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)

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

What are neighbouring activities?
Examples:
STCP 2006-2009
NESTA in the UK
Activity Theory - freedom of action

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/indications:
  – Issues of knowledge
  – Issues of emotion

Neighbouring activities

- 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?

Engeström, 1987

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?
- 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>Country</th>
<th>Year</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iceland</td>
<td>1999, 2007</td>
<td>A curriculum for excellence</td>
</tr>
<tr>
<td>Scotland</td>
<td>2007</td>
<td>A curriculum for excellence</td>
</tr>
<tr>
<td>European</td>
<td></td>
<td>A curriculum for excellence</td>
</tr>
</tbody>
</table>

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

School science – central activity

School science in Iceland 2006-2007

Policy makers
- Criteria of knowledge: knowledge of just about science, what the student should know and be able to do
- Professional development support with resources, moving into professional development
- Local authorities
- Some school development support

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

Practice/In class: What is the role of knowledge? What is the role of emotion?

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

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

IR project, 2007
Science and Technology Policy Council

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 and issues of power and control:

- 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

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

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

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 grassroots organisations.

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.”

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/ScienceCommunicationConferenceScottishSCC/index.html
Division of labour activity

<table>
<thead>
<tr>
<th>Individual scientists</th>
<th>Science communication</th>
<th>Science centres</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Borrow a scientist”</td>
<td>Science at the coffee shop</td>
<td>Science Centre (feasibility study)</td>
</tr>
<tr>
<td>NESTA Science and Engineering Ambassadors</td>
<td>Edinburgh Science Festival</td>
<td>Our Dynamic Earth Science Centre</td>
</tr>
<tr>
<td>Scotland</td>
<td>Europe/International</td>
<td>Other national</td>
</tr>
</tbody>
</table>

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 valence arising from ... Interactions with others ... Must provide evidence to others and I am competent

Neighbouring activities

Culturally more advanced activity?

- Culturally more advanced object
  - Object activity
- Subject-making activity
- Instrument-making activity
- Division of labour making activity
- Community

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

Subjects – interests
- agency, identity, motivation

Artefacts and initiatives from neighbouring activities

Are there common interests? What is the role of knowledge and knowledge-related activity? What is the role of emotion?

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

Distribution of labour –
- power/status and task distribution
Individual interests met
Individual interests not met
Collective interests met
Collective interests not met

TEACHER
Low motivation
Strong identity

Collective - Individual +
COMPETENT TEACHER
High motivation
Strong identity

Collective - Individual -
COERCED TEACHER
Low motivation
Weak identity

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”?