Interdisciplinary Education: Challenging and Motivating both Students and Teachers.

Machiel Keestra, Institute for Interdisciplinary Studies, University of Amsterdam
Waterford Institute of Technology, Jan. 9, 2013
Why inter-disciplinarity?

Karl Popper: “We are not students of some subject matter, but students of problems. And problems may cut right across the boundaries of any subject matter or discipline.”

(Conjectures and Refutations, Karl Popper, 1963, p. 67)
How much help does a robot with or without a ‘face’ get? (1st year project)
Institute for Interdisciplinary Studies (www.iis.uva.nl)

• Bachelor degree Natural and Social Sciences (± 400)

• Bachelor degree Future Planet Studies (± 200)

• Research Master in Brain and Cognitive Sciences (±100)

• Research Master in Forensic Science (±60)

• Interdisciplinary electives (± 1000)

• Honours classes (± 150)

• Interdisciplinary minors (100)
The I.I.S. Natural & Social Sciences (B.Sc.) bachelor: from interdisciplinarity to disciplinarity & back again

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AC = Academic core, ID = Interdisciplinary Domain, T123 = Themes, M = Major/specialization
Stages of interdisciplinarity – corresponding to ID characteristics

ID teaching & learning require of a person ever more:
- openness
- curiosity
- risk-taking
- being (self-)critical
- tolerance of ambiguity
- tolerance of uncertainty
- flexibility
- empathy
ID courses which differ in:
- level of work
- width of ID
- didactics
- disciplinary depths
- original work

**LEVEL 100  Human Action:**
4 sub-domains – small project

**LEVEL 200  Our Genetic Identity:**
Problem based learning

**LEVEL 300  Interdisc. Research Seminar:**
4 large domains – large project
1st year research project for a ‘Human Action’ course: “do animals have rituals, too?”
Encyclopedie (1750-1765): survey & cohesion of all available knowledge & expertise
Whehwell’s 1850 classification of domains of reality & corresponding sciences: still neat & surveyable
Classificatory Explosion of Sciences according to Dewey’s Decimal System:
1873 edition = 2000 entries
recent edition = 27,000 entries + 13,000 additions

000 – Computer science, information and general works
100 – Philosophy and psychology
200 – Religion
300 – Social sciences
400 – Language
500 – Science (including mathematics)
600 – Technology and applied Science
700 – Arts and recreation
800 – Literature
900 – History and geography
Interdisciplinary science is always a dynamical phenomenon.
Interdisciplinary science is always a dynamical phenomenon

‘Betweenness van ID tijdschriften’
(Leydesdorff, 2008)
Interdisciplinarity’s emergence

- 1920’s (‘26?): Social Science Research Council
- WW II and after: technological and social scientific demands for interdisciplinarity
- 1972: OECD report ‘Interdisciplinarity: Problems of Teaching and Research in Universities
- 1979: Association for Integrative [Interdisciplinary] Studies
- 2011: International Network for Interdisciplinarity & Transdisciplinarity
‘Meat the future: is artificial meat a sustainable alternative?’ (3rd yr.)

- Management: niche-construction
- Technology: scaling up of production
- Biology: structure & quality of artificial meat
Drivers towards IDR research:

- The Inherent Complexity of Nature and Society
- The Drive to Explore Basic Research Problems at the Interfaces of Disciplines
- The Need to Solve Societal Problems
- The Stimulus of Generative Technologies
  (Nat. Acad. Sciences report: Facilitating interdisciplinary research, 2004)
Interdisciplinarity comes in different forms:

1. Borrowing of concepts, methods
2. Problem oriented collaboration
3. Bordering interdisciplinarity; increasing unification
4. Emergence of a new inter-discipline

European context and goals of education

- Eur. Comm. Bergen communique, 2005:
  - Goals of education are ‘preparing the student for the labour market, for further competence building and for active citizenship.’

- European Commission, 2006, ‘Modernisation Agenda’:
  - ‘Modernising Universities for Europe's competitiveness in a global knowledge economy’
  - ‘Enhance interdisciplinarity and transdisciplinarity.’

- Follow-up report from the Commission, 2008:
  - Mobility
  - New Skills for New Jobs
  - University-Business cooperation
  - Transparency in higher education performance
# New Curricula - Aiming for ‘Relevance’

Table 1: Traditional and Emerging Curricula

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<th>Traditional Curricula</th>
<th>Emerging Curricula</th>
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<tr>
<td>Knowing that</td>
<td>Knowing how</td>
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<tr>
<td>Written communication</td>
<td>Oral communication</td>
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<td>Personal</td>
<td>Interpersonal</td>
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<td>Internal</td>
<td>External</td>
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<td>Disciplinary skills</td>
<td>Transferable skills</td>
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<td>Intellectual orientation</td>
<td>Action orientation</td>
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<td>Problem-making</td>
<td>Problem-solving</td>
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<td>Knowledge as process</td>
<td>Knowledge as product</td>
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<td>Understanding</td>
<td>Information</td>
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<td>Concept-based</td>
<td>Issue-based</td>
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<td>Knowledge-based</td>
<td>Talk-based</td>
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<td>Pure</td>
<td>Applied</td>
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<td>Proposition-based learning</td>
<td>Experential learning</td>
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*Source: Barnett et al. (2001, p. 437).*
Drivers against interdisciplinarity

- disciplinary structure of the university
- disciplinary structure of academic education
- lack of emphasis on critical thinking, metacognition, higher order thinking
- organization and funding of research
- peer review process
‘Musical & rythmic stimulation in patients with Parkinson’s disease’ (3rd year)

- Medicine – diagnosis & therapy
- Psychobiology - dopamine-circuits
- Musicology – (mathematical) analysis of musical elements
An influential definition of interdisciplinarity:

[Interdisciplinary studies is] a **process** of answering a question, solving a problem, or addressing a topic that is **too broad or complex** to be dealt with adequately by a single discipline or profession . . . and draws on disciplinary **perspectives and integrates** their insights through construction of a more comprehensive perspective.”

(J. Klein & B. Newell: Advancing Interdisciplinary Studies, 1997.)
An Integrated Model of the Interdisciplinary Research Process

A. Drawing on disciplinary insights.
   1. Define the problem or state the focus question
   2. Justify using an interdisciplinary approach
   3. Identify relevant disciplines
   4. Conduct a literature search
   5. Develop adequacy in each relevant discipline
   6. Analyze the problem and evaluate each insight to it

B. Integrating insights and producing an interdisciplinary understanding
   7. Identify conflicts between insights and their sources
   8. Create or discover common ground
   9. Integrate insights
   10. Produce an interdisciplinary understanding of the problem and test it
Requirements for scientifically and societally robust academic education.

- Scientific, cognitive skills
- Meta-cognitive skills
- Critical thinking skills
- Communicative skills
What results can come from interdisciplinary research?

- knowledge of new empirical facts
- conceptual & theoretical modifications
- extended explanatory mechanism
- optimization function
- technological innovation
- more robust intervention (medical, etc.)
- more sustainable policy advice

etcetera
‘Why and how do tumor cells collaborate?’
(3rd year)

Three different majors:

- Biomedical science: tumor growth
- Psychobiology – evolutionary game theory
- Econometrics – mathematical model of collaboration
Triangulation exercise:

- Three different specializations
- Step 1: Subjects from your own discipline (taking others’ into account)
- Step 2: Discover/formulate an overlapping subject
- Step 3: Formulate several questions/topics on that subject from your own discipline
- Step 4: Consider what type(s) of integration you would aim at.
Thanks!

INTERESTED?

- www.units.muohio.edu/aisorg/index.shtml (Association for Integrative Studies)
- www.transdisciplinarity.ch (Transdisciplinarity_Net)
- www.nchchonors.org (Nat. Collegiate of Honors Colleges)
- www.iis.uva.nl (Inst. Interdisciplinary Studies, A’dam)
- http://home.medewerker.uva.nl/m.keestra