Final COLDEX Evaluation

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Outline

- COLDEX educational objectives
- Actions taken after the reviewers' comments
- Evaluation objectives and scope
- Instruments and Methodology
- Results, ongoing activities
- Potential reuse
- Conclusions

COLDEX: Educational Objectives

- Learner centred approach to design and evaluation of the technology and scenarios
- Active Science Discovery in Mixed Groups
- Stimulate creativity
- Enable cultural diversity
- New methodologies for creating, processing and exploiting digital content

Reviewers' Recommendations

- Selecting appropriate data collection instruments
- Identifying sites for evaluation activities
- Reinforcing European "Open User Scheme" activities

Revised Evaluation Plan

- Suggestion to apply an evaluation plan across COLDEX scenarios
- Additional evaluation related to local scenarios
- Focus on students' perceptions
- COLDEX requirements as objectives that guide operationalizing the evaluation

Evaluation Objectives

- Fostering scientific experimentation through innovative technology

- COLDEX learning requirements (D 2.2.1): Authenticity, construction, collaboration, reflection, multi-modal interaction

Scope of Evaluation

Scenario	**Modul**
Astronomy	- Crater - Moon - Water Rocket - Telescope
Biodiversity	- BeLife - FoodinSpace Workshop - School Project
Maze	- Maze
Stochastics	- Stochastics

Evaluation Variables	Evaluation Instruments
Knowledge	→ Questionnaire
Attitudes and Motivation	→ Intrinsic Motivation Questionnaire
	→ Science Attitudes Questionnaire
	→ Computer Attitude Questionnaire
Usability	→ System Usability Questionnaire
	→ One- to- One Observation
Coldex Requirements	→ Teacher Checklist
Collaboration	→ Observation Rubric
Other	→ Content Analysis, Ethnography, Interviews

Evaluation Variables and Instruments

Knowledge

Attitudes and Motivation

Usability

Coldex Requirements

Collaboration

Other

- *Name:* Knowledge Tests
- *Sources:* TIMMS, COLDEX
- *Structure:*

Competency Levels	Competency Types
Factual knowledge	Scientific Competence
Applied knowledge	Conceptual Competence

- *Examples:*

  Maze

  Biodiversity

  Stochastics

  Moon

Evaluation Variables and Instruments

Knowledge

Attitudes and Motivation

Usability

Coldex Requirements

Collaboration

Other

- *Names:*
  Test of Science-Related Attitude (TOSRA)
  Computer Attitude Questionnaire (CAQ)
  Intrinsic Motivation Questionnaire (IMI)

- *Sources:*
  Fraser, B. L. (1978)
  Deci, E. L., Koestner, R., & Ryan, R. M. (1999)
  Knezek, G., & Christensen , R. (2000)
- *Target:* Student
- *Selected Scales:* Enjoyment, Scientific Inquiry, Anxiety, Effort, Importance
- *Example*

Translation of Questionnaires

Knowledge

Attitudes and Motivation

Usability

Coldex

Requirements

Collaboration

Other

- *Questionnaires:* IMI, TOSRA, CAQ
- *Language:* English - German
- *Procedure:*

- 2 independent translations
- Discussion between the 2 translators and 1 reviewer
- Back translation by 2 different translators
- Revision
- Face validity testing
- Revision

Evaluation Variables and Instruments

Knowledge

Attitudes and Motivation

Usability

Coldex Requirements

Collaboration

Other

- *Names:* SUS, One to One usability etc
- *Source:* Brooke, J. (1996). SUS: A Quick and Dirty Usability Scale. In: P.W. Jordan, B. Thomas, B.A. Weerdmeester & I.L. McClelland (Eds.), Usability Evaluation in Industry. London: Taylor & Francis.
- *Target:* Student / Evaluators
- *Example:* "I think that I would like to use this system frequently"

Evaluation Variables and Instruments

Knowledge

Attitudes and Motivation

Usability

Coldex Requirements

Collaboration

Other

- *Names:* COLDEX Activity Questionnaire, COLDEX Environment Questionnaire
- *Source: COLDEX*
- *Target: Teacher*
- *Foci: COLDEX activity requirements (D2.2.1) , DExT*
- *Example: Activity Questionnaire, Environment Questionnaire*

Evaluation Variables and Instruments

Knowledge

Attitudes and Motivation

Usability

Coldex Requirements

Collaboration

Other

- *Name:* COLDEX Collaboration Rubric
- *Source:* COLDEX
- *Target:* Evaluators / Student Activity
- *Foci:* Types of Collaboration, Types of Argumentation, Types of Information, Type of Communicated Content, Type of Instructional Approach
- *Example:* Collaboration Rubric

Evaluation Variables and Instruments

Knowledge

Attitudes and Motivation

Usability

Coldex Requirements

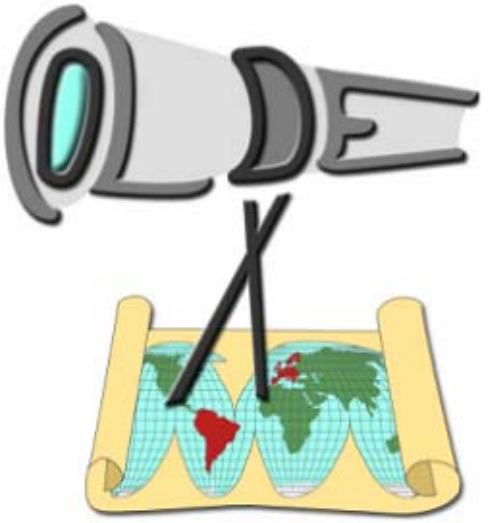
Collaboration

Other

- *Names:* Content Analysis, Ethnograpy, Open Questionnaires
- *Source:* Mayring (2000), Schuler et al. (1993), COLDEX
- *Targets:* Student Activity, COLDEX DExT
- *Foci:* Student explanations, Learning Setting, Documents
- *Example:* DExT Questionnaire

COLDEX in Action:

A Field study at Arabyskolan, Sweden



April 2005, Germany

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Outline

- Purpose of the study
- Method
- Implementation
- Preliminary Findings
- Summary

Purpose of this field study

- Implement the Challenge Based Learning (CBL) approach in a school
- Evaluate CBL and other COLDEX related work
- Disseminate the use
- Period of field study : September 2004 to May 2005

Methods

- To get an overall view of the use:
  - Qualitative methods for data collection

    (field study-visits and interviews. Including observation, video recording, photo, artifacts, informal interviews and discussions)

Methods

- In order to describe the school situation and the work done we use an ethnographical approach to analyse the collected material.
  - Activity Theory is used to structure the context and the description
    - helps to clarify and be aware of the context, roles of people, dependencies and tools.

Methods

Creating the OUS environment:

- Presentations for teachers in the region
- Workshops for teachers
- The school with specially interested teachers was selected

Implementation: The educational context

- Arabyskolan
- Students range: 13 – 16 years old
- 400 students and 35 teachers
- High presence of immigrant students (about 40%)

Implementation: about the teachers

5 teachers involved

They teach in:

- Math
- Natural Science
- Technology
- Arts

- *Elective topics and orientations:*
  - Science
  - Sports
  - Communication
  - Practical - Aesthetic

Implementation: about the students

The students:

159 students

Grade 7th

6 working groups (class)

Implementation: The content

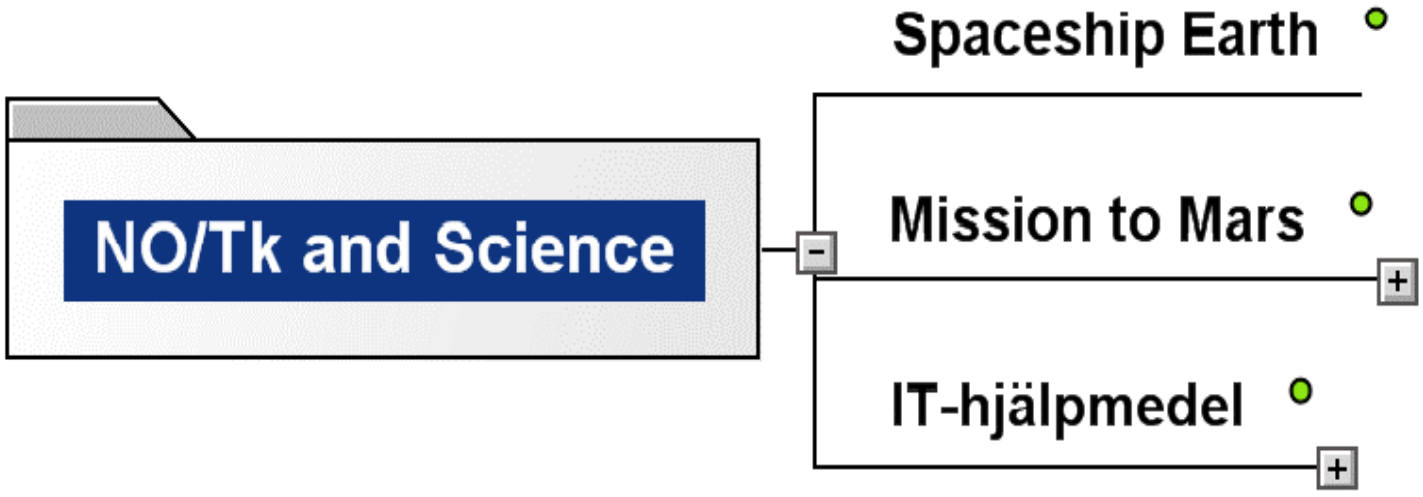
The Spaceship Earth project has the following goals:

- The structure, anatomy and function of plants
- Experiences through field studies
- The sun and the solar system
- Atoms and molecules

Implementation

- Circulation of Compounds, for example the water cycle
- Study Visits, for example Xperiment Huset and the greenhouse at Växjö municipality

Implementation: The structure



Implementation

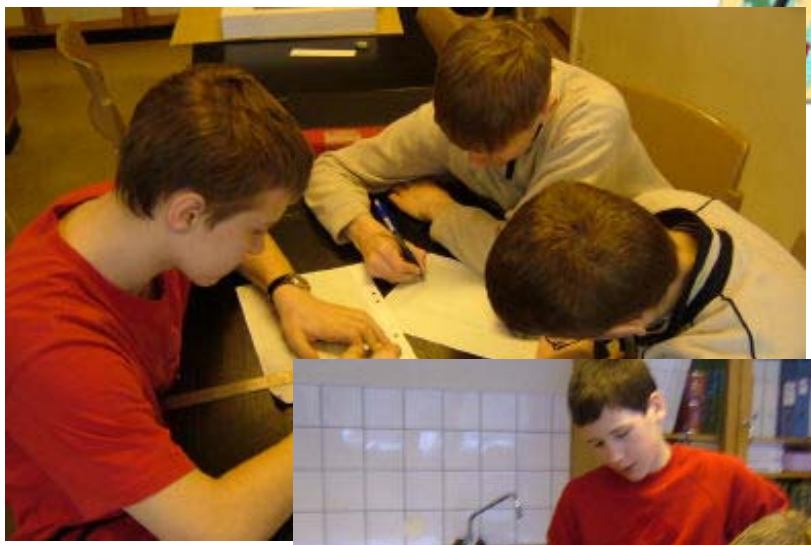
Mission to Mars

- 18 Students who selected the science track
- The challenge:
  Plan a trip to Mars
- Three subgroups working with 3 diffrent problems

Implementation

Each group should explore:

Building a model of a space ship and a space station:



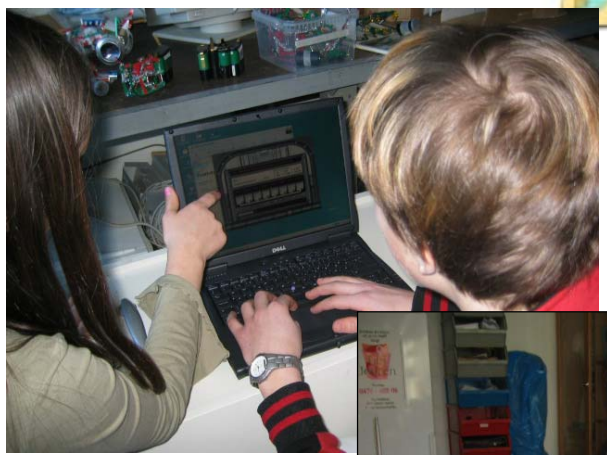
- Discussions
- Drawings (Pen/Paper)
- Model in scale (Paper)
- Construction (Low cost material)
- Documentation (Computer based)
- Evaluation

Implementation

Each group should explore:

Food supply

- Simulation (BioBlast)
- Planting (At school, In Biotube)
- Building Model (for watering)
- Visit the Greenhouse of the municipality
- Documentation (ex, Web site)
- Evaluation

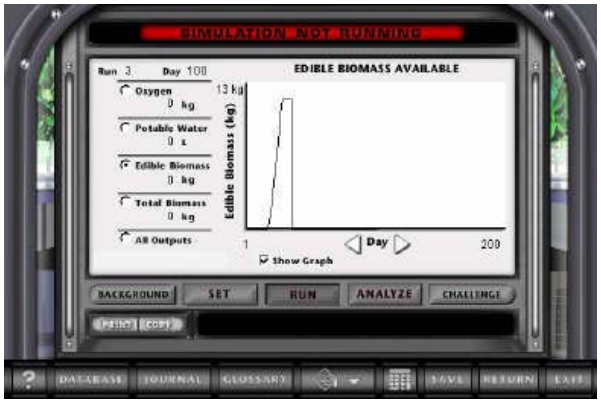


Implementation

Implementation: IT Tools

COLDEX related:

- BioBlast
- Robolab
- COOLModes



Generic tools:

- OpenMind
- Web site – Nasa
- Digital Camera

Preliminary Findings

- The idea of conducting scientific experiments and explore science not only in the school settings
- The importance of an attractive environment to support science learning and to promote motivation towards science
- Promoting the social/role exchange in the transition between formal and informal learning settings
- The transition and combination between the real and the virtual in order to have new insights into scientific inquiry and modeling
- Putting the tools in a real setting gave us insights regarding the refinement (interaction and functionality) of these IT tools.

Preliminary Findings

- Teachers point of view
  - CBL
    - "The way to work [explorative and examining] is not new for us…New… was the visit to the Xperiment Huset"
    - "Students learn to get information and work with IT tools"
    - "They are creative and in a way independent and have to make own decisions and at the same time they have to compromise."

Preliminary Findings

- The BioTube
  - "It would be interesting to be able to change certain parameters by the web too, for example time for light, which temperature and what nutrients to use"
  - "next time perhaps we can use the concept on something far away and then the students is used to the way to work."
- InquiryTool
  - "It is a good idea to use when you work with PBL (Problem Based Learning) or Challenge Based Learning."
  - "…we did not find it easy enough to use."
- CoolModes
  - "They found it very easy to use and were able to see its advantages, for example they saw soon the possibility to use the same calculation tree for more than one calculation"

Preliminary Findings

- LOR
  - "It is important in many ways for students and teachers to exchange ideas and experiences in a common portal."
  - "You can discuss problems, share experiences and get feedback from those who work with the same topics."
  - "Students get more motivated when they can publish their documents."
  - "They improve their knowledge in English"
  - "Both teachers and students can be inspired by ideas on how to improve teaching and learning when they can have a realistic look to scientific work in other countries and parts of the world."
  - "I would like LOR to be easier to use"

Preliminary Findings

- Reflections
  - CBL
    - It worked out fine in this group of students
    - It is hard work to work collaborative
    - The laptops became a natural artifact in the class room
    - An open atmosphere in the teacher team, learning from each other
    - The collaboration with Xperiment Huset has after some hesitant attempts improved into an beneficial model for visits and exchange of interest
  - The Tools
    - Some redesign is necessary (in collaboration with the users) and also improvements can be done

On-going work

- Activities in collaboration with Xperiment Huset in the fields of astronomy and plant growing
- Exploring the LOR for storing and retrieving the different digital materials of the projects
- Experiencing and using CoolModes in the school

Future Activities

- Continue to work with this approach next year with 7th graders. Moreover, further development of new activities for 8th graders
- Explore collaboration with their colleagues in Social Science in order to apply the Challenge Based Learning method.
- Exploring collaboration with other COLDEX school partners, specially those that are Spanish speakers
- Further collaboration with Xperiment Huset

Promising results

Dissemination:

- The school won a prize (20.000 Euros) from technology companies in the East Sweden region for best technology education in compulsory schools. The collaboration with COLDEX was one important factor for this selection.

- The teachers from an upper secondary school in technology came for an educational visit, they had heard about the work at Araby school

Summary

The purpose with this field study was…

- Implement the Challenge Based Learning concept in a school
- Evaluate the concept and other COLDEX related work
- Disseminate its use
- We are still in the process of analyzing the data we have collected

Overview Evaluation of Scenarios

	Knowledge	Attitudes and Motivation	COLDEX Requirements	Collaboration	Usability	Other
Astronomy	✓	✓	✓	✓	✓	✓
Biodiversity	✓	✓	✓		✓	✓
Maze	✓	✓		✓	✓	
Stochastics	✓	✓	✓	✓		✓

Sample Size and Questionnaires per Scenario

Knowledge

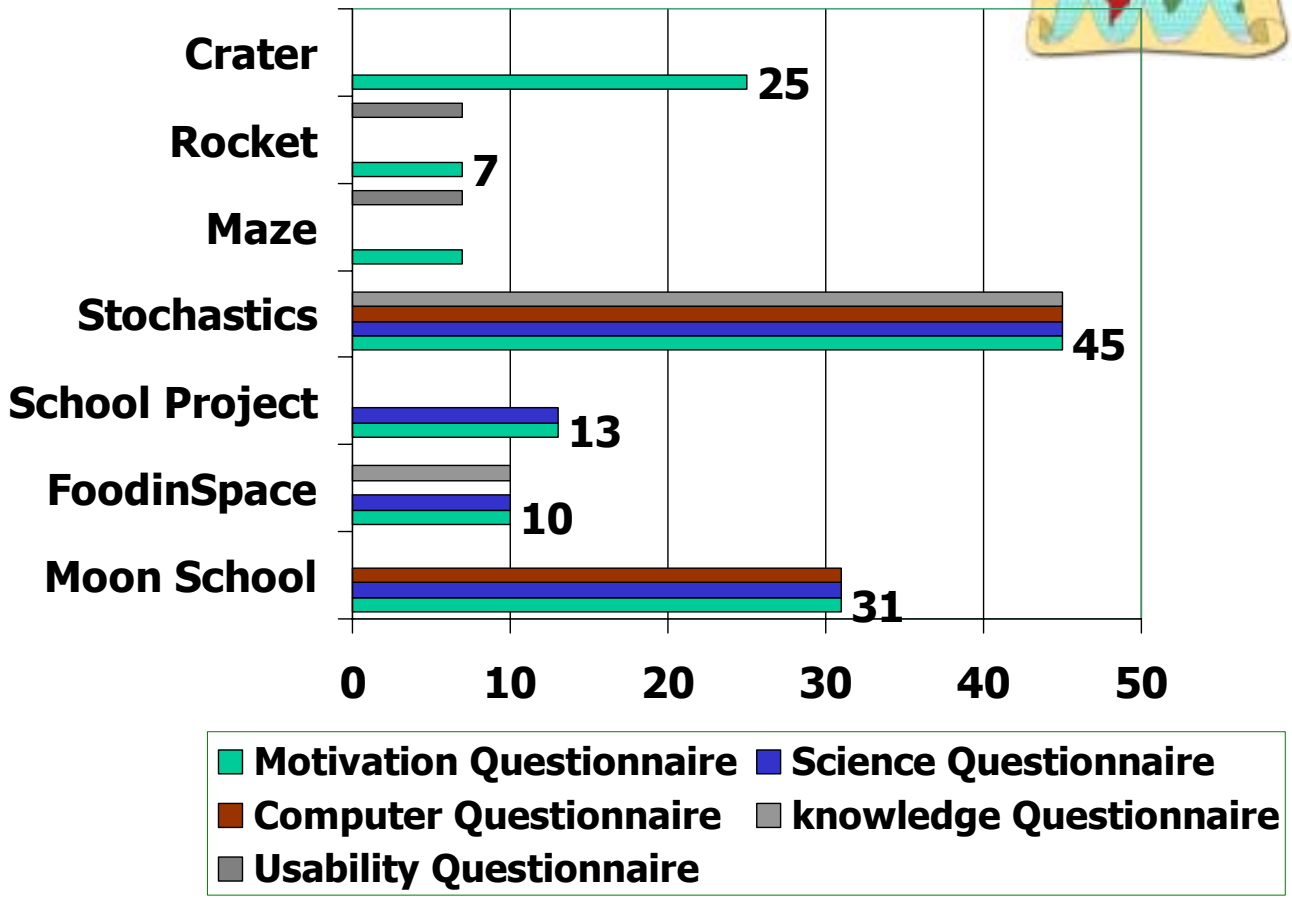
Attitudes and Motivation

Usability

Coldex Requirements

Collaboration

Other



Context variables

Knowledge

Attitudes and Motivation

Usability

Coldex

Requirements

Collaboration

Other

- Scenario/Module
- Grade /Age
- Gender
- School

Results: Gender Differences

Knowledge

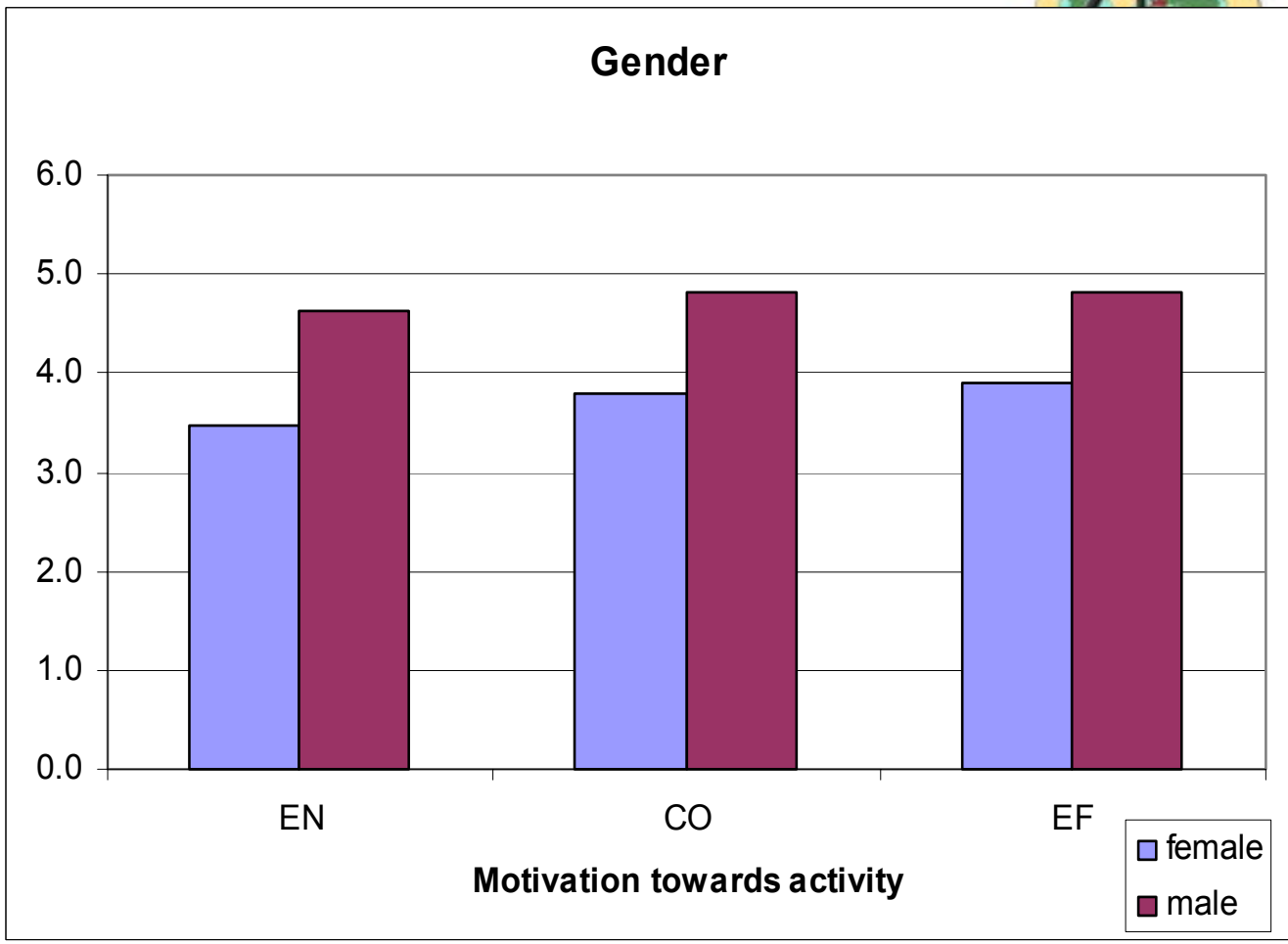
Attitudes and Motivation

Usability

Coldex Requirements

Collaboration

Other



Results of Attitudes and Motivation Questionnaires

Knowledge

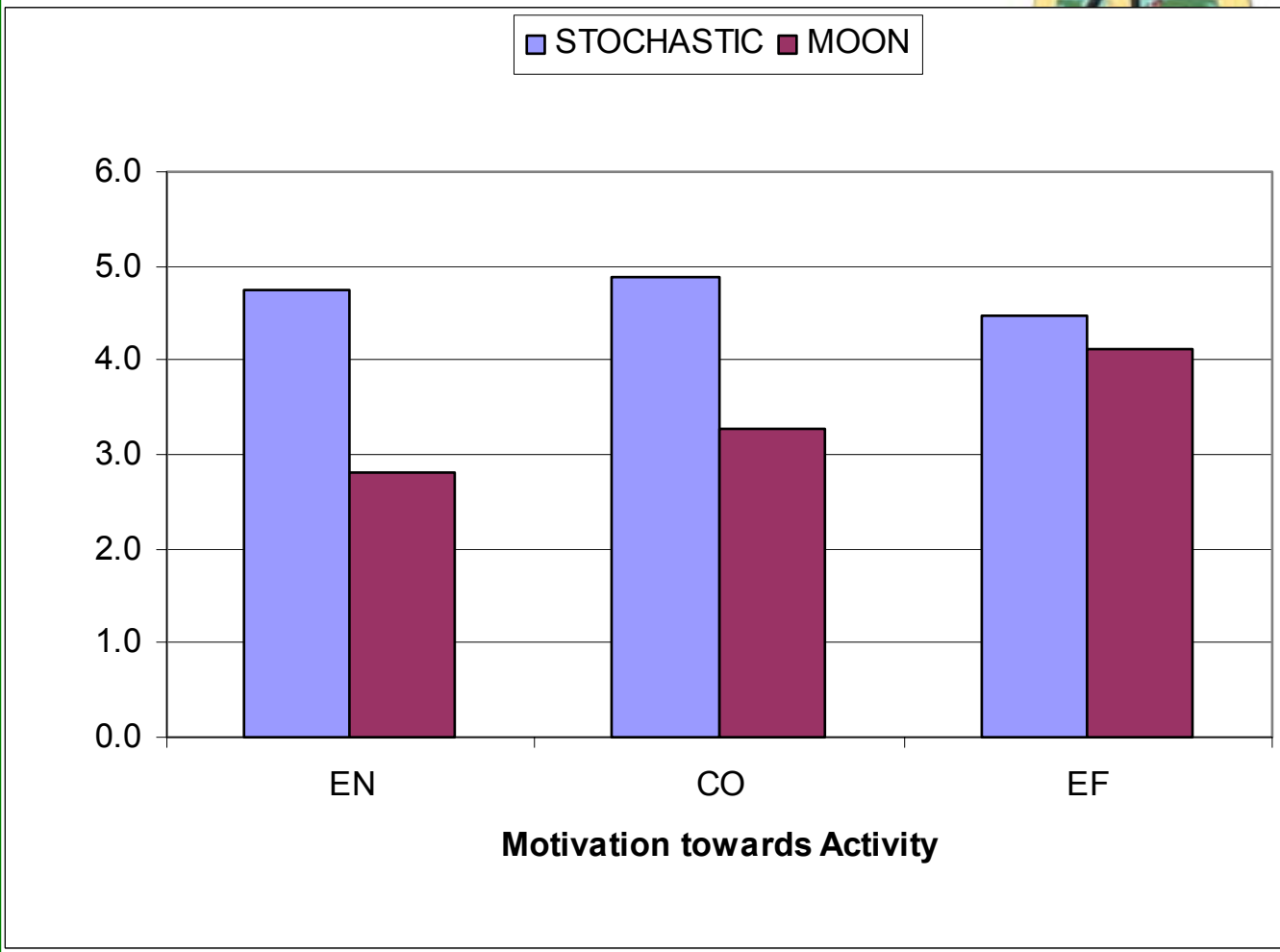
Attitudes and Motivation

Usability

Coldex Requirements

Collaboration

Other



Results of Observational Data

Knowledge

Attitudes and Motivation

Usability

Coldex

Requirements

Collaboration

Other

Focus on 3 Sessions:

1. Beginning Cool Modes Session
2. LOR Session
3. Final Cool Modes Session

Observation
1. Beginning Cool Modes Session

Knowledge

Attitudes and Motivation

Usability

Coldex

Requirements

Collaboration

Other

- Much collaboration within small groups
- Little collaboration among groups
- Much expert request
- Much tool-related discussion
- Little task-related discussion

Observation
2. LOR Cool Modes Session

Knowledge

Attitudes and Motivation

Usability

Coldex Requirements

Collaboration

Other

- Some collaboration within small groups
- No collaboration among groups
- Much expert information request
- Some tool-related discussion

Observation
3. Final Cool Modes Session

Knowledge

Attitudes and Motivation

Usability

Coldex

Requirements

Collaboration

Other

- Much collaboration within small groups
- Some/much collaboration among groups
- Much sharing of ideas
- Much expert information request
- Some tool-related discussion
- Some/much task-related discussion

Potential Re-use of Instruments

- Reliability of translated instruments
  - Correlation of Motivation and Science scales highly significant
  - Good alpha values for science and motivation but not for computer
- Collaboration Rubric for Observation
- Knowledge tests re-usable in school activities

Outlook

- Further analysis of questionnaire data and backup with observational data, LOR student artefacts
- Correlation between Knowledge tests and attitude questionnaires
- Analysis of Teacher Perceptions

Maze Knowledge Item

What categories of mazes are possible:

a) Detour maze
b) Mazes with islands
c) Multiple exits
d) Inner exit(s)

Biodiversity Knowledge Item

What is the name of the plant part where carbon dioxide and oxygen can move in and out of the plant?

a) Granum

b) Thylakoid

c) Stoma

d) Chlorophyll

Stochastics Knowledge Item

A coin was thrown 60 times.

27 times „Averse“ occured.
The relative frequency is

a) 27

b) 27%

c) 27/60

d) 50%

COLDEX Activity Items

Authentic Activities	What kind of scientific activities are possible in the overall learning activity? *Examples:* hypotheses, do experiments, formulating a scientific problem, defining rules, taking measurements
Construction of artifacts	Did students produce objects (e.g. Documents, visual representations, data…)? Have these objects been re-used?

COLDEX Environment Items

Sharing and exchange of Information	Did your environment allow uploading or sharing information, objects, and results using the COLDEX platform?
Use of COLDEX tools and learning material	Did your learning environment support using help files, different COLDEX software in the COLDEX platform or other instructional material?

Criteria	A	B
1) Types of Collaboration	No **one-to-one** peer collaboration	Little **one-to-one** peer collaboration
2)	Collaboration **within** one group	Little collaboration **within** one group
3)	No collaboration **among** groups	Little collaboration **among** groups
4) Types of argumentation	**Requests** no information from other groups or only when prompted	**Requests** little information from other groups
5)	Does not **share** any ideas or information to teammates or only when prompted	**Shares** very few ideas or little information
6)	Uses no **tools** to explain arguments or only when prompted	Uses little or few **tools** to explain arguments
7) Types of information	Uses no databases (**external** information)	Uses rarely databases (**external** information)
8)	Requests **expert** information	Requests rarely **expert** information
9) Type of communicated content	Communicates no **task related** information	Communicates little **task related** information
10) (R)	Communicates no **tool**	Communicates **little tool**

Example Scientific Inquiry Survey

- Was the process of experimentation that you experienced in the workshop different compared to the process that you are used to in school ? How was it different?
- "Did explaining/justifying your guesses help you to think about the conditions that could affect your investigation?"

Science Attitude Questionnaire

- ” Science is one of the most interesting school subjects. “
- “I would prefer to do my own experiments than to find out information from a teacher. ”
- “I would rather find out about things by asking an expert than by doing an experiment. “

Computer Attitude Questionnaire

- ” I am tired of using a computer. “
- “I will be able to get a good job if I learn how to use a computer.”
- “I enjoy computer games very much. “

Motivation Questionnaire

- ” I am satisfied with my performance at this task.”
- “I didn’t put much energy into this.”
- “I didn’t try very hard to do well at this activity. “

DExT Questionnaire

- "Did the structure of the DExT provide sufficient guideline for you to enable you to carry out these activities in your classroom with your students? "

  yes No