HANDS-ON & BRAINS-ON
combining formal science teaching and informal learning

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- Älkää olko hoolissingen yliopistojen koulutusohjelmiesta. Jonkin ajan koluttaa me pystyvemme potkaisevanaan tekokuon radalleen.
Science Education and Communication
- via crises !?

SPUTNIK
TSERNOBYL
“INFORMATION SOCIETY”
2061
PISA –positive crises…
CLIMATE
LISBON STRATEGY

....... or via pro-active way!!!!!
Science, technology and education (Salmi 1993)
INFORMAL LEARNING

FORMAL EDUCATION

Family
Peer groups
Organisations

School system
pre-school
primary school
secondary
higher
university

Special Education
Vocational schools
Adult education

Museum
Library
Science centre
Mass media
www

LEARNING BY CHANCE
• Eight European science centres & other institutes developing interactive exhibitions towards Open Learning Environments
Experience & Education (Dewey 1938)

Learning by doing
pedagogical principle is often oversimplified

Not a question of isolated tricks,
but always part of a complete,
planned learning process.
Laboratory Case Studies at Heureka

* cognitive learning – some evidence

* motivation - strong

* making observations - developed
Consequences & recommendations

COGNITIVE LEARNING:
- aware of misconceptions
- age: concrete and abstract thinking level

MOTIVATION:
- introduce the scientific method via interesting laboratory work
Meaningful learning: components & further questions

1. Content should be meaningful for the learner
   * motivation

2. Learning should be arranged pedagogically in a meaningful way; according
   * the age of the learner
   * pre-knowledge and skills of the learner
   * logical structure of the topic to be taught
Sight-seeing as a scientific method…

“Sight-seeing" is a term normally used for watching something from outside.

Analysis: "sight-seeing" as a scientific method from Darwin to modern high-energy physics!

(Opppenheimer 1972)
Learning to observe – it is possible

Curiosity and perception may be more inherent in some persons than others, but they can be encouraged and developed.

However, making observations demands careful work in laboratory
Teaching to make observations is possible

Training to make and record observations includes as well unexpected as expected results.

No “correct” or “incorrect” answers.
Learning to discover – not a myth

Discovery consists of seeing what everybody has seen and thinking what nobody has thought.

Albert Szent-Gyorgyi (1937)

In the fields of observation, chance favours only the prepared mind.

Louis Pasteur (1880)
School success: pre-knowledge

- The pupils who were above the average with their school grades, performed better in the pre-knowledge test. The difference was statistically significant to the average and below-average pupils.
- The teachers’ grades correlated very strongly with the results.
TEST GROUP WITH AR

School success: post-knowledge

- The pupils who were above average did perform clearly best also in the post-knowledge test.
- However, the pupils with less-than-average school grades were clearly catching up with the others.
CONTROL GROUP WITOUT AR

School success: post-knowledge

- In the control group the pupils with less-than-average school grades were NOT *catching up* with the others

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Motivation types: situation

• Situation motivation: motivation grows from a new situation. Temporary, external factors are important. Social relations are often an affecting factor. Entertainment.
• Typical features:
  • * short-lasting
  • * learning is easily disturbed
  • * learning is orientated to irrelevant subjects
Motivation types: instrumental

• Instrumental motivation: the basis is to get a reward and/or to avoid punishment. The main stimulus is ‘to get things done’ rather than being interested in the deeper meaning of the subject.
• Typical features:
  • the goal is often to pass an examination
  • the learning of isolated facts, but not common principles
  • connections or the theoretical background are less important for the learner
  • facts are very quickly forgotten after an examination
Motivation types: intrinsic

• Intrinsic motivation: The basis of this motivation is a real interest in the topic studied. No other person persuades. Curiosity, exploring and problem solving are key elements of this motivation.

• Typical features:
• * a critical and open-minded attitude to learning
• * seeing the connection between isolated facts and the topic area as a whole
• * connection between theory and practice
Group task: WorkPackages

• Pointing out the strategic points of hands-on science teaching for curriculum analysis!
• What are the key elements of learning to make observations in each WorkPackage?
• How to teach to learn to make observations?
References:

