Evidence Based Engineering Education: Research and Practice

Arnold Pears
Department of Information Technology
Uppsala University
Sweden
Agenda

- Research area
- Goals and systematic investigation
- Examples of my contributions.
Trends in higher education

1980's
Marton and Säljö – Deep and Surface Learning [Entwistle, 1991]

1981

1990
Boyer – Priorities of the Professoriate [Boyer, 1990]

1996
Biggs – Constructive Alignment [Biggs, 1996]

2009
Hattie – Visible learning [Hattie, 2009]

2014
Wieman – T-factor survey instrument [Weimann, 2014]
Context of Evidence Based Education

- Education Research
- Disciplinary Research
- Computing & Engineering Education Research
- Teaching and Learning in the Discipline
Cognitive Shift

Introspection                                                Scholarly discourse

Teaching Practice in Computing and Engineering

Intuition                                                Evidence
The education of the future

Technology

Learner

Future Education

Pedagogy
Research Goals

- Contribute insight
- Understand learning
- Improve practice
Managing Systematic Change

- Scholarly practice & reflection
- Student learning
- Disciplinary and general education research
- Development of learning env.
- Quality Framework
Group Discussion - systematic innovation

<table>
<thead>
<tr>
<th>Aspect of System to be Changed</th>
<th>Intended Outcome</th>
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<tbody>
<tr>
<td><strong>I. Disseminating:</strong></td>
<td>Prescribed</td>
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<tr>
<td>CURRICULUM &amp; PEDAGOGY</td>
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<td>Change Agent Role: Tell/Teach</td>
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<td>individuals about new teaching</td>
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<td>conceptions and/or practices and</td>
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<td>encourage their use.</td>
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<td><strong>Diffusion</strong></td>
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<td><strong>Implementation</strong></td>
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<td><strong>II. Developing:</strong></td>
<td>Emergent</td>
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<td>REFLECTIVE TEACHERS</td>
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<td>Change Agent Role:</td>
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<td>Encourage/Support individuals to</td>
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<td>develop new teaching conceptions and/or</td>
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<td><strong>III. Enacting:</strong></td>
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<td>POLICY</td>
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<td><strong>Quality Assurance</strong></td>
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<td><strong>Organizational Development</strong></td>
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<td><strong>IV. Developing:</strong></td>
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<td>SHARED VISION</td>
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<td>Change Agent Role:</td>
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<td>Empower/Support stakeholders to</td>
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<td><strong>Learning Organizations</strong></td>
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<td><strong>Complexity Leadership</strong></td>
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Case Study 1

Designing high quality research
How?
Case Study 2

Improving student learning of programming
Approach

• Re-structuring programming instruction

• Focus on the role of experience, and practice in the development of professional competence.

• Utilise current research in the domain, and observations from professional practice.
Enhancing learning

- Key results from learning and teaching research
  - research on motivation and activated learners (e.g. Dweck:1999)
  - deep vs surface learning (Trigwell 1999, Biggs 1987)
  - threshold concepts (Meyer 2005) and conceptual change (Entwistle 2007)
Relevant CE and EE research

- Importance of helping students to appreciate tacit aspects of expert knowledge and behaviour. {Mancy: 2006}

- Self efficacy, creativity, and motivation {Williams: 2001, McDowell03, Jacobson:2008}

Enhancing learning

Revealing tacit knowledge
Interactive code development in lecture environment

Leveraging research on self efficacy and self theories
Resulting in a peer interaction approach to practical work

Motivation and engagement
Enhance opportunities for self determination and creativity.
Allow student groups to define significant aspects of their own assignments.
Assessing for learning

Final grade: Fail, Pass, Pass with credit, Pass with distinction

Grade based on:
- Pass in 10 of 13 supervised programming sessions,
- Final grade determined by a project assessment,
  - 30 minute group oral exam
  - 15 minute individual oral exam
- Qualitative criteria used to determine, final grade.
Questions?