EVOLUTION OF COMPETENCES FOR NEW ERA OR EDUCATION 4.0

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Facts

2020

Your students start to teach

2040

Students of your teacher start to work
Year 2040
Future 2040?
NEW KIND OF PROBLEM
From the first to the fourth industrial revolution

1. Industrial revolution
   Introducing mechanical production machines powered by water and steam
   Industry 1.0
   End of the 18th century.

2. Industrial revolution
   Introducing mass production lines powered by electric energy
   Industry 2.0
   Beginning of the 20th century

3. Industrial revolution
   Through the use of electronics and IT further progression in autonomous production
   Industry 3.0
   Beginning of the 70th

4. Industrial revolution
   Based on cyber-physical-systems
   Industry 4.0
   Today – year 2040

Level of complexity

Source: DFKI/Bauer IAO

The XXV conference of Czech Educational Research Association (CERA/ČAPV) “Impact of Technologies in the Sphere of Education and Educational Research” at 13 - 14 September 2017
Cyber physical system
Robots as colleagues instead of work tools

Ergonomic relief for the older staff member. Highly incriminating and physical tough jobs reducing new tasks and the need for qualifications (programming?)

Robots as training partner? Or as gateway to inferior jobs
IoT: Industry 4.0 as part of a digitized economy

Internet of things

- Digitized services
- Industry 4.0
- ... (not fully visible)

Smart products
Smart factory

Product innovation
Process innovation
Autonomous agents
Digital networking

Labor 4.0
Calculation in cloud

Industry 4.0

Cloud

Suppliers

Logistics

Computer/server

Digital production

Sensors

Physical production

Humans communicating with robots

Customised products

Virtual production

Smart products

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Just a normal day in the smart factory (3 KIND OF COMMUNICATION)

Task to the production system – Order: 500pcs. in one week

I can work this Saturday.

I refill the magazine.

Turn me on!

Capacity’s are overloaded till Friday

I got to be at the goods issue in 2 hours

Two hours overtime today!

Magazine is empty! Please refill!

Your BBQ weekend is canceled

I can work this Saturday.

I can’t do Saturday
Industry 4.0

*Four basic principles* support the economy and determine the scenarios of their implementation. These principles are:
Principle 1: *Interoperability*

*Interoperability*: the ability of machines, devices, sensors and people to connect and communicate among each other and on the Internet of things (IoT), as well as on other internet (global) connections.
Principle 2: *Informational transparency*

*Informational transparency*: the ability of information systems to create virtual copies of the physical world (various simplified, clear models) by connecting large databases and various sensor systems, which, for example, is done today in weather forecasting.
**Principle 3: Technical support**

*Technical support*: the first form is the technical support of support systems, which display a large amount of data in a clear, visual manner (for example, tables turned into appropriate graphic representations), which aids in fast and competent problem solving. The second form is the ability of cyber-physical systems (CFS) to support a person carrying out unpleasant, tiring or dangerous tasks, such as the use of robots in the search and disposal of mine fields.
Principle 4: *Decentralised decision-making*

*Decentralised decision-making*: the capability of cyber-physical systems (CFS) to make decisions and carry out their given tasks as quickly as possible, and in an automated, independent manner. A person need intervene only if the CFS is not capable of independent decision-making.
Changing at the jobs market 1969 - 2014

At the spring 2016 at the Saxion - University of Applied Sciences in Enschede (Netherlands) something about 40 % of yobs will change till 20 years.

Prof. Michek Stanislav
Transformation of work structures at the automotive auto body manufacture (e.g. VW Golf)
Educational requirements

Education model of the 19th and early 20th century is built up for:

• 20% professionals,
• 30% merchants and office workers,
• 50% physical labourers.

Needs of the 21st century:

• a minority of unqualified, temporary and seasonal workers (approximately 1/8) and

• hardworking, self-educated workers with the initiative to manage their own work and time (approximately 7/8),

which calls for the development and achievement of higher taxonomic and cognitive levels of competency.
Labor 4.0 - Skills

**2015**
1. Complex problem solving
2. Coordinating with others
3. People management
4. Critical thinking
5. Negotiation
6. Quality control
7. Service orientation
8. Judgment and decision making
9. Active listening
10. Creativity

**2020**
1. Complex problem solving
2. Critical thinking
3. Creativity
4. People management
5. Coordinating with others
6. Emotional intelligence
7. Judgment and decision making
8. Service orientation
9. Negotiation
10. Cognitive flexibility
Labor 4.0 - Emotional intelligence?

Self-Awareness
- Emotional Self-Awareness

Self-Management
- Achievement Orientation
- Adaptability
- Emotional Self-Control
- Positive Outlook

Social Awareness
- Empathy
- Organizational Awareness

Relationship Management
- Conflict Management
- Coach and Mentor
- Influence
- Inspirational Leadership
- Teamwork
Labor 4.0 – cognitive flexibility

• *Competency-based development knowledge* in the area of CFS and IoT, connected to the internet of people. In short, we need specialized engineering (STEM) knowledge upgraded with digital literacy 4.0.

• Interoperability requires *communication competence 4.0*, which includes not only the skills of human-human communication, but also the skills of human-machine communication and the understanding of machine-machine communication.

• *The ability to develop systems* that support people when making decisions in complex situations by means of visualization and processing large amounts of data (data mining), as well as the *ability to resolve complex* problems in real time (critical judgement, critical decision-making).

• Decentralized decision-making means that most decisions will be made by machines with the help of various algorithms (such as Google filters). A person's role will be to make these decisions only in “critical, badly defined situations”, when these algorithms fail.
Challenges for the workforce

- rapid change of necessary qualification
- ergonomical improvement through the use of robots
- creation of new jobs for high skilled workers in the areas of planning, configuration and maintenance of the new technologies
- expansion of low-skilled work through the use of robots and assisting systems
- Extensive control and monitoring of workers behavior and performance
- Increased expections regarding individual flexibility

NEW METHODS OF TEACHING/LEARNING

NEW WAY OF THINKING
Today Education state of the art

Every country's education system is its basis for progress and the groundwork for its future. A common feature in successful education systems is the balance between tradition and the capacity to be flexible and able to adapt to current social trends.

Today, we understand that the knowledge that formed the basis of progress in the 19th and 20th centuries is insufficient in the modern world (the 21st century).
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EDUCATION 4.0

• To be a **good teacher** you need to acquire a large set different kind of interdisciplinary knowledges, each of which binds an idea of the causal relation, cause and consequences, possible antecedents and causes, possible developments and consequences, and possible interventions to strategy of teaching.

• The use of **contemporary learning strategies** as research and problem based learning connected with brain based technique and information communication technologies provided scholars from diverse disciplines—notably philosophers, linguist, chemists, biologists, physists environmental scientists and engineers an unusual opportunity to observe possible flaws in their own thinking.
EDUCATION 4.0 - SOLUTIONS

NEW KIND OF PROBLEM

REQUIRES

1. NEW METHODS OF SOLUTION

REQUIRES

2. NEW WAY OF THINKING
<table>
<thead>
<tr>
<th>Competencies for the 21\textsuperscript{st} Century</th>
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</thead>
<tbody>
<tr>
<td><strong>Analytical skills</strong></td>
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<tr>
<td>Critical thinking</td>
</tr>
<tr>
<td>Problem solving</td>
</tr>
<tr>
<td>Decision-making</td>
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<tr>
<td>Research and development</td>
</tr>
</tbody>
</table>
COMPETENCES BASED EDUCATION

PROCESS OF EDUCATION

TEACHER       STUDENTS
EDUCATION 4.0 - *self-education*: PROBLEM

What can we do?

We can (must) use contemporary methods/models of teaching/learning as
Transdisciplinary model
Problem and research based learning
Incorporate in the model how humans learning (use of brain based technique)

DEVELOP COGNITIVE & SOCIAL COMPETENCES
FOR TEACHERS AND FOR STUDENTS
Transdisciplinar cognitive neuroscience paradigm
PROBLEM AND RESEARCH BASED LEARNING

With PBL and RBL we develop high cognitive level:

- Creative thinking
- Critical thinking
- Problem solving

AND

- Collaboration, cooperation, dialog
NEW WAY OF THINKING

Barin based technique
Brain based technique
**Brain based technique**

Working memory can stay activated for only 10-20 minutes for demanding task.

**Sessions of Sub-topics**

- **Introduction**
- **Sub-topic 1**
- **Sub-topic 2**
- **Sub-topic 3**
- **Rounding off**

<table>
<thead>
<tr>
<th>3 min</th>
<th>Active start</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 min</td>
<td>Demo/Exercise</td>
</tr>
<tr>
<td>4 min</td>
<td>Feedback/Discussion</td>
</tr>
<tr>
<td>3 min</td>
<td>What next? How to retain?</td>
</tr>
</tbody>
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Brain based technique

How the Brain Learns - an ideal lesson is divided into three sections:

1. Students best remember the information that comes first (prime-time 1),
2. They remember second best the information that comes last (prime-time 2).
3. Teens remember least the information that comes in the middle (downtime).
COGNITIVE (10. Cognitive flexibility) vs. SOCIAL (6. EI) COMPETENCES
Cognitive competences (individualization and differentiation)

- Creative thinking
- Critical thinking
- Problem solving
- Individual teaching
- Individualism
- Egoism
- Self-sufficiency
- Self-just me, ever, but
- I’m the only one
Social competences (emotional intelligence)?

Human was and still is social being!!
Social competences (EI)?

- **Self-Awareness**
  - Emotional Self-Awareness

- **Self-Management**
  - Achievement Orientation
  - Adaptability
  - Emotional Self-Control
  - Positive Outlook

- **Social Awareness**
  - Empathy
  - Organizational Awareness

- **Relationship Management**
  - Conflict Management
  - Coach and Mentor
  - Influence
  - Inspirational Leadership
  - Teamwork
Social competences – global awareness

Collaborative learning

Teaching in the class

Awareness (proprioception)

Efficiency of teaching

No. of students

50% 84% 98%

2σ

1σ
CONCLUSION
AS CONCLUSION

• Problem – changeable world – LABOR 4.0

• Solution – New way of thinking – EDUCATION 4.0

• Time – We must start with EDUCATION 4.0 YESTERDAY
Thank you for your attention!