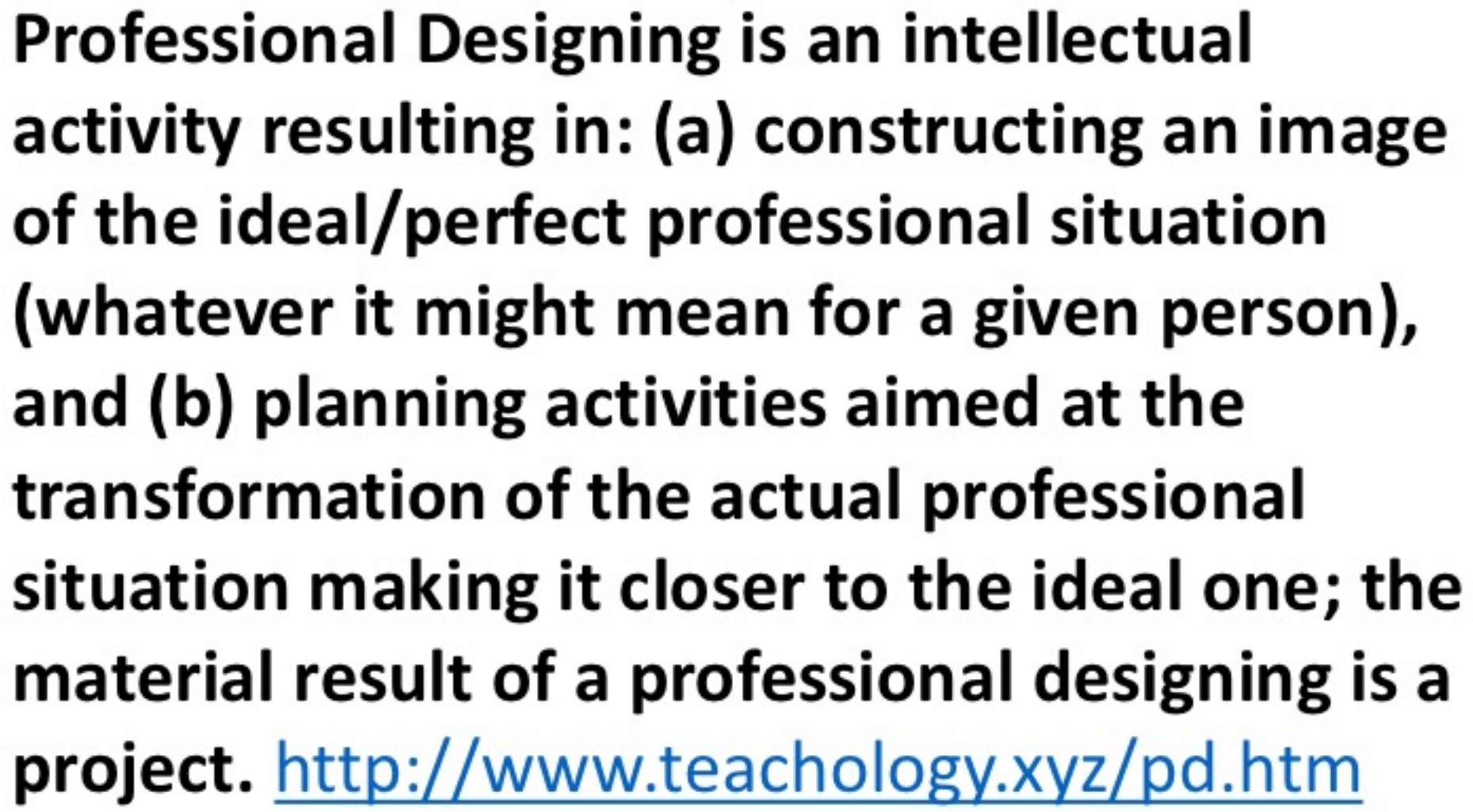
The Circle emerged in the early 1950s and took its final shape in 1954 in the course of the discussion on the issues of logic that was held at the Philosophy Department of the Moscow State University. It was first known as the Moscow Logical Circle (MLC). The founding fathers of the MLC were A. A. Zinoviev, G. P. Shchedrovitsky, S. A. Grushin and M. K. Mamardashvili.

In the year of 1958, after the split-up with A. A. Zinoviev, G. P. Shchedrovitsky became the ideological and organisational leader of the Circle, and the Circle took the name of the Moscow Methodological Circle. Today GP's pupils established independent organisations proceeding with the intellectual traditions of the Circle, and the MMC took the form of a broader Methodological Movement.

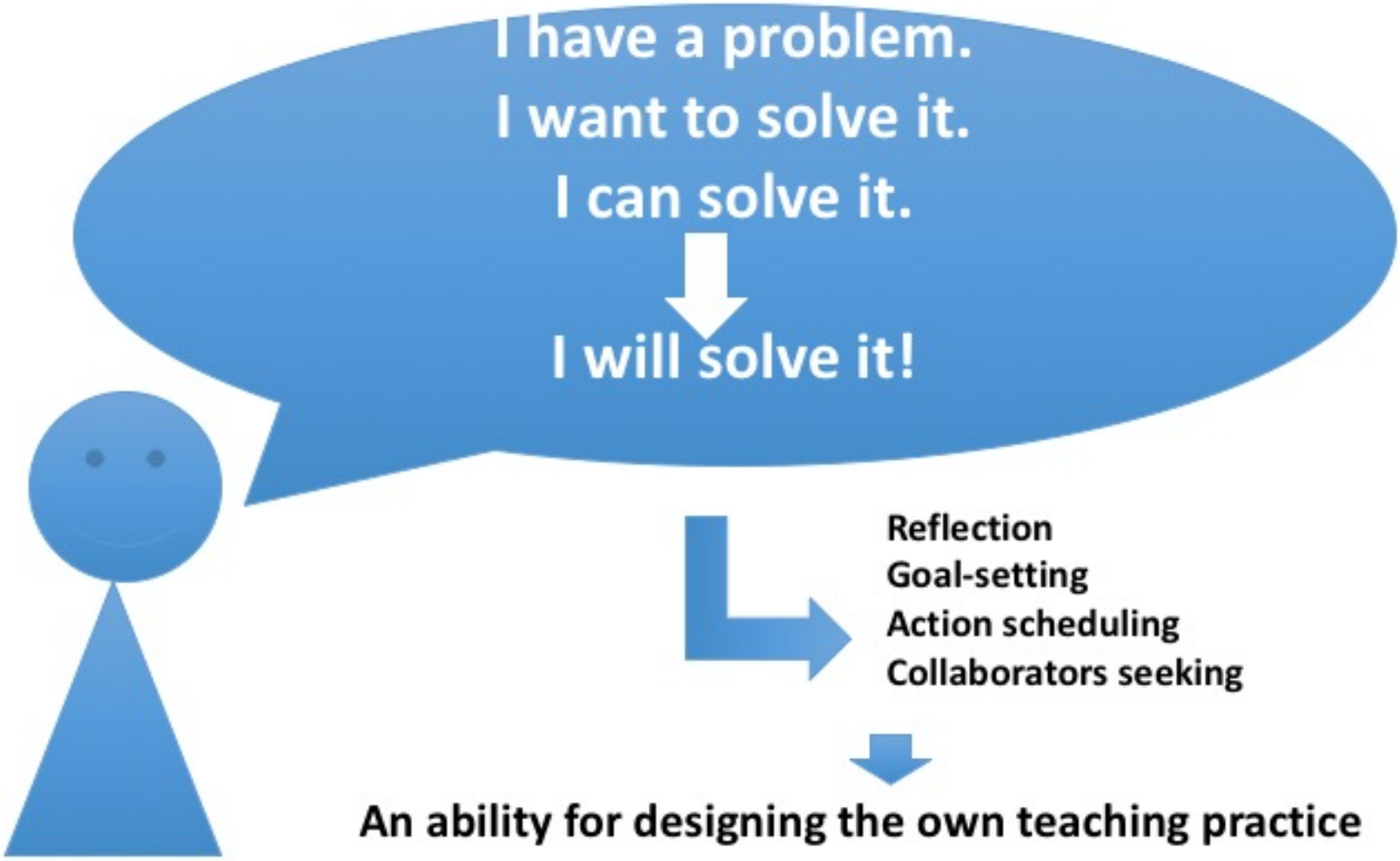
Shchedrovitskiy Georgiy Petrovich (1929-1994) - Russian philosopher and psychologist. Studied the problems of interrelations between Pedagogy, Logic, Sociology and Psychology. Researched intellectual activity, methods of solving mathematical problems by children, the place of play activity in children's communities. Proposed the idea of conceptual-genetic logic. In 1980s developed, in collaboration with his students and followers, participatory planning games combining the characteristics of training and business games with intellectual methodological discourse.

Professional Designing helps to ignite and maintain a process of transformative development of an individual or an institutional educational practice.

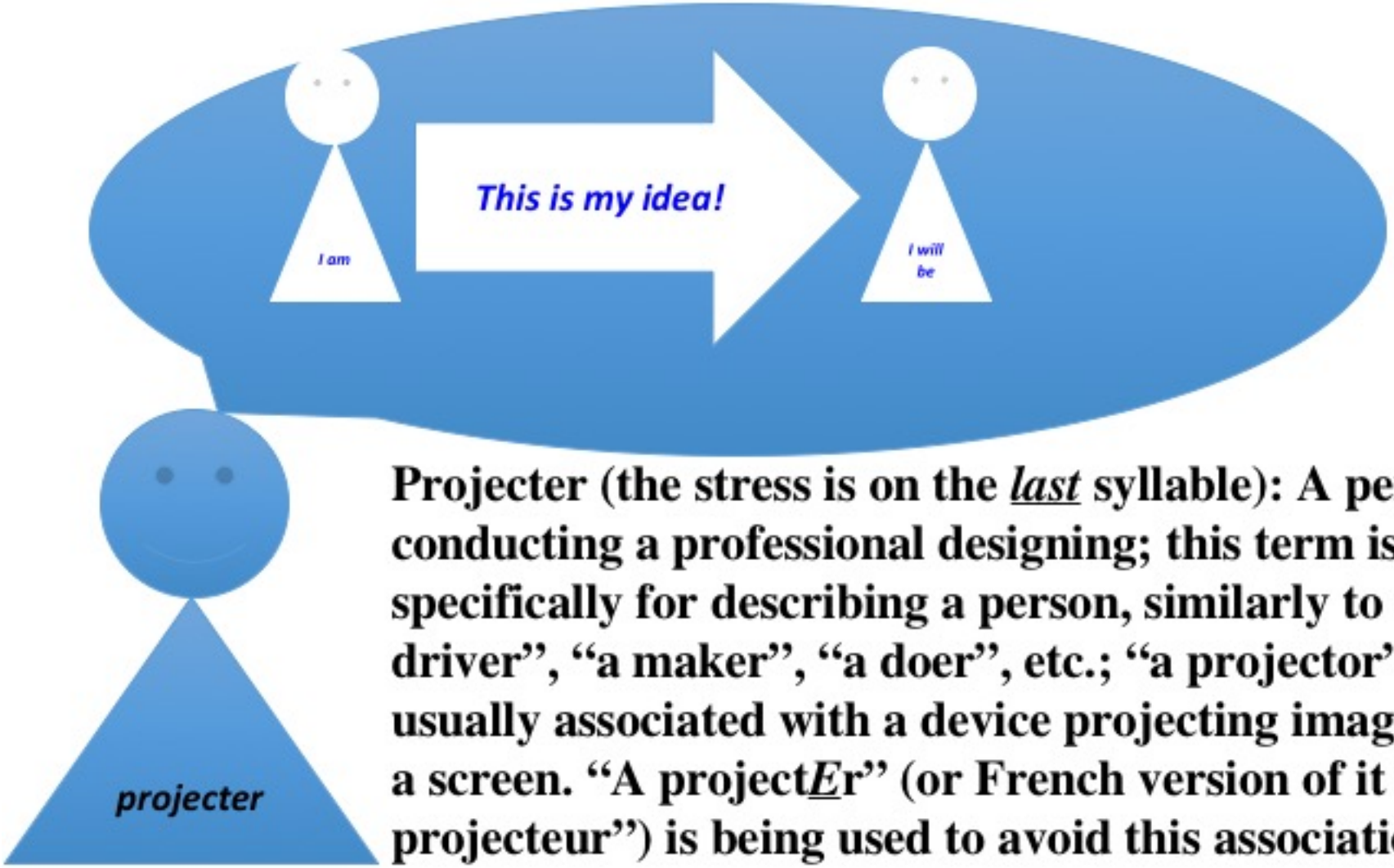
67. By a definition: Professional Designing is an intellectual activity resulting in: (a) constructing an image of the ideal/perfect professional situation (whatever it might mean for a given person), and (b) planning activities aimed at the transformation of the actual professional situation making it closer to the ideal one; the material result of a professional designing is a project. The link on the screen leads to a broader description of Professional Designing and its application to teacher professional development: http://www.teachology.xyz/pd.htm.



68. In order to transform his or her professional situation, teachers (a) must be willing to change their own practices, and (b) must be able to make the change. This means that professional skills, abilities, competencies of a teacher should include not only specific subject-related skills or teaching-related personal qualities, but also “meta-skills”, allowing to manage processes of idealization (i.e. drawing mental images), reflection, goal-setting, action scheduling, and so on, which are required for transforming a human practice. A combination of such skills forms the ability for designing the own teaching practice.

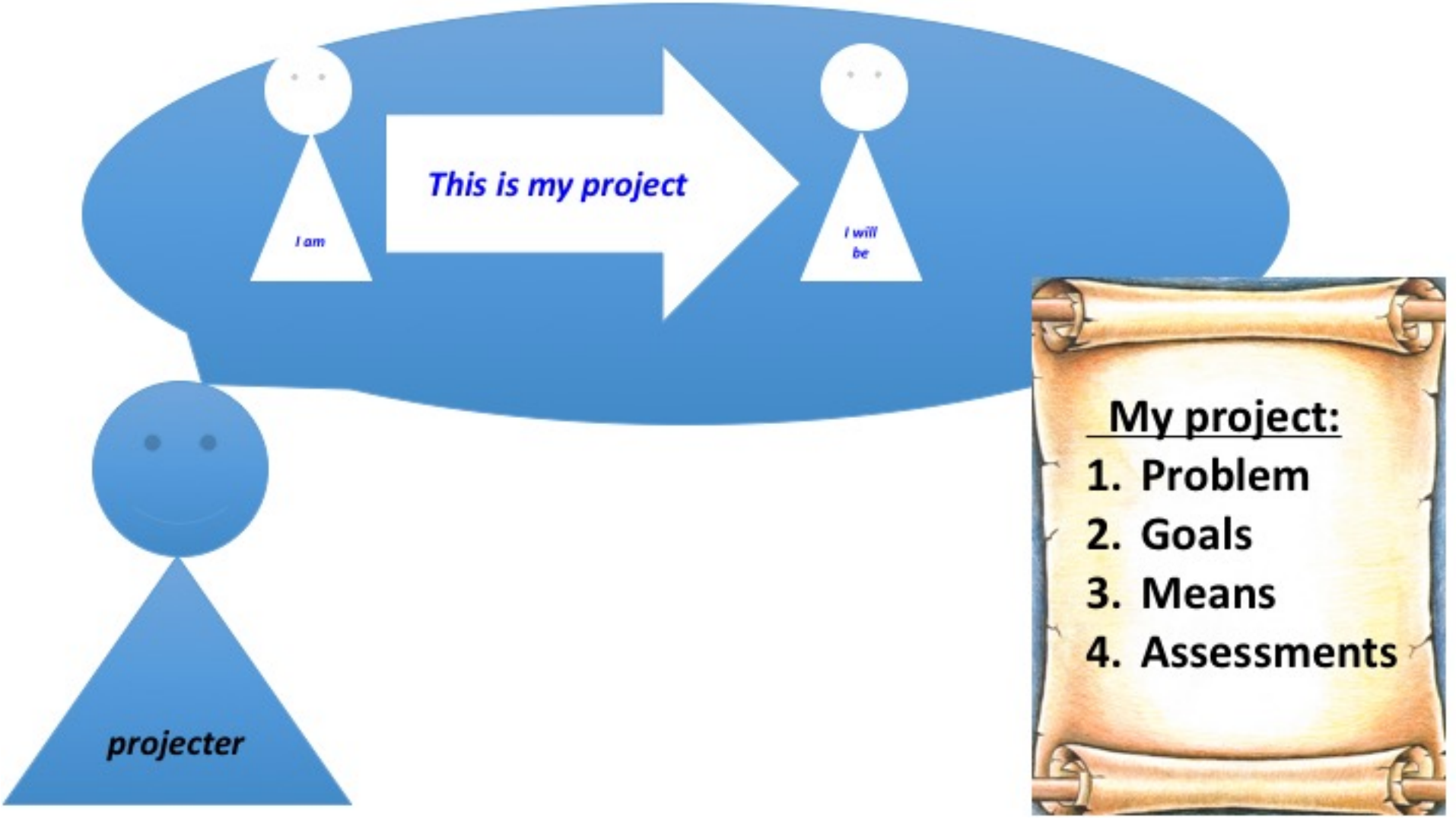


69. A professional designing is an activity that takes place primarily in the area of personal values and motives, goals and objectives, actions and procedures, problems and possible solutions. When conducting a professional designing, or shortly – when designing, one does not deal with real objects or subjects, but manipulate with the abstract concepts relevant to the one's professional practice (here and below a person conducting a professional designing is called a designer, or a projecter). The first product of a professional designing is the formation of a project idea.



Projecter (the stress is on the *last* syllable): A person conducting a professional designing; this term is used specifically for describing a person, similarly to "a driver", "a maker", "a doer", etc.; "a projector" is usually associated with a device projecting images on a screen. "A project*Er*" (or French version of it "a projecteur") is being used to avoid this association.

70. In simple terms, a project idea of a designer describes in his or her words “what is wrong with what I do”, and “how will I fix it”. The presence of a project idea does not automatically ensure its future realization, but it indicates the direction of the future actions of the designer; the project idea becomes the basis for the development of a detailed professional project – i.e. a textual representation of a current professional situation, certain professional problems, and proposed steps for solving those problems, including criteria and procedures for assessing the progress.



71. The most important product of a professional designing is a personal professional project, the existence of which significantly increases chance for a teacher implementing in the future practice knowledge presented during a workshop.

72. A professional designing – as a human activity – is essentially situational; its ultimate goal is to find mechanisms for self-transforming a concrete current professional situation of a projecter. A projecter never works alone; there is always a set of active or potential collaborators (or competitors).
An effective form for coordinating professional goals and actions, based on the implementation of project-aimed activities, is the so-called “activity-organizing workshop”. AOW participants usually represent coworkers from an institution or an institutional entity, or represent the same district.

73. Communicating processes ignited during AOW and aimed at unveiling images, views, and opinions of participants about professional activities of themselves and others are complicated and sometimes emotional. That demands the involvement of an experienced moderator (a.k.a. a “methodolog”, a.k.a. a “methodologist”; the former term is more broadly used in the context of AOW). Guided by a methodolog, AOW participants become actively engaged into an individual professional designing. As the result of this work, the participants inevitably advance their ability to conduct a professional designing. The effectiveness of AOW strongly correlates with the experience of a methodolog moderating the event.

Activity-Organizing Workshop (AOW)

74. It is very important for the success of the whole event that participants would be willing to openly discuss their teaching experience (including such personal and usually internal matters as their values, moral limits, beliefs, life expectations, professional aptitudes, goals and actions). This conversation usually leads to an eventual realization of the existence of some gap/disconnect/incoherence between the results and the structure of actual teaching practice and the declared teaching goals and methods. When the existence of this gap is clearly presented to a participant, the so-called “problematic situation” has been reached.

75. All precedents of AOW demonstrate that when teachers are immersed into a professional designing it positively affects their teaching practice in general and an ability to self-improve their teaching practice in particular. The conclusions on the effectiveness of the project-oriented methods of organizing teacher professional growth were made on the basis of individual interviews, surveys, and reflective feedback from teachers, and observations of teachers' activities during events and while teaching students before and after events.

76. The four projects described in this presentation aim at transforming the way education is currently being reformed. We have to reform educational reform. And the first thing we need to do is to change our perception of education as an art, or as a sport. Effective teaching is based on a deep understanding of learning processes, and constant professional growth of our teachers. Thank you.

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Areas of expertise:

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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)

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"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. =>

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