CERI work on educational innovation

Innovative Learning Environments

Innovation Strategy for Education & Training

Innovative Teaching for Effective Learning
New skills demands

• Changing external skills demand is the main driver for innovation

• Research questions:
  – *Do innovation-driven economies require more and better educated populations?*
  – *What qualifications do innovative businesses need?*
  – *What individual skills should education systems foster?*
Economy-wide measures of routine and non-routine task input (US)

Source: Levy and Murnane, 2005
Working in creative jobs

Increase in creativity-oriented jobs (Canada, 1901-2006)

Note: The 1981 and 1991 data points have been approximated due to data limitations. Source: Martin Prosperity Institute analysis based on data from Statistics Canada.
Skills supply hampering innovation

(odds ratios: innovative vs. non-innovative (ref))

- Lack of finance from sources outside your enterprise
- Lack of funds within your enterprise or enterprise group
- Innovation costs too high
- Lack of information on markets
- Difficulty in finding cooperation partners for innovation
- Lack of information on technology
- Markets dominated by established enterprises
- Uncertain demand for innovative goods or services
- No need to innovate due to prior innovations
- No need to innovate because no demand for innovations

Source: OECD, based on CIS data
Which tertiary education studies lead to active participation in innovation?

Source: OECD, based on REFLEX and HEGESCO data
Critical skills for the most innovative jobs (tertiary-educated workers)

Likelihood (odds ratios) of reporting the following job requirements: people in the most innovative jobs vs. least innovative jobs

- come with news ideas/solutions: 2.97
- acquire new knowledge: 2.44
- willingness to question ideas: 2.34
- alertness to opportunities: 2.24
- present ideas in audience: 2.18
- analytical thinking: 2.15
- master of your own field: 2.11
- coordinate activities: 2.05
- write and speak a foreign language: 2.02
- use computers and internet: 2.00
- make your meaning clear: 1.99
- use time efficiently: 1.98
- mobilize capacities of others: 1.97
- work productively with others: 1.95
- write reports or documents: 1.94
- perform under pressure: 1.81
- knowledge of other fields: 1.76
- negotiate: 1.76
- assert your authority: 1.56

Source: OECD, based on REFLEX and HEGESCO data
Which pedagogies foster innovation skills?

- The relative importance of theory versus practice-based instruction matters for becoming an innovator (higher education data)
Relative emphasis on practice- and theory-based instruction

Odds ratios between innovators and non-innovators, by field of study

Source: OECD, based on REFLEX and HEGESCO data
Relative emphasis on practice- and theory-based instruction

Odds ratios between innovators and non-innovators, by type of innovation

Source: OECD, based on REFLEX and HEGESCO data
Link between theory- and practice-based instruction and critical skills for innovation

**Effect size on (self-reported) skills level**

<table>
<thead>
<tr>
<th>Skill</th>
<th>Theory score</th>
<th>Practice score</th>
</tr>
</thead>
<tbody>
<tr>
<td>analytical thinking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>acquire new knowledge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>use computer and internet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>question own and others' ideas</td>
<td></td>
<td></td>
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<tr>
<td>coordinate activities</td>
<td></td>
<td></td>
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<tr>
<td>present ideas in an audience</td>
<td></td>
<td></td>
</tr>
<tr>
<td>come up with new ideas and solutions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>alertness to new opportunities</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: OECD, based on REFLEX and HEGESCO data
Table 1. Theory-based programmes have distinct strong points from practice-based university programmes

Likelihood of reporting skills as strong points of the university programme, by mode of teaching and learning

<table>
<thead>
<tr>
<th>Emphasis on Theory</th>
<th>(n.s.)</th>
<th>(+)</th>
<th>(-)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(+)</td>
<td>analytical thinking</td>
<td>Mastery of your own field or discipline</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ability to rapidly acquire new knowledge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(-)</td>
<td>ability to write reports, memos or documents</td>
<td>ability to question your own and others’ ideas</td>
<td>alertness to new opportunities</td>
</tr>
<tr>
<td>n.s.</td>
<td>ability to perform well under pressure, ability to use time efficiently</td>
<td>ability to use computers and the internet</td>
<td>ability to come up with new ideas and solutions</td>
</tr>
<tr>
<td>(+)</td>
<td>ability to make your meaning clear to others</td>
<td>ability to present products, ideas or reports to an audience</td>
<td>ability to mobilise the capacities of others</td>
</tr>
<tr>
<td>(-)</td>
<td>ability to coordinate activities</td>
<td>ability to negotiate effectively</td>
<td>ability to assert your authority</td>
</tr>
</tbody>
</table>

Legend: (+) indicates a significant positive association; (-) a significant negative association; and (n.s.) a non-significant association.

Source: based on Reflex and Hegesco.
Which pedagogies foster innovation skills?

- The relative importance of theory versus practice-based instruction matters for becoming an innovator (higher education data)
- And the kind of pedagogical activities involved matters as well (PISA data)
Science scores and interest in science are not always fostered simultaneously.
Pedagogies for innovation skills

Science score

Interest in Science Topics
Pedagogies for innovation skills

**Science Enjoyment**

- Application: 26
- Hands-on: 1
- Interaction: 11
- Investigation: 2

**Science Self-Efficacy**

- Application: 15
- Hands-on: 4
- Interaction: 5
- Investigation: 4
Which pedagogies foster innovation skills?

- The relative importance of theory versus practice-based instruction matters for becoming an innovator (higher education data).
- And the kind of pedagogical activities involved matters as well (PISA data):
  - Application oriented pedagogies foster interest, enjoyment and self-efficacy in science, but not the science score itself.
  - Active investigation has a negative impact on science score, but fosters science enjoyment.
Teaching beliefs and practices

- Countries differ in relative preference of teachers to constructivist or direct transmission types of teaching beliefs (TALIS 2008 data)
TALIS on teaching beliefs and practices

- Direct transmission beliefs
- Constructivist beliefs
Teaching beliefs and practices

• Countries differ in relative preference of teachers to constructivist or direct transmission types of teaching beliefs (TALIS 2008 data)
• But also in the relative preference of teachers for types of teaching practices (TALIS 2008 data):
  – Structuring teaching practices
  – Student-oriented teaching practices
  – Enhanced activities
TALIS on teaching beliefs and practices

- Structuring teaching practices
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Teaching beliefs and practices

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• But also in the relative preference of teachers for types of teaching practices (TALIS 2008 data):
  – Structuring teaching practices
  – Student-oriented teaching practices
  – Enhanced activities
• And within countries different profiles of teachers have different preferences (new analysis on TALIS 2008 data)
Latent profiles of teachers and their relative preference for teaching practices

Classroom teaching practices

- Structuring
- Student orientation
- Enhanced activities

Italy

class A: 46% of teachers in Italy
class B: 41% of teachers in Italy
class C: 13% of teachers in Italy
Latent profiles of teachers and their relative preference for teaching practices

Austria

- Class A: 57% of teachers in Austria
- Class B: 34% of teachers in Austria
- Class C: 9% of teachers in Austria

Classroom teaching practices

Structuring

Student orientation

Enhanced activities
Latent profiles of teachers and their relative preference for teaching practices

Korea, Republic of

- Class A: 65% of teachers in the Republic of Korea
- Class B: 27% of teachers in the Republic of Korea
- Class C: 7% of teachers in the Republic of Korea

Classroom teaching practices

- Structuring
- Student orientation
- Enhanced activities
• *Haus der kleinen Forscher* = Germany's largest-scale skills training initiative in early education:
  – 200 networks (long-term partners serving 20,952 preschool institutions; about 550,000 people involved)
  – To raise the spirit of research in children
  – To convey first elements of scientific knowledge (8 themes: water - air - carbonation - mathematics - light, colour, vision - electricity and energy - magnetism - acoustics)
  – To get them interested in scientific/technical/mathematical issues; and
  – To improve thinking, language and social skills (by learning through research)
• *La Main à la Pâte* (i.e. collaborative, hands-on work), a 15 year-old successful French initiative now expanding (about 60 countries):
  – Offering comprehensive approach to science education in pre-primary and primary school, based on experimentation
  – Developing in children, through collective experimentations, discussions and individual reflection, interpersonal skills while learning science (children taught to respect different viewpoints, to listen to others and to compare other ideas with their own)
  – Nurturing values such as rigour, willingness to understand, humility, and openness to constructive social interactions
  – Revisiting gender stereotypes when it comes to science, thus encouraging girls to choose scientific pathways in the future
Arts: a special case in the curriculum

Figure 1. Strengthening verbal skills through the use of classroom drama: a clear link

Note: The vertical axis represents the effect size of seven meta-analyses studying the impact of drama classes on the acquisition of verbal skills. In these classes students read and acted out stories (drama condition) or just read the stories (no-drama condition). The effect sizes for Kadas and Wright and for Conard correspond to the effect size of two other prior meta-analyses.

Source: Podzleny (2000)
Some final thoughts

- Educational innovations happen when innovative ideas and approaches on *what* and *how* interconnect
  - Interaction of content and teaching methods matters
- Various teaching practices produce different sets of skills
- New learning research will help us understand better how learning happens and can be ‘engineered’ in a better way, for example
  - Interaction of social, temporal, spatial, visual processing in cognitive development
  - Interaction of cognitive and emotional processes
Thank you!

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