Conflicts in ‘school science’: the role of neighbouring activities

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Purpose of this study

- To construct an activity theory perspective on neighbouring activities to ‘school science’

- To consider possible tensions thus arising in the central activity
  - especially with respect to teachers

- Have been working towards an activity theory perspective on school science (cf. Intentions and reality project 2005-2007, ASE and ESERA papers, 2007)

What are neighbouring activities?

Examples:
- STCP 2006-2009
- NESTA in the UK
Background and data

The central activity
- *Intentions and reality* research on science education in Iceland
  - Case studies in Iceland on schools and communities
  - Interviews with teachers and learners about school science

Neighbouring activities
- Participation in and access to artefacts and initiatives
  - In Iceland
  - In Scotland
- Interviews from participants in three activities in Iceland
- Reciprocal field-visits – Scotland and Iceland
“We need more ‘real science’ in our school science lessons. Science learning needs to inspire our future scientists and citizens by being challenging and creative.”
In today's activity theory the focus is shifting toward analyzing 'freedom of action' in complex collective settings undergoing transformations.


• I am asking:
  – What freedom of action do teachers experience in school science?
  – How is this related to neighbouring activities?

• Preliminary results/indicators:
  – Issues of knowledge
  – Issues of emotion
Neighbouring activities

Engeström, 1987

- What do we find in the central activity (CA) of school science?
- What do we find in the neighbouring activities?
- What tensions affect the central activity (CA)? The culturally more advanced central activity (CACA)?
- What do we find in the object activity?

What is the role of knowledge and knowledge-related activity? What is the role of emotion?
Central activity of school science

- History and curriculum
- Classroom science
- Capacity to teach science
School science – history - three Cs  
Curriculum, comparative studies, constructivism

- Tensions in science education  
  - Science as knowledge vs. science as knowledge-creation  
    - Content-process dilemma, especially since the 1950s  
    - TIMSS, ROSE, PISA since the mid-1990s  
      - issues of power and control in the classroom

- What is ‘school science’?  
  - Why is science taught in schools?  
  - What does it mean ‘to teach’ science?  
  - How do children learn science?  
  - What conflicts are there in school science?

- Division of labour - expertise  
  - Who knows? Who knows what to teach? What do you need to know in order to teach? Who knows how to teach?
Factors affecting science teaching

Capacity gaps

- Resource adequacy
- Time
- Professional support
- School ethos and the status of science as a school subject
- Skills, knowledge and professional attitudes

AC Preferred
AC Actual
Situation (in praxis)

Actual situation (in praxis)

Preferred situation (ideal form)
School science – central activity
School science in Iceland 2006-2007

**Policy-makers**
Criteria of knowledge: knowledge of and about science; what the student should know and be able to do

**Local authorities**
Some school development support with resources; moving into professional development<<

**Central/classroom activity:**
- Little direct teaching;
- reading of texts;
- very little practical work;
- written exams;
- a subject-based approach in middle and lower secondary;
- integration in early years;
- pupils mostly passive

**Teachers**
- Many lack subject knowledge;
- rely heavily on published materials;
- afraid of practical work;
- not teaching science by choice

**Principals**
Curriculum leadership matters but is generally weak

**Learners**
- Limited knowledge of science and technology in society; want more practical work

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**Interest/lack of interest**
What is the role of knowledge?
What is the role of emotion?

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IR project, 2007
• Neighbouring activities
  – Objects and object activity
  – Hypothesis
  – Subject/community creating, instrument creating
  – Changing the division of labour

What is the role of knowledge and knowledge-related activity?
What is the role of emotion?
## Object activity

<table>
<thead>
<tr>
<th></th>
<th>Iceland</th>
<th>Scotland</th>
<th>Europe/International</th>
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</thead>
<tbody>
<tr>
<td>National curriculum</td>
<td>1999, 2007</td>
<td>A curriculum for excellence</td>
<td>ROSE, PISA, TIMSS</td>
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<td>Comparative studies</td>
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<td>Education 2010</td>
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<td>Interventions</td>
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<td>Science in society</td>
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<td>NESTA</td>
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"Science includes experiences and outcomes in biological, chemical, physical and environmental contexts.

The most important goal for science education is to stimulate, nurture and sustain the curiosity, wonder and questioning of children and young people.

... The revised curriculum will be based on the big ideas of contemporary science and the scientific concepts that underpin these."

A curriculum for excellence

What is the role of knowledge and knowledge-related activity? What is the role of emotion?
Public investments in education, scientific research, technical development and innovation reap ample returns from scientific, social and economic advances. (p. 1)

The key to success is a vision of the future and tenacious, well-educated people capable of evaluating and exploiting opportunities associated with the rapidly changing social and market conditions. (p. 7)

The STPC underlines the following.....

There is a need for improving teaching methods in sciences and technological subjects at the compulsory levels and to encourage young people to enrol in such fields. This includes also changes in the curricula for teacher education. (p. 7)
Knowledge – science - innovation

- Everyday knowledge and scientific/procedural knowledge

- Knowledge and issues of power and control:
  - creation, transmission and acquisition of knowledge (processes, Bernstein)

- Knowledge and the individual:
  - content, skills and attitudes (curriculum, Bloom)
  - scientific literacy – democratic participation (national curriculum)

- Knowledge and society:
  - scientific literacy (PISA)
  - science and society – engagement

- Knowledge and the economy:
  - the knowledge society (policy)
  - science, technology and innovation
  - innovation and prosperity

Division of labour
Object formation
Knowledge
Motive/Interest

Working together to build appealing education programmes and appealing careers
What is the role of knowledge and knowledge-related activity?

“Science shops occupy an important place in the local communities they serve. These community-based research organisations provide new or recombined knowledge, in a bottom-up manner, in response to the practical research needs of ordinary people and grass-roots organisations.

For example:

Although they are local in reach, cross-border networking enables the science shop movement to blossom and grow by allowing individual shops to share expertise and know-how.”

Hypothesis at this point

• A key tension between neighbouring activities and the central activity lies in their effect on the **subject, community and division of labour triad** in the central activity and what this means for the **object/outcome**

• Who creates and defines knowledge and learning opportunity?

• Who has power and control?

• In what way do neighbouring activities reflect creation of knowledge and how do they affect transmission and acquisition of knowledge?

• What implications do neighbouring activities have for emotions (identity and motivation) and for agency and communities in school science?
On behalf of ASE Scotland and partners ......may I offer everyone a warm welcome to our Annual Conference at Crieff, March 9th and 10th 2007. This is Scotland’s premier opportunity to network with others in the field of science education at all levels. There will be primary school teachers, secondary teachers, lecturers, technicians, advisers, manufacturers and trainers all with a common interest.
Three conference strands:

- **Science in Society** – public engagement, policy through dialogue and the Science Centres Network

- **Science Education** – linking formal and informal learning, in light of the Scottish Executive’s review of the science curriculum and other adult learning initiatives

- **Science Communication** – science and the media, science PR and science events

http://www.the-ba.net/the-ba/ScienceinSociety/ScienceCommunicationConference/ScottishSCC/index.html
## Instrument creating activity

<table>
<thead>
<tr>
<th>Resource Type</th>
<th>Iceland</th>
<th>Scotland</th>
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</tr>
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<tbody>
<tr>
<td>Web-based information</td>
<td><em>Science web</em></td>
<td></td>
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<tr>
<td>Magazines</td>
<td><em>Living science</em></td>
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<tr>
<td>Resources (not textbooks)</td>
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<td><em>Channel 4</em></td>
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<tr>
<td>Textbooks and school webs</td>
<td><em>National Centre for Educational Materials</em></td>
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<tr>
<td>School science equipment</td>
<td><em>Skólavörubúð</em></td>
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<td><em>PASCO</em></td>
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- Why do people have written language?
- What can you tell me about diving sea birds?
- When were rats first known in Iceland?
- What is geothermal heat?
- When did the first Icelandic mass medium come into existence, and when was it launched?
## Division of labour activity

<table>
<thead>
<tr>
<th>Individual scientists</th>
<th>Iceland</th>
<th>Scotland</th>
<th>Other national</th>
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<tbody>
<tr>
<td>“Borrow a scientist”</td>
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<th>Science communication</th>
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<td>Science at the coffee shop</td>
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<td>Edinburgh Science Festival</td>
<td>BA</td>
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<td>The Research Paper</td>
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<td>ECSITE</td>
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- Science Communication: Science at the coffee shop, The Research Paper, Edinburgh Science Festival
- Science Centres: Science Centre (feasibility study), Our Dynamic Earth Glasgow Science Centre

Other national initiatives:
- NESTA
- Science and Engineering Ambassadors
- BA
- ECSITE

**Object formation**
- Division of labour
Neighbouring activities
Culturally more advanced activity?

Culturally more advanced object
Object activity

Subject-making activity
Instrument-making activity
Division of labour making activity
Community

CACA:
Return to enquiry based work;
Use project activity;
Big contemporary ideas;
Pupils to be innovative;
Wonder, curiosity

What about emotion – the motivation and identity of the teacher?
Emotion – motivation and identity

- Emotion, motivation and identity are integrally related
- Subject and object stand in dialectical relation
- Need to go beyond knowledge ability only in terms of scientific or mathematical actions to include emotion
  - “The workplace-related motivation is high when the subject realizes both individual and collective interests in the same action”
  - Identity .... Who I am with respects to others and myself is fundamentally related to my participation in collective activity and to individual and collective emotional valences arising from ... Interactions with others ... Must provide evidence to others and I am competent
**Subjects** – interest, agency, identity, motivation

**Artefacts and initiatives**

**Communities** - same object
  - Teachers
  - Learners
  - A classroom (Teacher/many learners)

**Distribution of labour** – power/status and task distribution

**Motivation**

**Emotion**

**Identity**

**Knowledge**
Conclusion

• Is there a reduction in the freedom of action?
• Have the neighbouring activities sent messages which lead teachers to question their knowledge and identity, to experience emotion and to question who defines the collective and individual interest?
• What conflicts exist between “the common interest” and “interest in”? 
Hello! Welcome to Our Dynamic Earth’s website! We’re a visitor attraction based in the heart of Edinburgh telling the unique story of our planet’s past, present, and future. As well as having the Mother Earth of all adventures, you’ll discover lots of fascinating facts about our planet.