Future trends in education – 21st century skills

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Trends in science performance (PISA)
Poverty is not destiny - Science performance by international deciles of the PISA index of economic, social and cultural status (ESCS).
Students expecting a career in science

Percentage of students who expect to work in science-related professional and technical occupations when they are 30

Legend:
- Science-related technicians and associate professionals
- Information and communication technology professionals
- Health professionals
- Science and engineering professionals

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Figure I.3.2

Percentage of students with vague or missing expectations
Boys and girls’ expectations of a science career

Students who expect to work as...

- science and engineering professionals
- health professionals
- information and communication technology (ICT) professionals
- science-related technicians or associate professionals

![Bar chart showing the percentage of boys and girls expecting certain careers.](chart.png)
Above-average science performance

Singapore
Canada
Australia
United Kingdom
Ireland
Portugal

Stronger than average beliefs in science

China
Hong Kong (China)
New Zealand
Denmark

Above-average percentage of students expecting to work in a science-related occupation

Japan
Estonia
Finland
Macao (China)
Viet Nam
B-S-J-G (China)
Korea
Germany
Netherlands
Switzerland
Belgium
Poland

Switzerland
Belgium
Poland

Norway

United States
Spain
Israel
United Arab Emirates

Bulgaria
Chile
Colombia
Costa Rica
Dominican Republic
Jordan
Kosovo
Lebanon
Mexico
Peru
Qatar
Trinidad and Tobago
Tunisia
Turkey
Uruguay
Students expecting a career in science by performance and enjoyment of learning

Figure I.3.17

- Low enjoyment of science
- High enjoyment of science
Early opportunities

- Language
- Numbers
- Peer social skills
- Emotional control

Brain sensitivity vs. Age in years

High

Low
Knowledge and skills for tomorrow
Digitalisation

Systems thinking

Global competence

Design thinking

Digital literacy

Information literacy
Digitalisation

- Democratizing
- Concentrating
- Particularizing
- Homogenizing
- Empowering
- Disempowering

Scale without mass

Google

1m $ / employee

120 k$ / employee
The kind of things that are easy to teach are now easy to automate, digitize or outsource
Labour productivity growth (2001 = 100)

Manufacturing

- Frontier firms: 3.5% per annum
- All firms: 1.7% per annum
- Non-frontier firms: 0.5% per annum

Services

- Frontier firms: 5.0% per annum
- All firms: 0.3% per annum
- Non-frontier firms: -0.1% per annum
Robotics

The Auto-auto

>1m km, one minor accident, occasional human intervention
Augmented Reality
A lot more to come

• 3D printing
• Synthetic biology
• Brain enhancements
• Nanomaterials
• Etc.
The Race between **Technology** and **Education**

Inspired by “The race between technology and education”
Pr. Goldin & Katz (Harvard)

- **Industrial revolution**
  - Social pain
  - Universal public schooling

- **Digital revolution**
  - Prosperity
  - Social pain

- **Technology**
  - Education
The multi-faceted world of knowledge
The human world of knowledge
The small world of the curriculum
The small world of the curriculum
The small world of the curriculum
The small world of the curriculum
The small world of the curriculum
The small world of the curriculum
The big world of learning

- The True
  The realm of human knowledge
- The Good
  The realm of ethics and judgement
- The Just and Well-Ordered
  The realm of political and civic life, binding social capital
- The Beautiful
  The realm of creativity, esthetics and design
- The Sustainable
  The realm of natural and physical health
- The Prosperous
  The realm of economic life
The OECD Learning Framework 2030

Interrelated Constructs:
- Motivation
- Identity
- Purposeful
- Growth mindset
- Self-efficacy/Positive self-orientation
- Hope

Knowledge:
- Disciplinary
- Interdisciplinary
- Epistemic
- Procedural

Cognitive & meta-cognitive:
- Social & emotional
- Physical & practical

Skills:
- Personal
- Local
- Societal
- Global

Attitudes and Values:

Competencies:

Well-Being 2030:
- Individual & Societal

Anticipation:
- Creating
- New Value

Taking:
- Responsibility

Reconciling:
- Tensions & Dilemmas

Action:
- Communities
- Peers
- Teachers

Students

Students

Students
Creating new value connotes processes of creating, making, bringing into being and formulating; and outcomes that are innovative, fresh and original, contributing something of intrinsic positive worth. The constructs that underpin the competence are imagination, inquisitiveness, persistence, collaboration and self-discipline.

In a structurally imbalanced world, the imperative of reconciling diverse perspectives and interests, in local settings with sometimes global implications, will require young people to become adept in handling tensions, dilemmas and trade-offs. Underlying constructs are empathy, adaptability, trust.

Dealing with novelty, change, diversity and ambiguity assumes that individuals can ‘think for themselves’. This suggests a sense of responsibility, and moral and intellectual maturity, with which a person can reflect upon and evaluate their actions in the light of their experiences and personal and societal goals; what they have been taught and told; and what is right or wrong.
Competencies

• Explain phenomena scientifically
• Evaluate and design scientific enquiry
• Interpret data and evidence scientifically

Recognise, offer and evaluate explanations for a range of natural and technological phenomena.

Describe and appraise scientific investigations and propose ways of addressing questions scientifically.

Analyse and evaluate data, claims and arguments in a variety of representations and draw appropriate scientific conclusions.
Competencies

• Explain phenomena scientifically
• Evaluate and design scientific enquiry
• Interpret data and evidence scientifically

Knowledge

• Content knowledge
• Knowledge of methodological procedures used in science
• Knowledge of the epistemic reasons and ideas used by scientists to justify their claims

“Epistemic knowledge” reflects students’ capacity to think like a scientist and distinguish between observations, facts, hypotheses, models and theories.

Each of the scientific competencies requires content knowledge (knowledge of theories, explanatory ideas, information and facts), but also an understanding of how such knowledge has been derived (procedural knowledge) and of the nature of that knowledge (epistemic knowledge).
Competencies

- Explain phenomena scientifically
- Evaluate and design scientific enquiry
- Interpret data and evidence scientifically

Knowledge

- Content knowledge
- Knowledge of methodological procedures used in science
- Knowledge of the epistemic reasons and ideas used by scientists to justify their claims

Attitudes

- Attitudes to science
- Scientific attitudes

Peoples’ attitudes and beliefs play a significant role in their interest, attention and response to science and technology.

PISA distinguishes between attitudes towards science (e.g. interest in different content areas of science) and scientific attitudes (e.g. whether students value scientific approaches to enquiry).
Comparing countries and economies on the different science knowledge subscales

Figure I.2.30

Chinese Taipei

Score points

Content knowledge, 538
Procedural and epistemic knowledge, 528
Comparing countries and economies on the different science knowledge subscales

Figure I.2.30
Comparing countries and economies on the different science knowledge subscales

Figure I.2.30
Memorisation is less useful as problems become more difficult (OECD average)

Source: Figure 4.3
Control strategies are always helpful but less so as problems become more difficult (OECD average)

Source: Figure 5.2
Elaboration strategies are more useful as problems become more difficult (OECD average)

Source: Figure 6.2
The big world of learning

• Rigor, focus and coherence
• Remain true to the disciplines
  – but aim at interdisciplinary learning and the capacity of students to see problems through multiple lenses
  – Balance knowledge of disciplines and knowledge about disciplines
• Focus on areas with the highest transfer value
  – Requiring a theory of action for how this transfer value occurs
• Authenticity
  – Thematic, problem-based, project-based, co-creation in conversation
• Some things are caught not taught
  – Immersive learning propositions
Some students learn at high levels
All students learn at high levels
Delivered wisdom
Recognising both students and adults as resources for the co-creation of communities, for the design of learning and for the success of students
Bureaucratic Look-up
Devolved Look-outward
Learning time and science performance

Figure II.6.23

PISA science score vs. Total learning time in and outside of school

OECD average

R² = 0.21
Learning time and science performance

Figure II.6.23

Score points in science per hour of total learning time

- Intended learning time at school (hours)
- Study time after school (hours)
- Score points in science per hour of total learning time
The past was divided

Teachers and content divided by subjects and student destinations

Schools designed to keep students inside, and the rest of the world outside
The future is integrated

Integrated: Emphasising integration of subjects, integration of students and integration of learning contexts
Connected: with real-world contexts, and permeable to the rich resources in the community
Less subject-based, more project-based
Uniformity
Diversity

Embracing diversity with differentiated pedagogical practices
Standardisation and Conformity

Standardisation and compliance lead students to be educated in batches of age, following the same standard curriculum, all assessed at the same time.
Ingenious

Building instruction from student passions and capacities, helping students personalise their learning and assessment in ways that foster engagement and talents.
Learning a place

Schools as technological islands, that is technology was deployed mostly to support existing practices for efficiency gains.
Learning an activity

Technologies liberating learning from past conventions and connect learners in new and powerful ways. The past was interactive, the future is participative.
Administrative control and accountability
Professional forms of work organisation
Public vs. private
Public with private
Idiosyncratic policies
Alignment of policies
Find out more about our work at www.oecd.org
  – All publications
  – The complete micro-level database

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and remember:
Without data, you are just another person with an opinion