

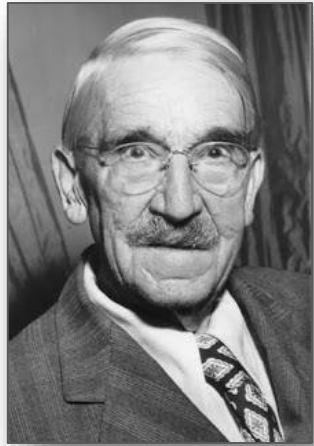
Concept and perspectives of STEM learning development

Rimkevichus Tatyana
Polymedia, brand-manager



Plan:

1. Relevance
2. What is STEM?
 - Concept of STEM
 - Key components of STEM-learning
3. Organization of STEM-learning process
 - Planning of educational environment
 - Equipment
 - Methods: content and pedagogic approaches
4. Examples of organizing STEM-centres
 - Scientific and design laboratory 'Ilmarinen' for pupils and students
 - Scientific-engineering and design laboratory 'Inzhevika'
 - Academy of talents

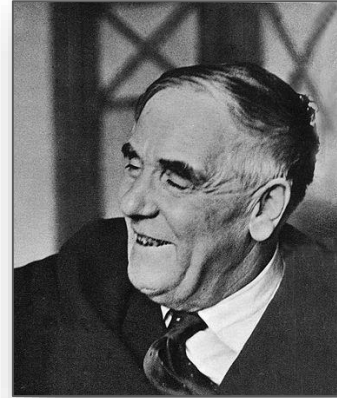


If we teach today's students as we taught yesterday's, we rob them of tomorrow

John Dewey, an educator and philosopher of XX century

*Main thing is not teaching knowledge,
but **understanding of what is
happening.***

Pyotr Kapitsa, a Soviet physicist

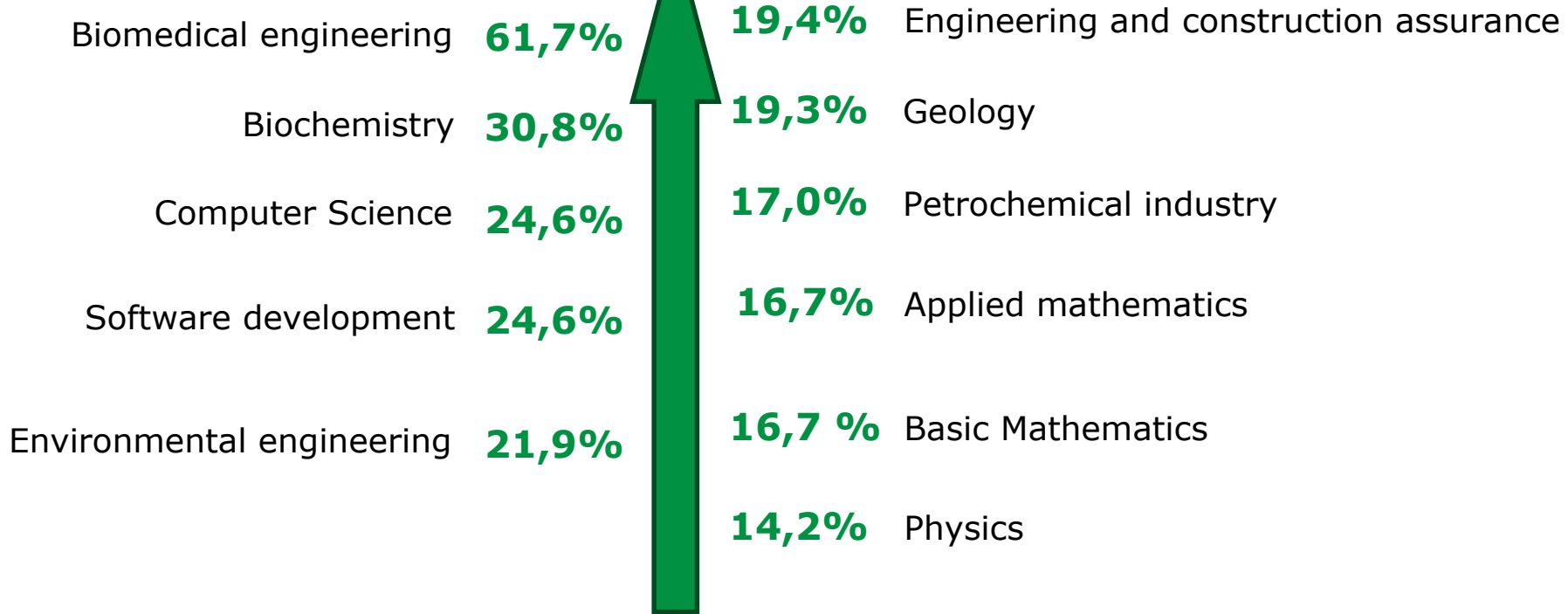


*It is necessary to develop **competencies in the field of Smart Technologies, AI, integration of cyber physical systems, future energy, designing and engineering.** It may be possible only through the establishment of effective scientific and innovation system.*

Nursultan Nazarbayev, the President of the Republic of Kazakhstan



Projections for the increase of interests of engineering professions till 2020



Tomorrow's professions



'Smart' road builder



Space biologist
and space
geologist

Genetic consultant

Molecular nutrition expert

Ecopreacher

Gene therapy
expert

'Smart; environment designer



Urban ecologist

Expert for mitigating
systemic environmental
disasters

Composite engineer

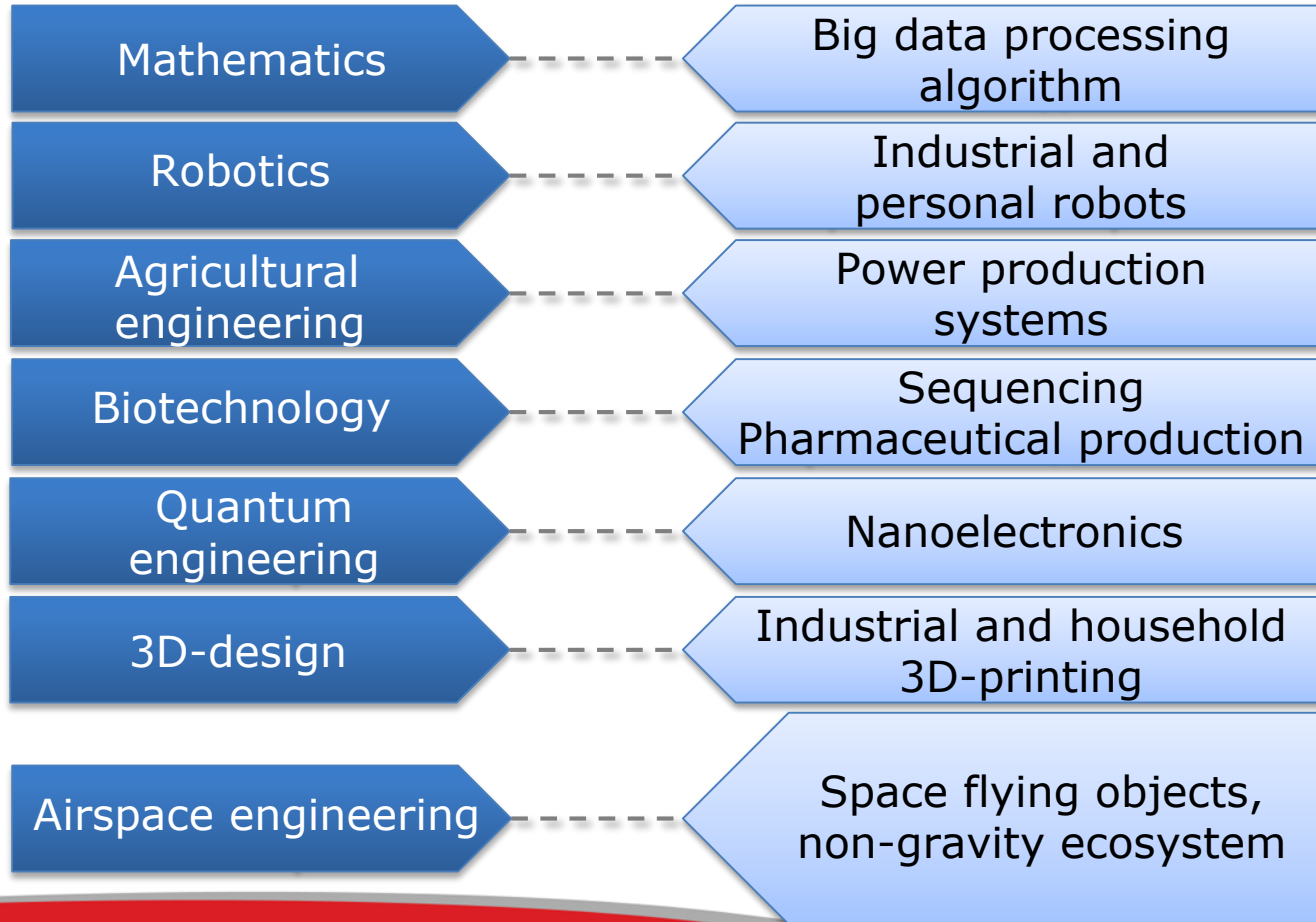


Foreman-
watcher

City farmer



Actual school disciplines till 2022



How to prepare for future?

systems and
algorithmic
thinking

work with a large
amount of information

Leadership and innovation

Cross-disciplines

Eco-thinking

be able to work in
a team and be
result-oriented



What is STEM?



S – science | естественные науки



T – technology | технологии

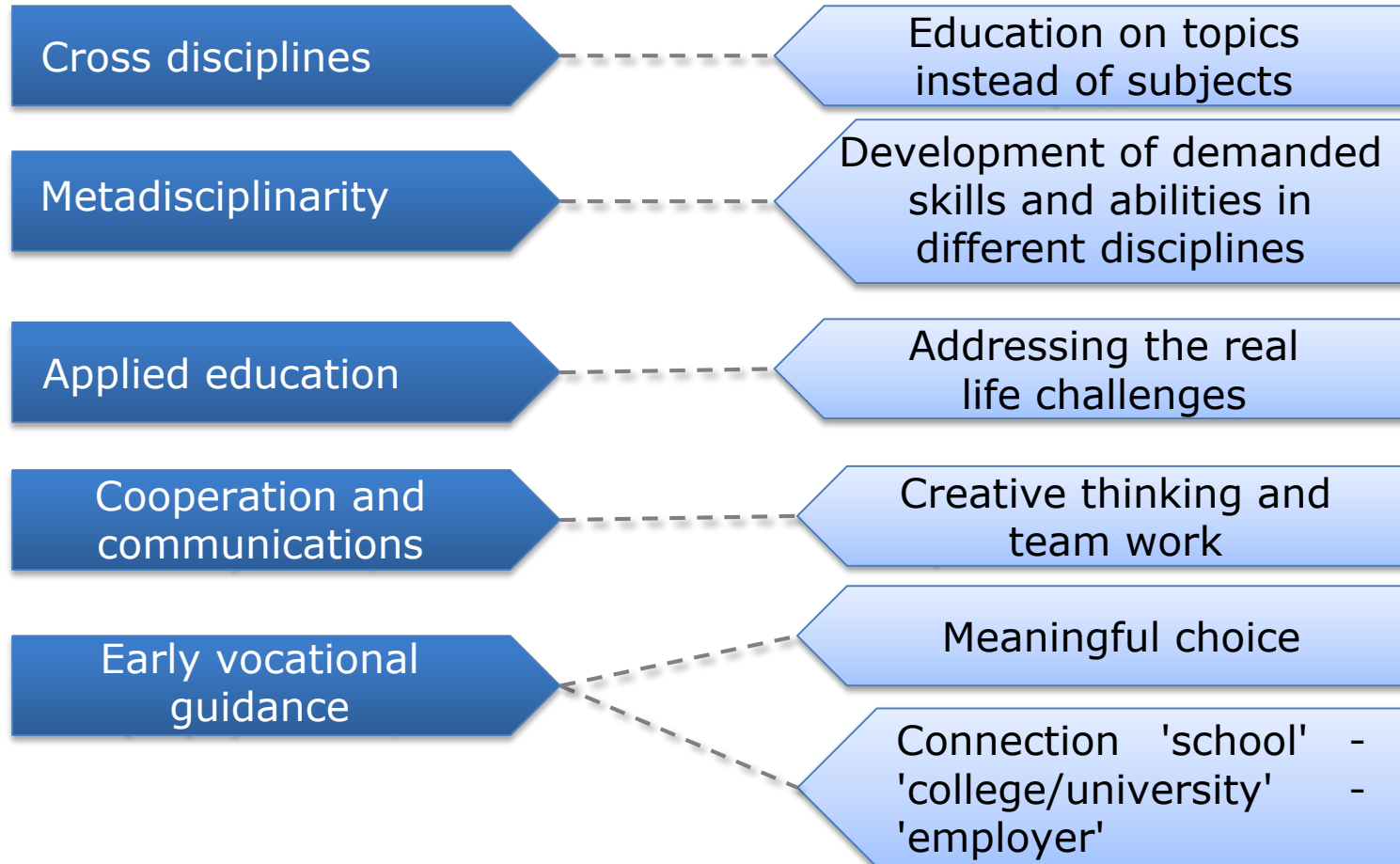


E – engineering |
инженерное искусство



M – mathematic | математика

Key components of STEM-learning



Organization of STEM-learning process:

Planning of educational environment

*The real effective education is impossible within the walls of an obsolete building; current school buildings' envelopes do not meet the modern needs. **School buildings should be the main educational resource.***

Architecture of modern school buildings, Naydanova P.V.,
'Architecton. Proceedings of higher education'



Planning of educational environment:

Why is it so important to change something?

Changing the content of education

Necessity of structural organizations of student councils

Limitation of school facilities

Integration of scientific and technological advances into educational process

Ineffective use of school area

Planning of educational environment: Exterior

'Smart School' design
(Irkutsk, Russia)



NY-Krohnborg School
(Bergen, Norway)



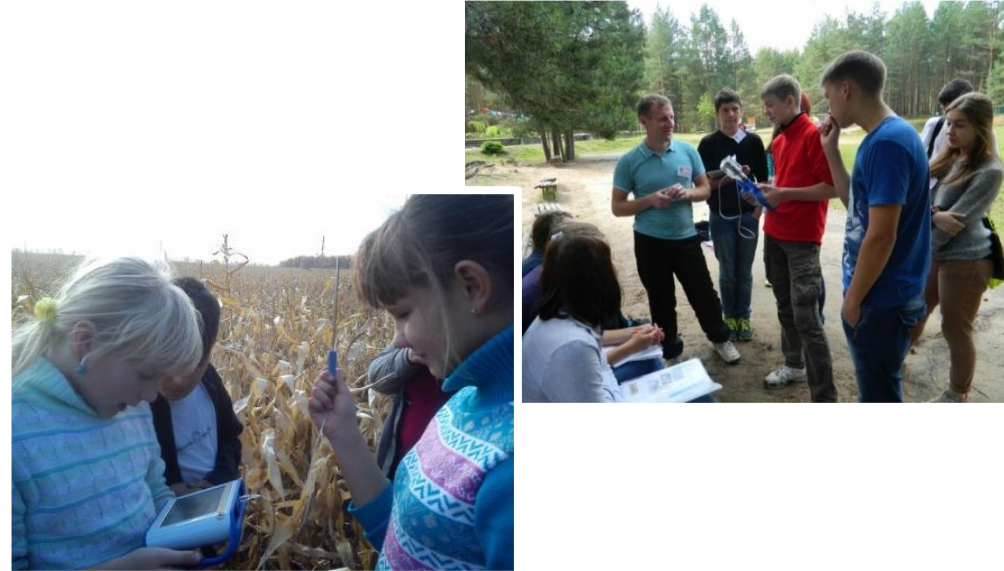
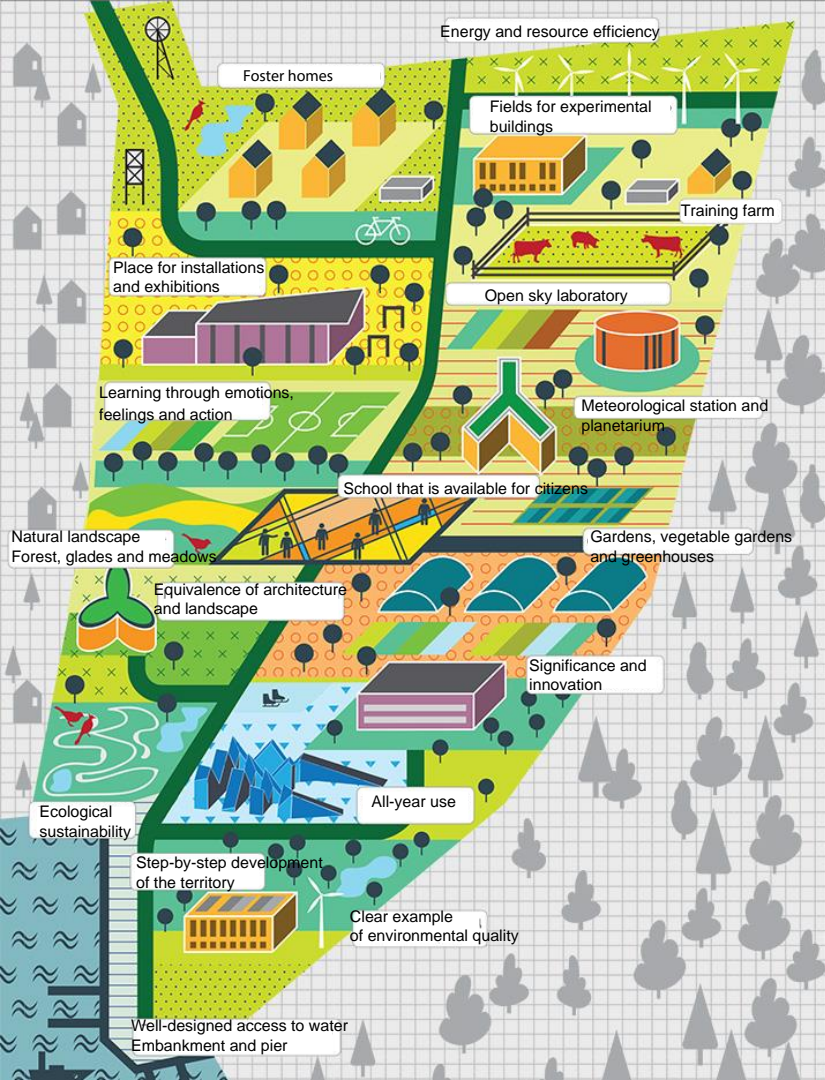
Serge Barranx School (Montfort-en-Chalosse, France)



Vibeeng School (Haslev, Denmark)



Planning of educational environment: School grounds are also educational environment

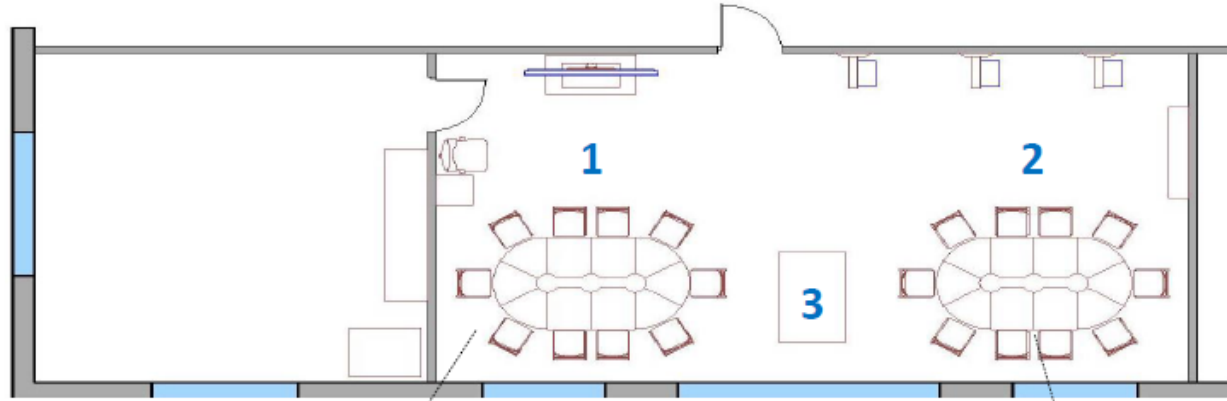


Approximate plan of the territory of 'Smart School'

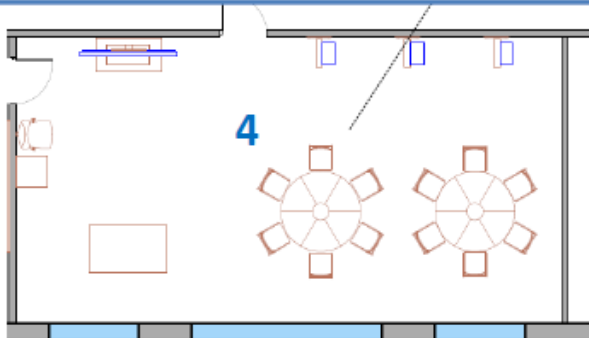
Planning of educational environment: Interior

1. Scientific laboratory projects
2. Robotics and engineering projects
3. Work space of a teacher

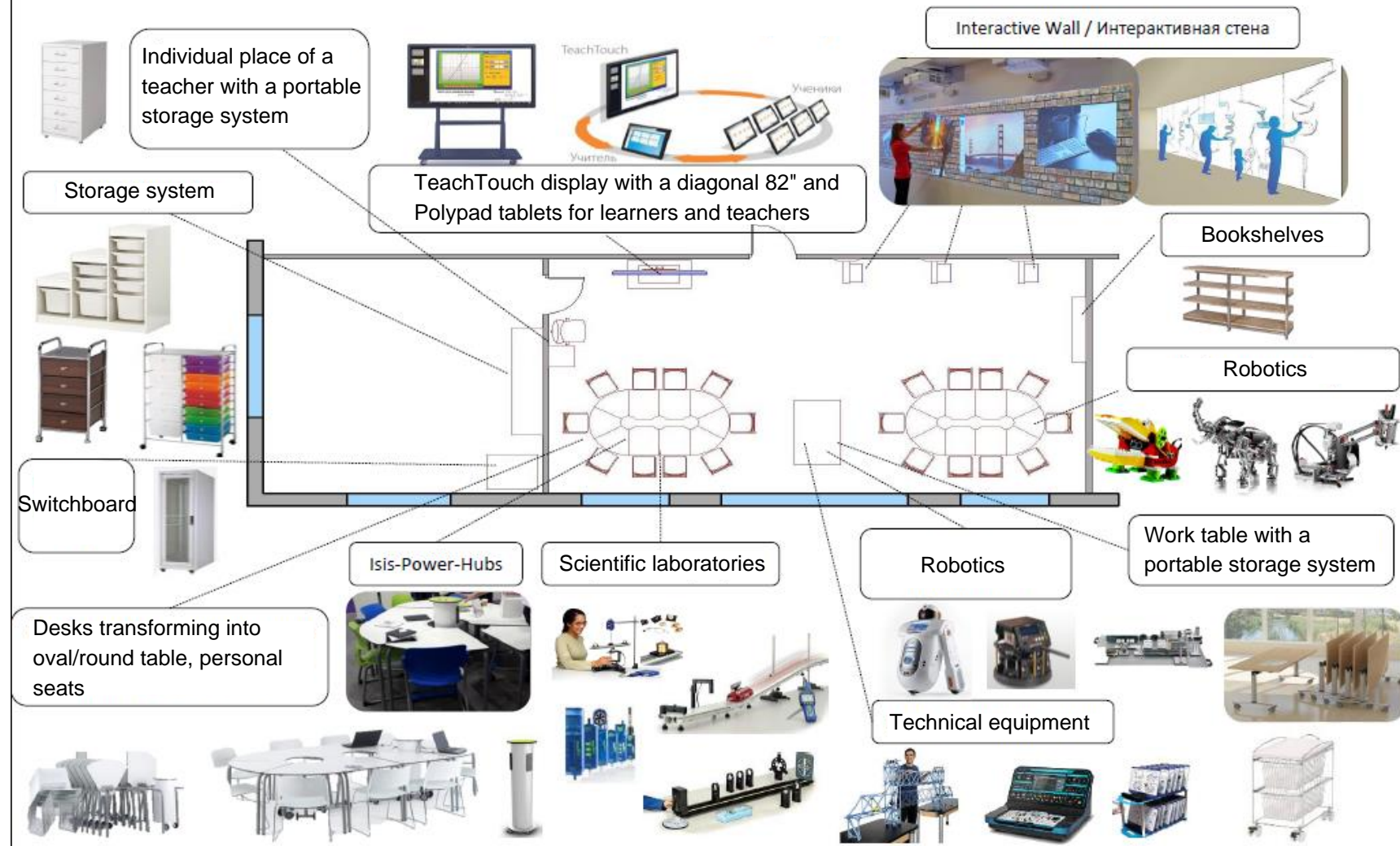
4. Collaboration - group work, interaction
5. Individual work



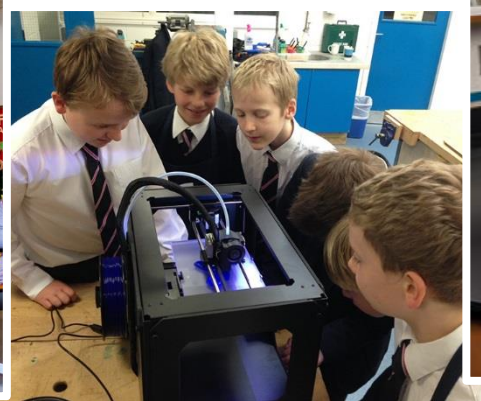
Possibility to transform into interactive environment for workshops, webinars, DE (distance education) and lectures



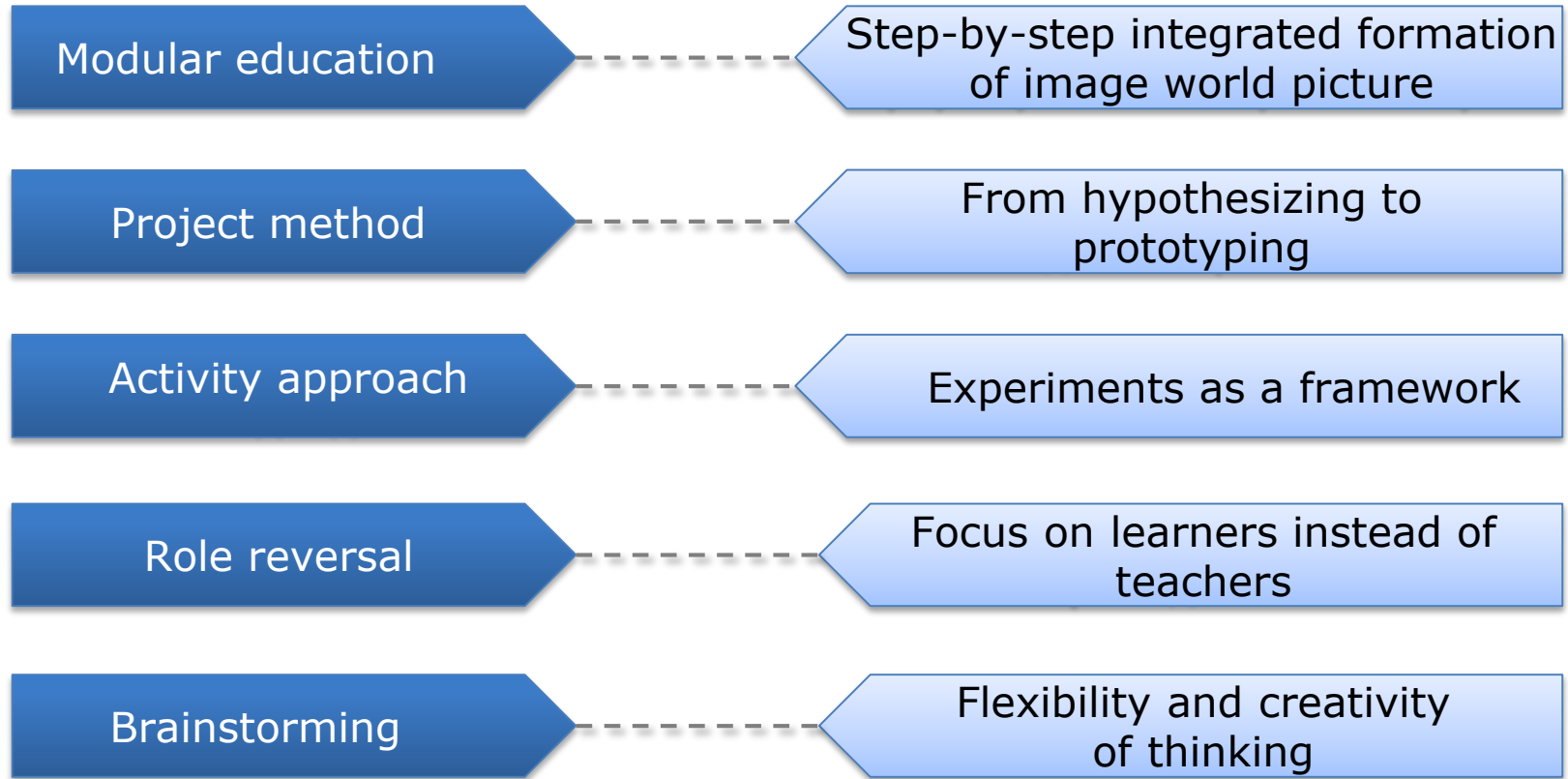
Organization of STEM-learning process: Equipment



Planning of educational environment: Interior and equipment



Organization of STEM-learning process: Approaches and practices



Organization of STEM-learning process: How to implement?

General education

Engineering classes

Subject oriented education

Additional education

Optional and club activities

Preparation to competitions and Olympiads

Scientific-technical creativity centres and technological parks for children

Cities of professions

Organization of STEM-learning process: How to implement?

Formation of scientific and engineering human capacity of the Region

Quality increase of learners and teachers training

Increase in the number of children engaged in scientific-technical creativity

Access to modern learning technology

Increase in the level of equipment

Networking cooperation of club activities

Activities for popularization of science and technologies

Increase in the level of methodological support

Participation in international competitions

STEM-festivals and fairs

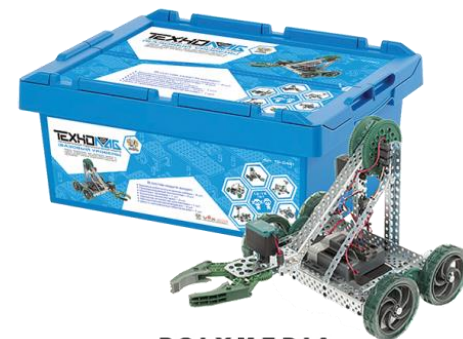
Shift summer camps

STEM-games

Meetings with experts

Organization of STEM-learning process: Available methods

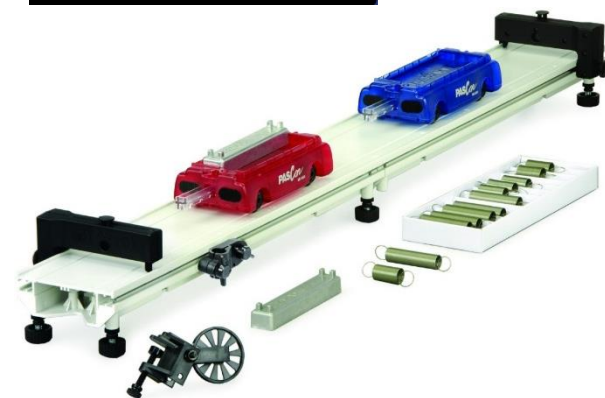
Age	Module	Biology	Chemistry	Physics	Aero
No limits	TeachTouch display device or interactive whiteboard	•	•	•	•
6-8 years	LEGO kit 'Robotics for the youngest children'	•	•	•	•
8-14 years	LEGO kit 'Robotics and engineering'	•	•	•	•
	LEGO kit 'Renewable energy sources'			•	
	LEGO Physics experiment			•	•
	LEGO kit 'Space projects'			•	•



Organization of STEM-learning process: Available methods

Age Module Biology Chemistry Physics Aero

14-18 years	VEX Robotics Basic set for study of robotics		•	•	
	ROBOT IS Set 'Bioid robots'	•	•	•	
	PASCO Collisions			•	
	PASCO Airbag		•		
	PASCO Biosphere	•			
	PASCO Space				•
	Copter Space. Aeromodule				•



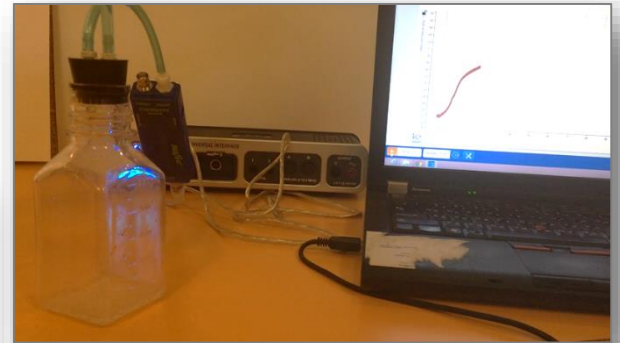
Organization of STEM-learning process: Preparation for competitions



worldskills
Russia



Organization of STEM-learning process: Shift summer camps



Summer STEM-camp
under NSU
(Novosibirsk)

Organization of STEM-learning process:

Professional development, examples



International Educational
Online Conference Intel



Network Academy ProektUM

EDCOMMUNITY  **RU**
образовательный проект Polymedia

Professional communities



Examples of implementation of STEM within additional education: Scientific and design laboratory 'Ilmarinen' for pupils and students (PetrSU, Petrozavodsk)

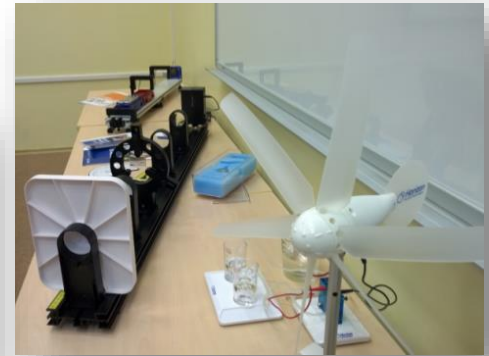
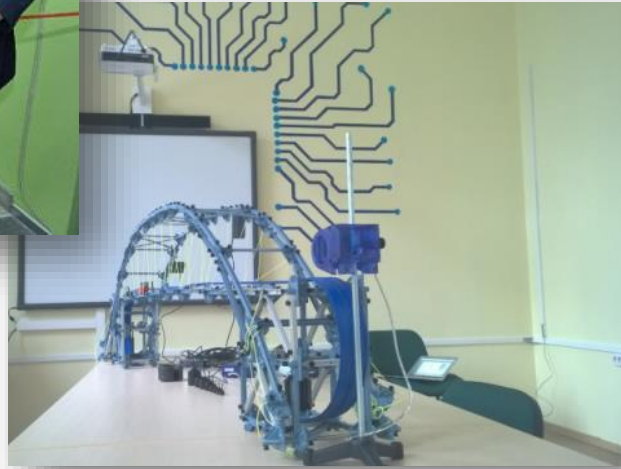
Илмаринен

научно-проектная лаборатория для школьников и студентов



education

EMC²



Scientific and design laboratory 'Ilmarinen' for pupils and students

Educational programs:

- Robotics (Grades 1-6)
- TechnoRoboCom (Grades 8-11)
- Arduino World (Grades 7-11)
- Science laboratory (Grades 8-11)

- Research studies and design works on biology (Grades 8-11)
- Bioinformatics for pupils (Grades 9-11)

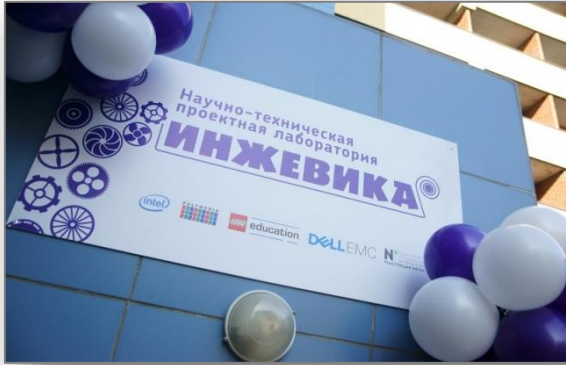
- Solution of Olympiads problems on physics, mathematics and astronomy (Grades 7-11)

Results of 2015-2016:

- Coverage of more than 500 learners
- Implementation of more than 30 projects
- Events for popularizing science and technologies



Examples of implementing STEM within additional education: Scientific-engineering and design laboratory 'Inzhevika' for pupils and students (NSU, Novosibirsk)



Scientific-engineering and design laboratory 'Inzhevika' for pupils and students (NSU, Novosibirsk)

Available training programs:

- LEGO education, basic level;
 - LEGO sports;
 - Arduino, basic level;
 - Competitive robotics - Arduino;
 - Arduino-projects: Bio-computer interface and biofeedback;
 - Arduino-projects: Automation of scientific research in biology;
 - Mobile apps for OC Android, basic level;

 - Computer sciences, Programming project;
 - Neuro computing and neuro mapping, basic level;

 - Bioinformatics, basic level;
 - Projects - Bioinformatics: Project Gene networks
 - Projects - Bioinformatics: Automatic determination of state of plants
 - PASCO modules 'Dynamics', basic
 - 'Collision' project, advanced
 - PASCO module 'Renewable energy sources', basic
- 'Effective wind generator' project, advanced
 - PASCO module 'Optics of the human eye', basic

 - 'The nature of vision and eye disorders' project, advanced
 - PASCO module 'Photosynthesis of aquatic plants', basic
 - 'Water blooming and water ecology' project, advanced
 - PASCO module 'Ecosystem', basic
 - PASCO module 'Earth natural zones', basic
 - 'Terraformation: modelling natural zones on other planets' project, advanced
 - 'Impact of antropogenic factors on ecosystem' project, advanced
 - PASCO module 'Designing and strength of materials', basic
 - 'Safe bridge construction' project, advanced
 - 'Human body mechanics' project, advanced
 - PASCO module 'Chemical analysis', basic
 - 'Organoleptic analysis of food products' project, advanced

Examples of implementing STEM within additional education: Academy of talents (Saint Petersburg)



Источник: ГБН

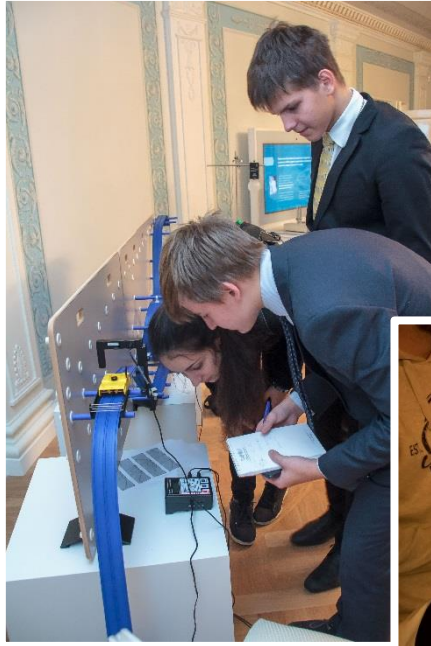


Academy of talents (Saint Petersburg):

Museum of entertaining science

Forms of organization of educational activity:

- Interactive tours
- Group project work under the leadership of a tutor



Funding

- Industry partner
- Manufacturing companies
- Property developers
- Funds
- Grants for educational development
- Federal and regional programmes for educational development



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