Conceptual Framework for Studying the Effects of ICT in Education

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CRELL at the Joint Research Centre

- CRELL is hosted by the Unit of Applied Statistics and Econometrics, JRC Ispra.
- As a Directorate General of the European Commission, the JRC provides scientific and technical support to Community policy-making.
- 7 Institutes in 5 Member States (total staff: 2,700).
- CRELL was established 2005 by Directorate General Education and Culture and the Joint Research Centre of the European Commission
- CRELL combines research in education, social sciences, economy, econometrics and statistics in an interdisciplinary approach
- 12 staff members
Emergence of European policy on Lifelong Learning

Lisbon European Council March 2000

Open method of coordination: Guidelines for the Member States
Indicators and benchmarks
Exchange of good practice
Peer reviews and mutual learning processes

Common objectives of education and training systems

European Quality Framework
Efficiency and Equity
### Detailed Work programme of 2002

- **3 strategic objectives**
- **13 detailed objectives**
- **5 benchmarks** (Reference Levels of Average Performance In EU Member States)
- **29 indicators for monitoring progress**

**Standing Group on Indicators and Benchmarks**
(27 EU countries, 2 EEA countries, Commission, OECD, Cedefop, Eurydice, CRELL)

**Progress Reports**
Communication on a Coherent Framework of Indicators and Benchmarks  
(Feb. 2007)

Policy Areas

1. Improving equity in education and training;
2. Promoting efficiency in education and training;
3. Making lifelong learning a reality;
4. Key competencies among young people;
5. Modernising school education,
6. Modernising VET (the Copenhagen process);
7. Modernising higher education (the Bologna process);
8. Employability.
1. Objectives: Strategic and detailed objectives

1. Improving the quality and effectiveness of education and training systems in the EU
   1. Improving education and training for teachers and trainers
   2. Developing skills for the knowledge society
   3. Ensuring access to ICT for everyone
   4. Increasing recruitment to scientific and technical studies
   5. Making best use of resources

2. Facilitating the access of all to education and training systems
   6. Open learning environment
   7. Making learning more attractive
   8. Supporting active citizenship, equal opportunities and social cohesion

3. Opening up education and training systems to the wider world
   9. Strengthening the links with working life and research and society at large
   10. Developing the spirit of enterprise
   11. Improving foreign language learning
   12. Increasing mobility and exchange
   13. Strengthening the European co-operation
2. Benchmarks: 5 EU European Reference Levels of Average Performance to be reached by 2010

1. Reduce the share of 15 years old low achievers in reading (PISA, level 1) by 20% compared to 2000
2. No more than 10% of young people (aged 18-24) should be early school leavers*
3. At least 85% of young people (aged 22) should have completed at least upper secondary education
4. Increase the number of MST graduates by 15%
5. At least 12.5% of adults (aged 25-64) should participate in lifelong learning.

*Early school leavers: percentage of the population aged 18-24 with at most lower secondary education and not in further education or training.
Progress in the 5 benchmarks

Based on data 2000-2007

Benchmark already achieved:
- Mathematics, science and technology graduates

Constant, but not sufficient progress:
- Early school leavers
- Upper secondary attainment
- Lifelong learning participation

No progress yet:
- Low achievers in PISA
3. Indicators: Coherent framework of indicators and benchmarks

| 1) | Participation in pre-school education |
| 2) | Special needs education |
| 3) | Early school leavers |
| 4) | Literacy in reading, mathematics and science |
| 5) | Language skills |
| 6) | ICT skills |
| 7) | Civic skills |
| 8) | Learning to learn skills |
| 9) | Upper secondary completion rates of young people |
| 10) | Professional development of teachers and trainers |
| 11) | Higher education graduates |
| 12) | Cross-national mobility of students in higher education |
| 13) | Participation of adults in lifelong learning |
| 14) | Adults’ skills |
| 15) | Educational attainment of the population |
| 16) | Investment in education and training (+ Creativity and Innovation) |
## Data sources

<table>
<thead>
<tr>
<th>ESS</th>
<th>LFS</th>
<th>Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>UOE</td>
<td>Mobility, financing</td>
</tr>
<tr>
<td></td>
<td>CVTS</td>
<td>Vocational education and training</td>
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<tr>
<td></td>
<td>AES</td>
<td>Self reported adult skills</td>
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<td></td>
<td>SICTU</td>
<td>ICT</td>
</tr>
<tr>
<td>PISA survey</td>
<td>Maths, reading, science skills</td>
<td></td>
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<tr>
<td></td>
<td>PISA-Vet</td>
<td>Vocational education and training</td>
</tr>
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<td></td>
<td>TALIS survey</td>
<td>Teacher education (CRELL)</td>
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<tr>
<td></td>
<td>PIAAC survey</td>
<td>Adult skills</td>
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<tr>
<td></td>
<td>AHELO</td>
<td>Learning outcomes in Higher education</td>
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<td>ICCS survey</td>
<td>Civic skills (CRELL)</td>
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<td></td>
<td>ICILS</td>
<td>Computer and information literacy</td>
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<tr>
<td>Language survey</td>
<td>Language skills (CRELL)</td>
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</tr>
<tr>
<td></td>
<td>L2L survey</td>
<td>Learning to learn skills (CRELL)</td>
</tr>
</tbody>
</table>
Indicator development

Quantitative analysis

Indicator identification

Data producers

Composite indicators and quantitative analysis

Indicators

Stat. & Ind.

Stat. & Ind.

Stat. & Ind.
Role of ICT

• **STAFF WORKING PAPER**: « The use of ICT for innovation and lifelong learning for all. A report on progress » (November 2008)

• **ICT CLUSTER** of 18 Member States

• **2009 - The European Year on Creativity and Innovation** ➔ Innovative learning through the use of ICT

• Ongoing **STUDIES** related to:
  • Learning 2.0
  • New learning communities through ICT
  • European-wide comparison of the impact of ICT on school education
  • Development of methodologies for ICT indicators
  • Study of the impact of TEchnology in Primary Schools (STEPS)
Need for regular studies on ICT impact

New technologies (e.g. ePortfolios)

Changing contextual conditions

New teaching practices

New ways of learning

Increasing policy interest in understanding phenomena, effects and interrelations

NEED TO BE FREQUENTLY UPDATED ABOUT TRENDS AND ICT Impact
Situation

• Most studies do not provide a clear information about the real effects of ICT on learner and learning for policy-making
• Lack of comprehensive studies of the complex interactions between various types of ICT implementation and the effects of other factors such as institution-based interventions, socio-economic status and institutional expenditures
• No large-scale longitudinal studies of ICT's impact in education

“Need for a thorough, rigorous, and multifaceted approach to analysing the impact of ICT on education and students' learning”
(Cox & Marshall, 2007, also Kikis & Kolias 2005; Aviram & Talmi 2004 etc.)
JRC Research:
Influence of ICT on educational performance

Research questions

• What are the ICT-related factors that (positively or negatively) stimulate performance and outputs of education?
• What is the impact of digital media on personal development and learning?
• How can ICT contribute to flexible learning arrangements?
• What are the indicators for observing educational effects of ICT and how can it be measured at a comparative level across individuals, institutions and countries?
Questions posed to the Assessment of ICT effects

• …what to assess
  • What do we want to assess?
  • Why do we want to assess (purpose)?
  • What “can” we assess, what not?
  • Terminology
• …how to assess effects
  • What do we have to look at when assessing the effects?
  • Is that what we assess that what we intended to assess?
  • What are the interrelations (e.g. to “innovation, creativity etc.”)
• …how to monitor effects?
  • How can we ensure regular monitoring?
  • How can we monitor progress made?
• ...how to come to comparable results?
  • What data sources are available and what do we have to collect?
  • How can existing data feed existing indicators (e.g. on ICT skills) across countries?
• …how can we report data (e.g. visualisation)
• …how to analyse data (analytical methodology)
What can we learn from surveys?
Example PISA: Availability and Use

% of respondents that use a computer, everyday or almost everyday

Source: PISA 2006
What can we learn from surveys?
Example PISA: PROFILES and PRACTICES

Percentage of students that reported use of computers for the following “Almost everyday”

Source: PISA 2006, CRELL calculations
Series represent % of all the students that answered the questions in PISA 2006, weighted by Final Student weight
What can we learn from surveys?

Example PISA: TRENDS

Source: PISA 2006, CRELL calculations: Percentage of students that reported use of computers “Almost everyday” at school
Series represent % of all the students that answered the questions Q3b, PISA 2006 and Q4b in PISA 2003 weighted by Final Student weight
What can we learn from surveys?

Example EMPIRICA: Classroom Practices (subject areas)

<table>
<thead>
<tr>
<th>Country</th>
<th>General primary education</th>
<th>Literature and languages</th>
<th>Humanities and social sciences</th>
<th>Mathematics, computer sciences</th>
<th>Physical education and sport education</th>
<th>Vocational education</th>
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<td>NMS XX</td>
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<td>60.1</td>
<td>65.5</td>
<td>60.1</td>
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</tbody>
</table>

Base Question: All teachers in the respective breakdown category and country.
Warning: When using computers and/or the Internet in class, ... are the pupils equipped with computers and/or Internet.
Indicator: Percentage of teachers who have ever used a computer in class to present or demonstrate
Source: EMPIRICA Learning 2008 (ITB)

xx%: based on at least 10 cases.
xx%: based on at least 50 cases.
xx%: based on less than 10 cases.
What can we learn from surveys?

Relationships

Source: PISA 2006, CRELL calculations
Series represent average country scores in the total Science scores (as reported in PISA 2006) and the ICT internet self-confidence scale (INTCONF weighted by final student weight)
Limitations

- Skills are mainly assessed in terms of ICT literacy and attitudes, not by pedagogical (teaching/learning) practices and mental effects on learner and learning

- Little indications about actual instructional use of ICT and its effects

- If we want to learn about the impact of e-portfolios in education there is little we can conclude from existing studies.
Challenges to be met

• Despite expected benefits for policy stakeholders at a general level current indicators and data do not provide sufficient information about ICT impact on learner and learning.

• Studying ICT effects on learner and learning requires analysis at a more detailed and complex level.

• A systematic approach is needed distinguishing between perspectives, domains, indicators of ICT implementation which need to be matched to specific objectives.
Monitoring ICT Effects in Education for Policy-making

Conceptual Framework
- Domains
- Indicators
- Stages

Model
- Instruments
- Data Sources

Analysis
- Methodology

Reporting

Context
- Resources
- Population
- Learning Culture
- Rationale
- Socio-Economic Factors

Policy Goals, Priorities
### Conceptual Framework for Studying ICT Effects

#### Domains
- Policies
- Resources
- Curriculum
- Organisation
- Teaching
- Learning

#### Indicators

<table>
<thead>
<tr>
<th>Domains</th>
<th>Indicators</th>
<th>Macro</th>
<th>Meso</th>
<th>Micro</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Examples</td>
<td>Examples</td>
<td>Examples</td>
</tr>
<tr>
<td>Implementation strategies</td>
<td>National policies for ICT-implementation</td>
<td>eLearning strategies in school</td>
<td>Intentions of ICT uses in courses</td>
<td></td>
</tr>
<tr>
<td>ICT-availability</td>
<td>ICT-penetration in education</td>
<td>Availability of LANs in school/class</td>
<td>Private access to ICT</td>
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<tr>
<td>ICT-related courses</td>
<td>Extent of curricula adaptation</td>
<td>ICT-related courses offered</td>
<td>Level of required for teaching/learning</td>
<td></td>
</tr>
<tr>
<td>ICT-related services for teachers, students etc.</td>
<td>ICT in schools for organ. purposes</td>
<td>Use of CMS for class management</td>
<td>Internet-delivered Assignments</td>
<td></td>
</tr>
<tr>
<td>Extent of ICT-use</td>
<td>ICT-implementation in school education</td>
<td>Pedagogical use of ICT in classroom</td>
<td>Teacher’ use of ICT for teaching</td>
<td></td>
</tr>
<tr>
<td>Extent of ICT-related activities</td>
<td>Students’ ICT-use</td>
<td>ICT-enhanced learning in class</td>
<td>ICT-related learning activities at home</td>
<td></td>
</tr>
</tbody>
</table>

#### Stages
- e.g. Morel’s Matrix
  - Emerging
  - Applying
  - Integrating
  - Transforming

#### Policy Areas
- e.g. European Union:
  1. Improving equity in education and training
  2. Promoting efficiency in education and training
  3. Making lifelong learning a reality
  4. Key competences among young people
  5. Modernising school education
  6. Modernising VET
  7. Modernising Higher Education
  8. Employability
     Innovation, creativity etc.
## Stages: e.g. Morel's Matrix

<table>
<thead>
<tr>
<th>Criteria/Phase</th>
<th>Emerging</th>
<th>Applying</th>
<th>Integrating</th>
<th>Transforming</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Development plan and policies</strong></td>
<td>Accidental. Restrictive. No planned funding.</td>
<td>Limited. Centralized policies.</td>
<td>Individual subject plans for ICTs. Permissive policies.</td>
<td>ICTs is integral to overall school development plan (budget, professional development etc).</td>
</tr>
<tr>
<td><strong>Community</strong></td>
<td>Accidental.</td>
<td>Parental and community involvement.</td>
<td>Subject-based community, providing occasional assistance. Global and local networked communities.</td>
<td>Broad-based learning community involving families, business, industry, organizations, universities etc. School as a learning resource for the community.</td>
</tr>
</tbody>
</table>
## Analysis / Methodology: e.g. CIPP

<table>
<thead>
<tr>
<th>CONTEXT EVALUATION</th>
<th>INPUT EVALUATION</th>
<th>PROCESS EVALUATION</th>
<th>PRODUCT EVALUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OBJECTIVE</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>To define the operating context, to identify and assess needs and opportunities in the context, and to diagnose problems underlying the needs and opportunities.</td>
<td>To identify and assess system capabilities, available input strategies, and designs for implementing the strategies.</td>
<td>To identify or predict, in process, defects in the procedural design or its implementation, to provide information for the preprogrammed decisions, and to maintain a record of procedural events and activities.</td>
<td>To relate outcome information to objectives and to context, input, and process information.</td>
</tr>
<tr>
<td><strong>METHOD</strong></td>
<td></td>
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</tr>
<tr>
<td>By describing the context; by comparing actual and intended inputs and outputs; by comparing probable and possible system performance; and by analyzing possible causes of discrepancies between actualities and intentions.</td>
<td>By describing and analyzing available human and material resources, solution strategies, and procedural designs for relevance, feasibility and economy in the course of action to be taken.</td>
<td>By monitoring the activity’s potential procedural barriers and remaining alert to unanticipated ones, by obtaining specified information for programmed decisions, and describing the actual process.</td>
<td>By defining operationally and measuring criteria associated with the objectives, by comparing these measurements with predetermined standards or comparative bases, and by interpreting the outcomes in terms of recorded context, input and process information.</td>
</tr>
<tr>
<td><strong>RELATION TO DECISION-MAKING IN THE CHANGE PROCESS</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>For deciding upon the setting to be served, the goals associated with meeting needs or using opportunities, and the objectives associated with solving problems, i.e., for planning needed changes.</td>
<td>For selecting sources of support, solution strategies, and procedural designs, i.e., for structuring change activities.</td>
<td>For implementing and refining the program design and procedure, i.e., for effecting process control.</td>
<td>For deciding to continue, terminate, modify, or refocus a change activity, and for linking the activity to other major phases of the change process, i.e., for recycling change activities.</td>
</tr>
</tbody>
</table>
Ongoing work

- Define set of indicators (type) and criteria during exploratory studies in selected areas

- Refinement