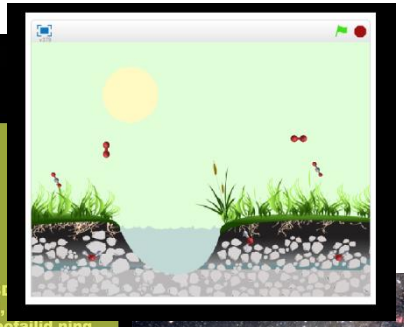
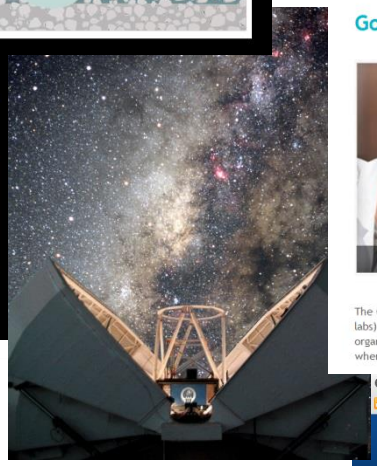
Research conducted by UT Educational Technology Research Group

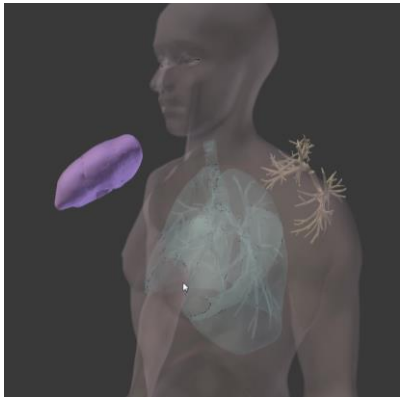
Margus Pedaste
University of Tartu
Faculty of Social Sciences and Education
Institute of Education
Centre for Educational Technology

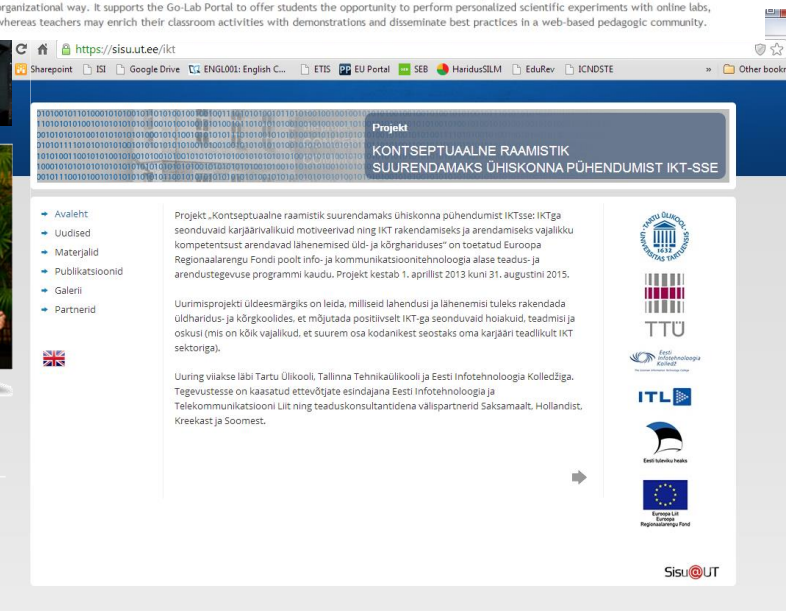
Our goals

- pre-service and in-service courses for teachers, school-leaders, university lecturers
- development of materials and methods to improve digital and technological literacy (incl. 3D, Scratch, inquiry learning)
- research on digital and technological literacy, inquiry skills and reflection (variety of learners, importance of teachers and methods, characteristics of learning materials)









Quantum Spinoff

Welcome at the official website of the European Quantum Spinoff project.
The Quantum Spinoff project will bring science teachers and their pupils in direct contact with research and entrepreneurship in the high-tech nano sector, with the goal of educating a new generation of scientifically literate European citizens and inspiring young people to choose for science and technology careers. Teams of pupils, guided by their science teachers, will be challenged to create a responsible and socially relevant valorisation of a scientific paper in

User Login

Username *

Password *

Plan

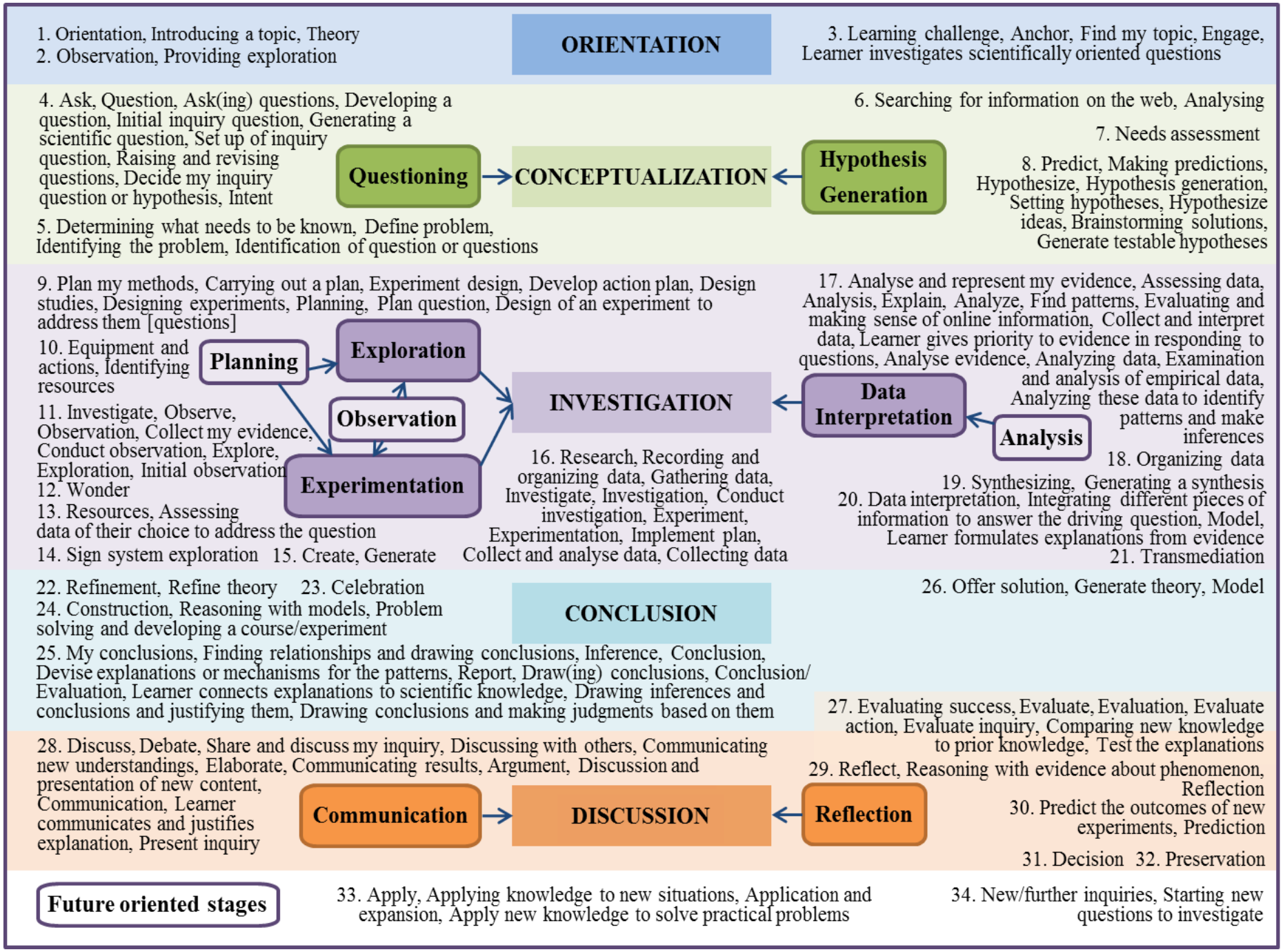
- pedagogical approach
  - inquiry learning
  - technology education and educational technology
- R&D
  - Go-Lab
  - ICT career choices
  - Biodigi
  - Quantum Spin-Off
  - Ark of Inquiry
  - Centre for Learning Innovation

Inquiry learning

- defined in general as ‘an approach to learning that involves a process of exploring the natural or material world, and that leads to asking questions, making discoveries, and rigorously testing those discoveries in the search for new understanding’ (de Jong 2006) and more specifically
- as a process of discovering new relations, with an approach where the learner formulates hypotheses and then tests them by conducting experiments and/or making observations (see Pedaste, Mäeots, Leijen, Sarapuu 2012).

Analysis

- 32 articles
- 109 different terms for inquiry phases
- 34 processes were sequenced and re-organized into 11 prospective phases
- these 11 were finally merged into five general inquiry phases along with a few sub-phases


1. Orientation, Introducing a topic, Theory
2. Observation, Providing exploration
ORIENTATION
3. Learning challenge, Anchor, Find my topic, Engage, Learner investigates scientifically oriented questions
4. Ask, Question, Ask(ing) questions, Developing a question, Initial inquiry question, Generating a scientific question, Set up of inquiry question, Raising and revising questions, Decide my inquiry question or hypothesis, Intent
Questioning
5. Determining what needs to be known, Define problem, Identifying the problem, Identification of question or questions
CONCEPTUALIZATION
6. Searching for information on the web, Analysing
7. Needs assessment
Hypothesis Generation
8. Predict, Making predictions, Hypothesize, Hypothesis generation, Setting hypotheses, Hypothesize ideas, Brainstorming solutions, Generate testable hypotheses
9. Plan my methods, Carrying out a plan, Experiment design, Develop action plan, Design studies, Designing experiments, Planning, Plan question, Design of an experiment to address them [questions]
Planning
10. Equipment and actions, Identifying resources
Exploration
11. Investigate, Observe, Observation, Collect my evidence, Conduct observation, Explore, Exploration, Initial observation
Observation
12. Wonder
13. Resources, Assessing data of their choice to address the question
Experimentation
14. Sign system exploration
15. Create, Generate
INVESTIGATION
16. Research, Recording and organizing data, Gathering data, Investigate, Investigation, Conduct investigation, Experiment, Experimentation, Implement plan, Collect and analyse data, Collecting data
17. Analyse and represent my evidence, Assessing data, Analysis, Explain, Analyze, Find patterns, Evaluating and making sense of online information, Collect and interpret data, Learner gives priority to evidence in responding to questions, Analyse evidence, Analyzing data, Examination and analysis of empirical data, Analyzing these data to identify patterns and make inferences
Data Interpretation
Analysis
18. Organizing data
19. Synthesizing, Generating a synthesis
20. Data interpretation, Integrating different pieces of information to answer the driving question, Model, Learner formulates explanations from evidence
21. Transmediation
22. Refinement, Refine theory
23. Celebration
24. Construction, Reasoning with models, Problem solving and developing a course/experiment
CONCLUSION
25. My conclusions, Finding relationships and drawing conclusions, Inference, Conclusion, Devise explanations or mechanisms for the patterns, Report, Draw(ing) conclusions, Conclusion/ Evaluation, Learner connects explanations to scientific knowledge, Drawing inferences and conclusions and justifying them, Drawing conclusions and making judgments based on them
26. Offer solution, Generate theory, Model
27. Evaluating success, Evaluate, Evaluation, Evaluate action, Evaluate inquiry, Comparing new knowledge to prior knowledge, Test the explanations
28. Discuss, Debate, Share and discuss my inquiry, Discussing with others, Communicating new understandings, Elaborate, Communicating results, Argument, Discussion and presentation of new content, Communication, Learner communicates and justifies explanation, Present inquiry
Communication
DISCUSSION
Reflection
29. Reflect, Reasoning with evidence about phenomenon, Reflection
30. Predict the outcomes of new experiments, Prediction
31. Decision
32. Preservation
Future oriented stages
33. Apply, Applying knowledge to new situations, Application and expansion, Apply new knowledge to solve practical problems
34. New/further inquiries, Starting new questions to investigate

Orientation

- The process of stimulating curiosity about a topic and addressing a learning challenge through a problem statement.

Conceptualization

- The process of stating theory-based questions and/or hypotheses.
  - *Questioning*: The process of generating research questions based on the stated problem.
  - *Hypothesis Generation*: The process of generating hypotheses regarding the stated problem.

Investigation

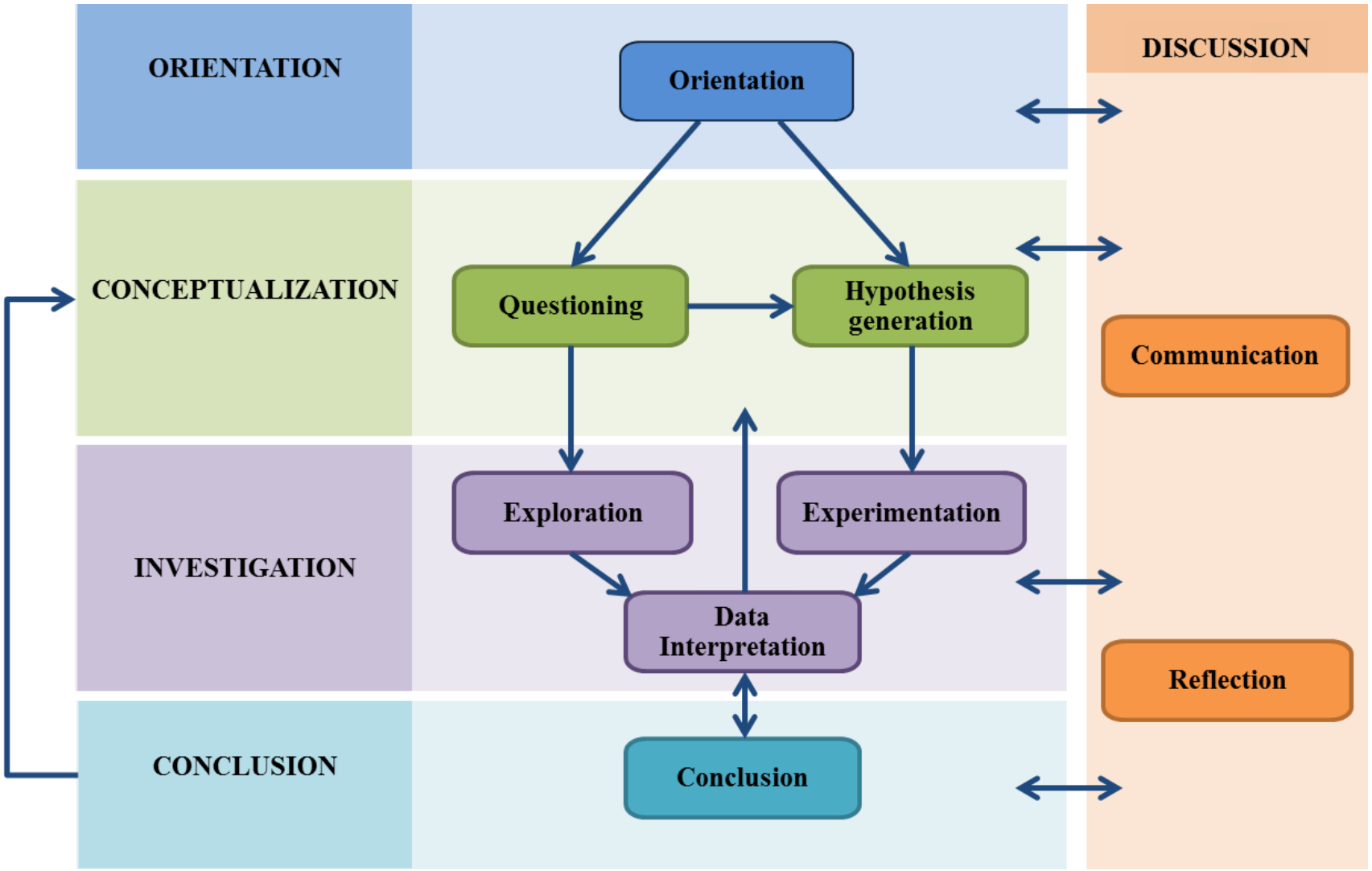
- The process of planning exploration or experimentation, collecting and analysing data based on the experimental design or exploration.
  - *Exploration*: The process of systematic and planned data generation on the basis of a research question.
  - *Experimentation*: The process of designing and conducting an experiment in order to test a hypothesis.
  - *Data Interpretation*: The process of making meaning out of collected data and synthesizing new knowledge.

Conclusion

- The process of drawing conclusions from the data. Comparing inferences made based on data with hypotheses or research questions.

Discussion

- The process of representing findings by communicating to others and controlling the whole learning process by engaging in reflective activities.
  - *Communication*: The process of presenting outcomes of an inquiry phase or of the whole inquiry cycle to others and collecting feedback from them.
  - *Reflection*: The process of describing, critiquing, evaluating and discussing the whole inquiry process or a specific phase.


ORIENTATION
CONCEPTUALIZATION
INVESTIGATION
CONCLUSION
Orientation
Questioning
Hypothesis generation
Exploration
Experimentation
Data Interpretation
Conclusion
DISCUSSION
Communication
Reflection

Technology education

- An approach to achieve technological literacy
- Technological literacy involves three types of abilities: i) to use technology, ii) to manage technology, and iii) to understand technology.
- In USA technological literacy is elaborated in the standards or curricula through three dimensions: i) ability/use, ii) knowledge and understanding, iii) awareness, or appreciation of, the relationships between technology, society and the environment.

Educational technology

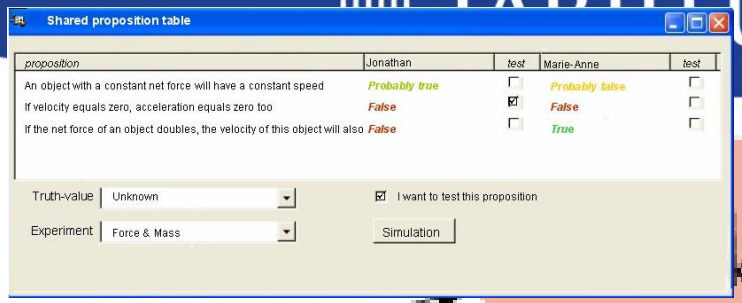
- facilitating e-learning, which is the learning and improving performance by **creating, using and managing** appropriate technological processes and resources
- trends: cloud based services, personal learning environments, collaborative work, pedagogical agents

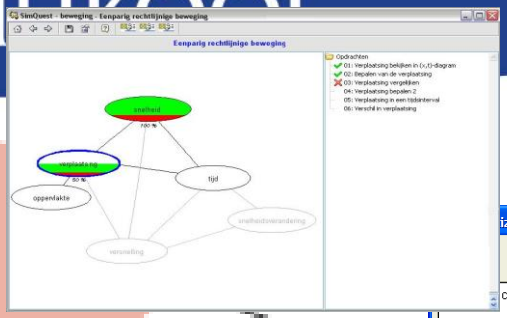
Go-Lab

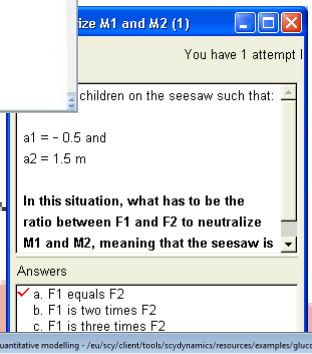
- EC 7th Framework ICT project
  - one of the biggest in education
- web-based learning environment
  - physics, biology, chemistry through remote labs, virtual labs and databases of these in using inquiry learning
  - teachers, lab owners, students (age 10-18)

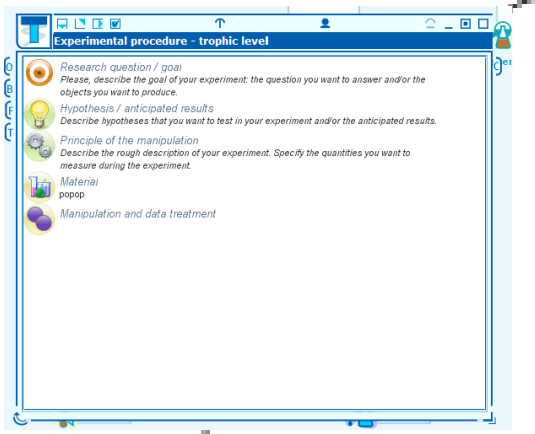
http://www.go-lab-project.eu/
http://www.golabz.eu/

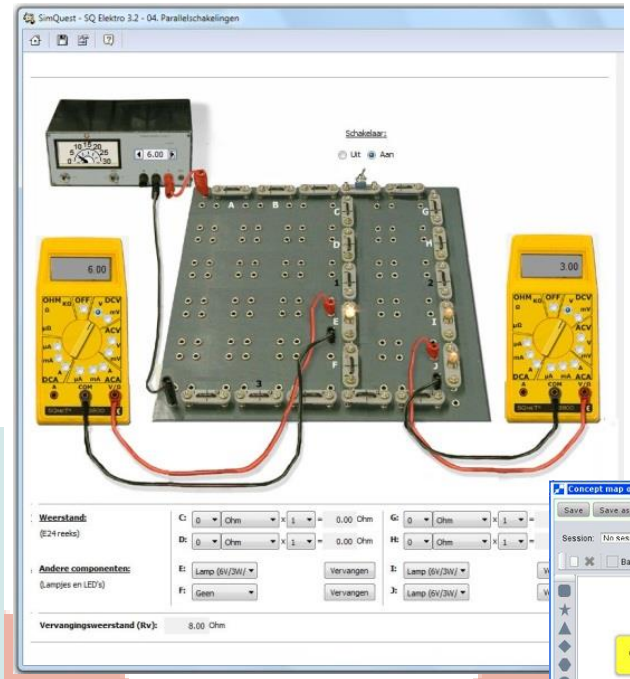
GO-LAB

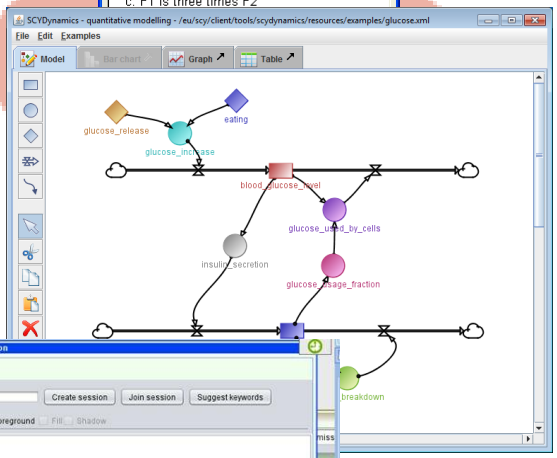

Shared proposition table
proposition
Jonathan
test
Marie-Anne
test
An object with a constant net force will have a constant speed
Probably true
Probably false
If velocity equals zero, acceleration equals zero too
False
False
If the net force of an object doubles, the velocity of this object will also
False
True
Truth-value
Unknown
I want to test this proposition
Experiment
Force & Mass
Simulation

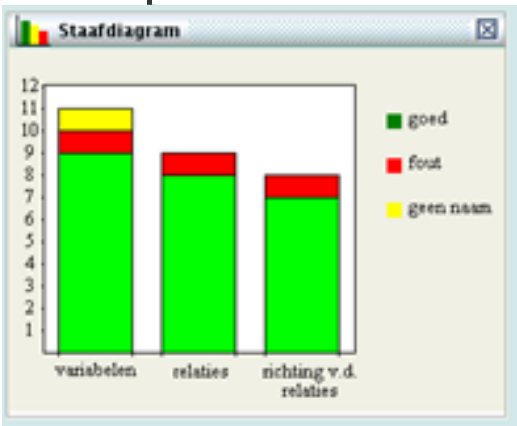

SimQuest - beweging - Eenparig rechtlijnige beweging
Eenparig rechtlijnige beweging
snelheid
verplaatsing
tijd
oppervlakte
snelheidsverandering
versnelling

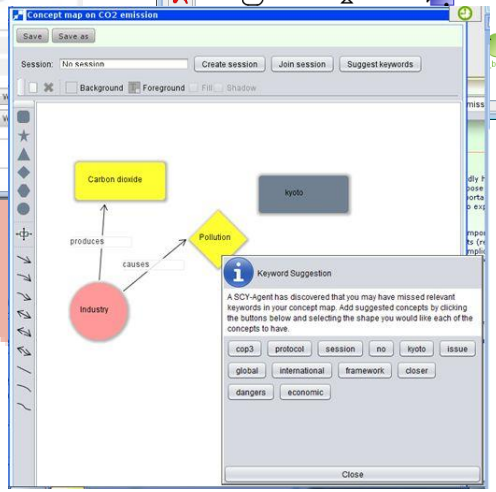

ize M1 and M2 (1)
You have 1 attempt l
children on the seesaw such that:
a1 = - 0.5 and
a2 = 1.5 m
In this situation, what has to be the ratio between F1 and F2 to neutralize M1 and M2, meaning that the seesaw is
Answers
a. F1 equals F2
b. F1 is two times F2
c. F1 is three times F2


Experimental procedure - trophic level
Research question / goal
Please, describe the goal of your experiment: the question you want to answer and/or the objects you want to produce.
Hypothesis / anticipated results
Describe hypotheses that you want to test in your experiment and/or the anticipated results.
Principle of the manipulation
Describe the rough description of your experiment. Specify the quantities you want to measure during the experiment.
Material
popop
Manipulation and data treatment


SimQuest - SQ Elektro 3.2 - 04. Parallelschakelingen
Schakelaar:
Uit
Aan
6.00
3.00
Weerstand:
Andere componenten:
Vervangingsweerstand (Rv):
8.00 Ohm


SCYDynamics - quantitative modelling - /eu/scy/client/tools/scydynamics/resources/examples/glucose.xml
File Edit Examples
Model
Graph
Table
glucose_release
eating
glucose_intake
blood_glucose_level
glucose_used_by_cells
insulin_secretion
glucose_storage_fraction
breakdown


Staafdiagram
goed
fout
geen naam
variabelen
relaties
richting v.d. relaties


Concept map on CO2 emission
Save
Save as
Session:
Create session
Join session
Suggest keywords
Carbon dioxide
kyoto
Pollution
produces
causes
Industry
Keyword Suggestion
A SCY-Agent has discovered that you may have missed relevant keywords in your concept map. Add suggested concepts by clicking the buttons below and selecting the shape you would like each of the concepts to have.
cop3
protocol
session
no
kyoto
issue
global
international
framework
closer
dangers
economic
Close

Examples of Go-Lab Inquiry Learning Spaces

- Radioactivity – virtual lab
  - Radiation and Cancer: Cure or Cause?
- Buoyancy – remote lab
  - Buoyancy
- Hypathia – database
  - Conservation of Momentum in particle collisions

ICT career choices

http://ikt.ut.ee/

- to **find interventions that should be applied** in general schools and higher education institutions to affect positively students' ICT-related attitudes, knowledge, and skills (that are all needed to increase the number of citizens who relate their professional career with ICT sector);
- therefore, this study focuses on **analysing how effective have been the interventions applied** in the recent 10 years in Estonian schools and are currently applied in the higher education institutions where students study ICT.

Some results

- What are the reasons why students want to study ICT?
- What are the reasons why ICT students start working while studying?

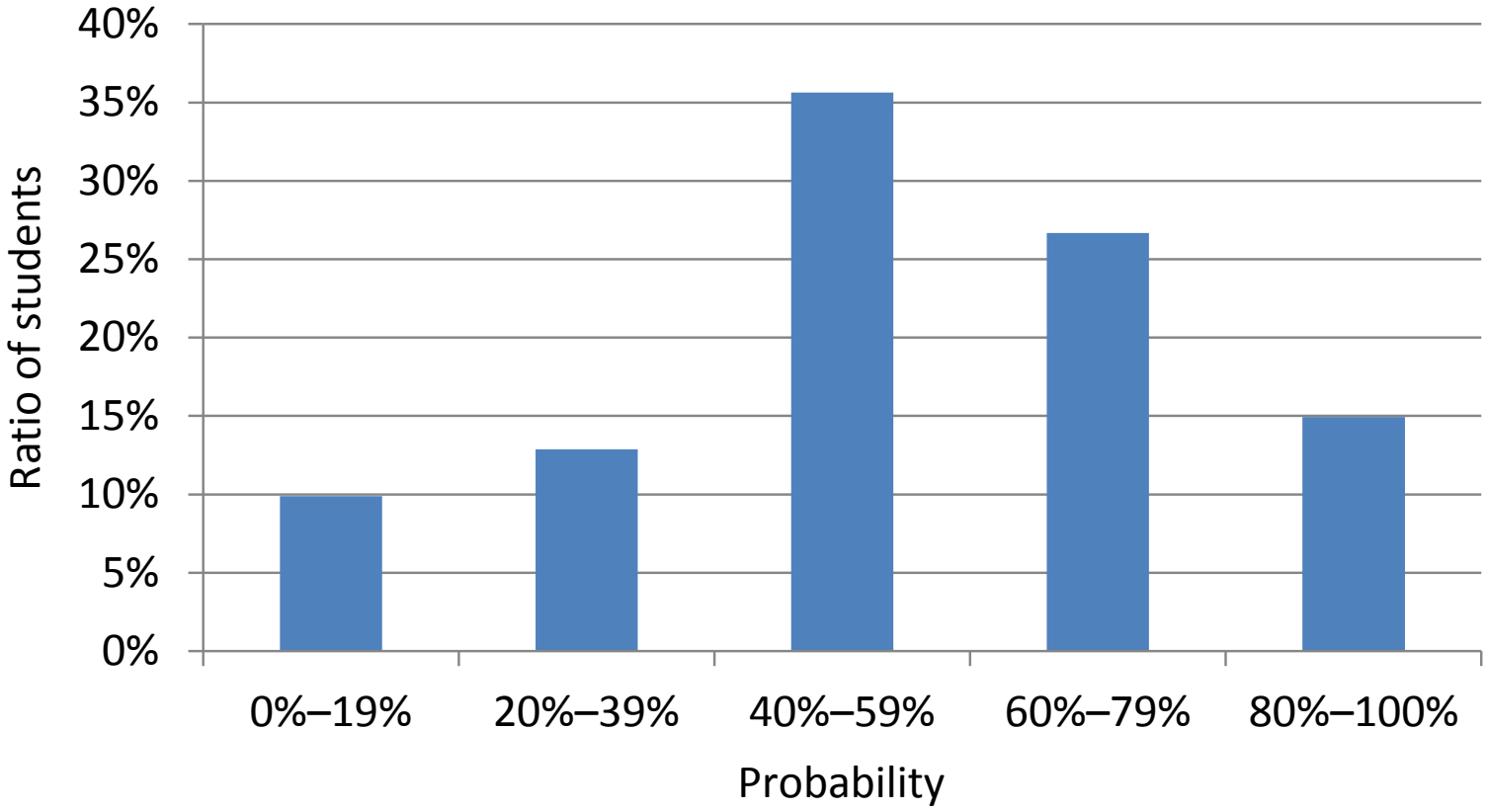
Methods

- September 2013
- 517 first year ICT students
- From 8 different curricula and 3 universities in Estonia where ICT is taught
- Questionnaire which contained multiple choice and open ended questions
- ICT students perception

The ‘breaking point’ that caused interest in ICT

Category	Percentage
First computer, experience of doing something	36%
Computer lessons	9%
Someone recommended, role model	9%
Everyday contact with ICT	7%
Computer games	6%
ICT field is important	5%
Interest came with time	5%
Interest in mathematics	4%
I like ICT	3%
Salary	2%
Other	14%

Probability of starting working during studies



Reasons to start working during studies

Reasons	Percentage
Financial situation	42%
Work experience	28%
Suitable job	12%
Having enough time	9%
Other	6%
Will not start work	3%

Biodigi

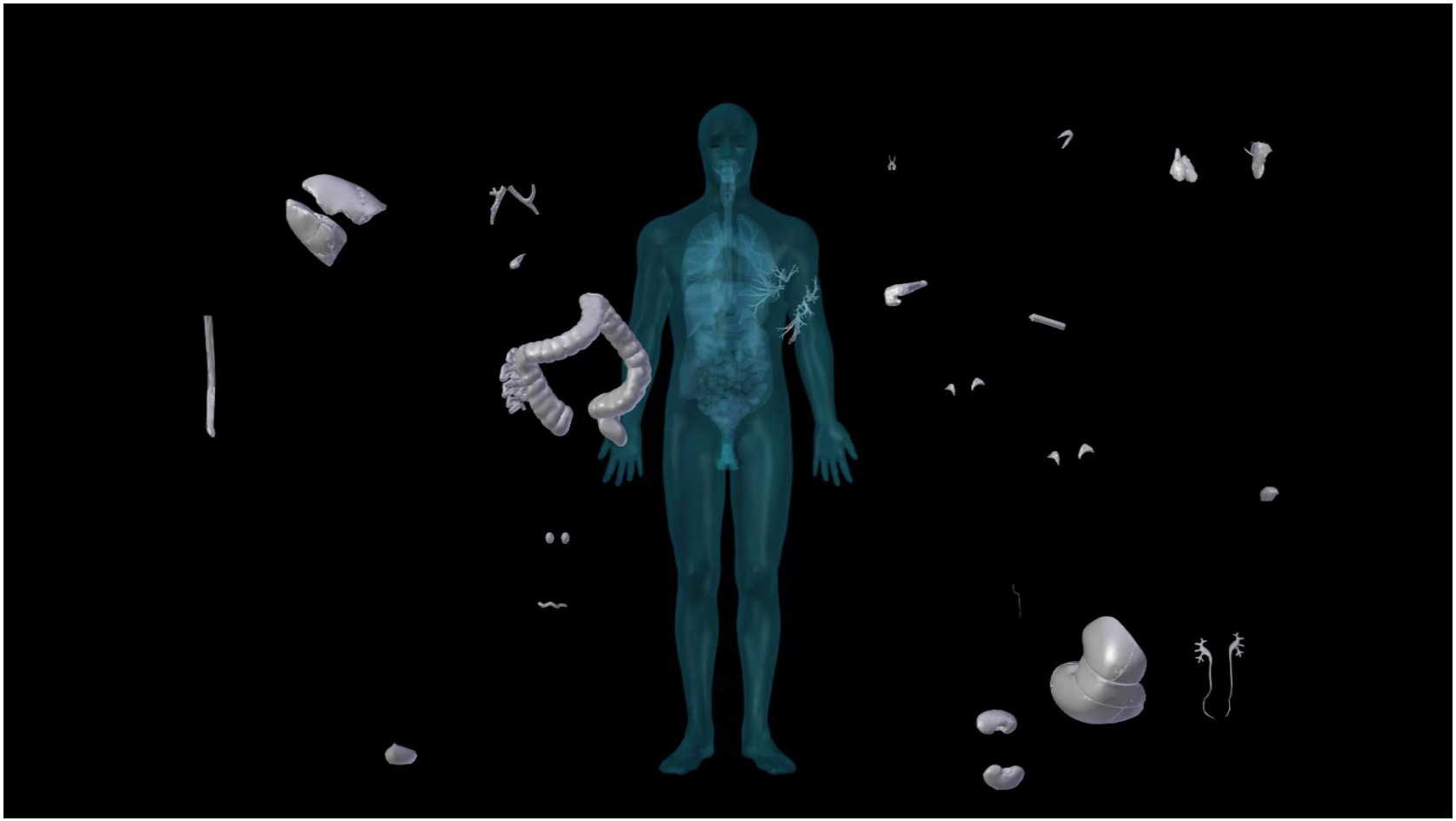
TeaMe

Euroopa Liit
Euroopa Sotsiaalfond

Eesti tuleviku heaks

- digital learning materials for biology course in gymnasium (2nd course)
  - energetics, development, human regulation
- focus on core knowledge and skills
- Scratch models, 3-D models, learning videos, audio materials, presentations

- Next week: Tallinn week of the University of Tartu Leo Siiman: 3D technology in school context: http://www.ut.ee/et/taiendusope/opetajate-paev



Quantum Spin-Off

- will bring science teachers and their pupils in direct contact with research and entrepreneurship in the high-tech nano sector,
- inspiring young people to choose for science and technology careers
- teams of pupils, guided by their science teachers, will be challenged to create a responsible and socially relevant valorisation of a scientific paper in collaboration with researchers and entrepreneurs.

http://www.quantumspinoff.eu/

Ark of Inquiry

http://ark.ut.ee

- EC 7th Framework project, 13 partners
- To raise youth awareness to Responsible Research and Innovation (RRI) by
  - providing young European citizens (7 to 18-year-olds) with a pool of engaging inquiry activities to improve
  - their inquiry skills, increase their awareness and understanding of conducting ‘real’ science, and prepare them
  - to participate in different roles in the European research and innovation process

Our targets in DoW

- framework for identifying inquiry activities that promote pupils' awareness of RRI;
- collect existing inquiry activities and environments from various projects;
- make these available through the Ark of Inquiry platform for learners, and supporters (teachers, science and teacher education students (100), and staff of universities and science centres (50))
- train at least 1 100 teachers to support pupils' inquiry activities
- implement the inquiry activities on a large-scale across a European school network (23 000 students)

Centre for Educational Innovation

- new life in old anatomicum
- for students, teaching and research staff, teachers
- new justified methods for innovative technologies
- opening: 22nd April 2 p.m.

Thank you!

Leo Siiman, Mario Mäeots, Heilo Altin, Külli Kori, Urmas Heinaste, Carlos Manuel Pacheco Cortés, Mirjam Burget, Kirsikka Kurg, Meelis Brikker jt

https://sisu.ut.ee/haridustehnoloogia

Margus Pedaste

margus.pedaste@ut.ee

www.ut.ee/pedaste/