Assessment for Improving Learning: A case of Finland

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Sunny greetings from
Finland - ”Pisa country”!

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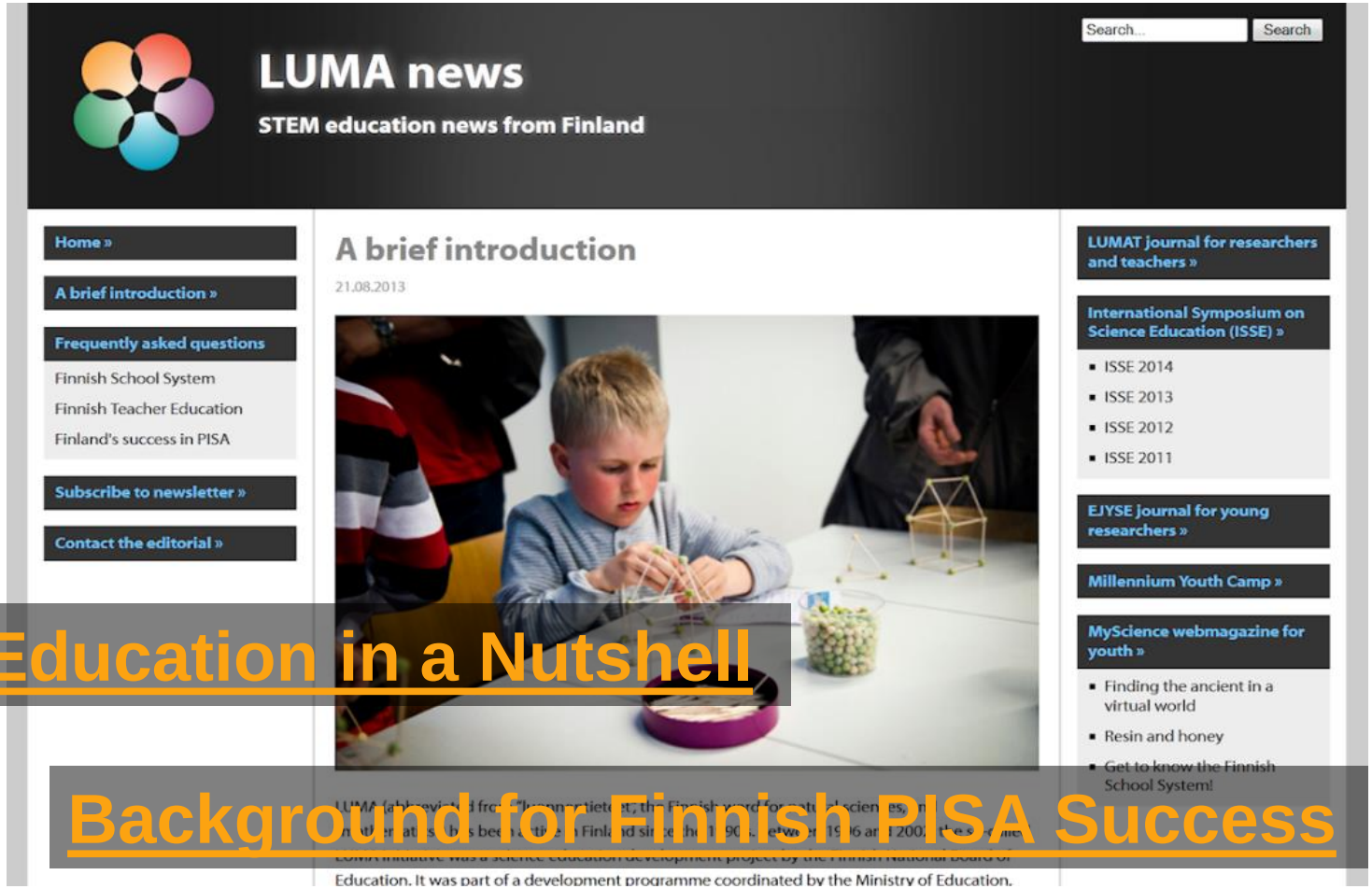


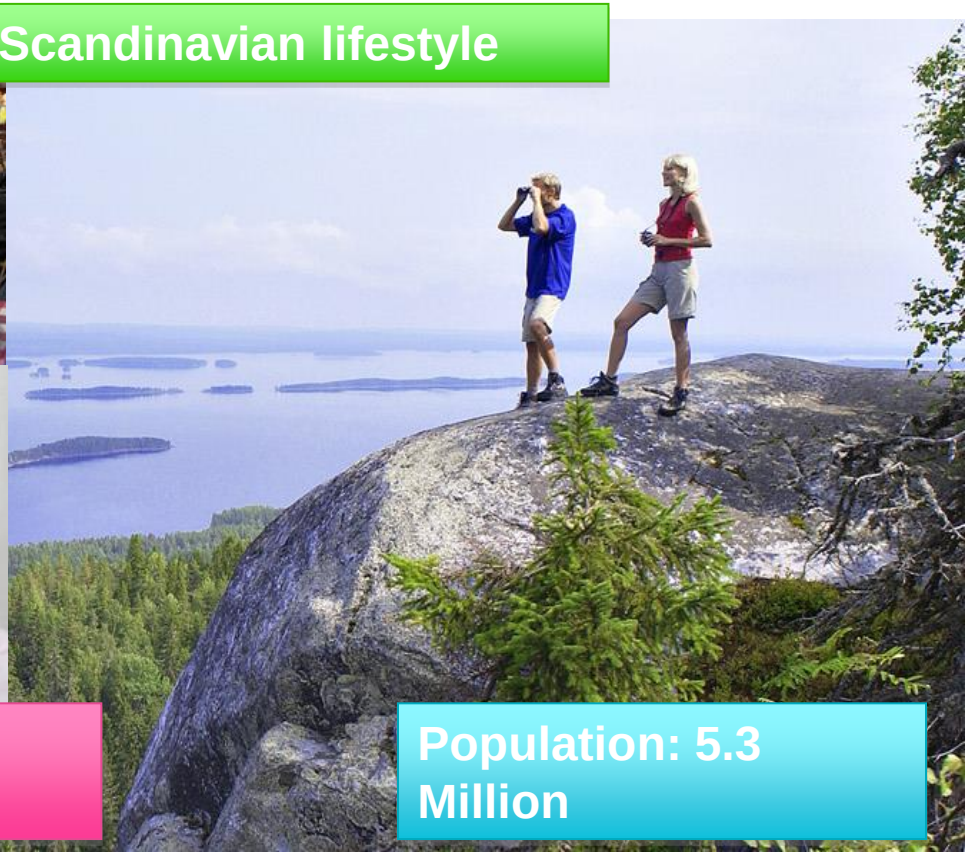
Finnish Education in a Nutshell

Background for Finnish PISA Success

Finland – a country of thousand lakes and islands

Scandinavian lifestyle

Officially bilingual: Finnish and Swedish



Population: 5.3 Million

See more: [This is Finland.fi]

Contents of My Presentation:

- Finland's Science Education Centre, the LUMA Centre **and Improvement of Learning through Assessment**
- **News** from Finnish Assessment
- **An Example in Details** How to Improve Assessment for Learning

IMPROVING LEARNING THROUGH

Finland's Science Education Centre, the LUMA Centre

for math, science and technology education

since 2003

LU stands for 'luonnontieteet', natural science in Finnish, and MA for mathematics.

A MOTTO:
A STUDENT IN A HEART

EMOTION AND COGNITION HAND IN HAND

Inspiring learning and teaching for lifelong learning

- Main objectives are to
  - promote interest and teaching of biology, chemistry, geography, mathematics, physics and technology (ICT)
  - enhance interaction between schools, universities and business and industry

SINCE YEAR 2003

Goal-oriented learning and teaching

GOALS

TEACHING

ASSESSMENT

A KEY THEME: DIFFERENT FORMS OF ASSESSMENT

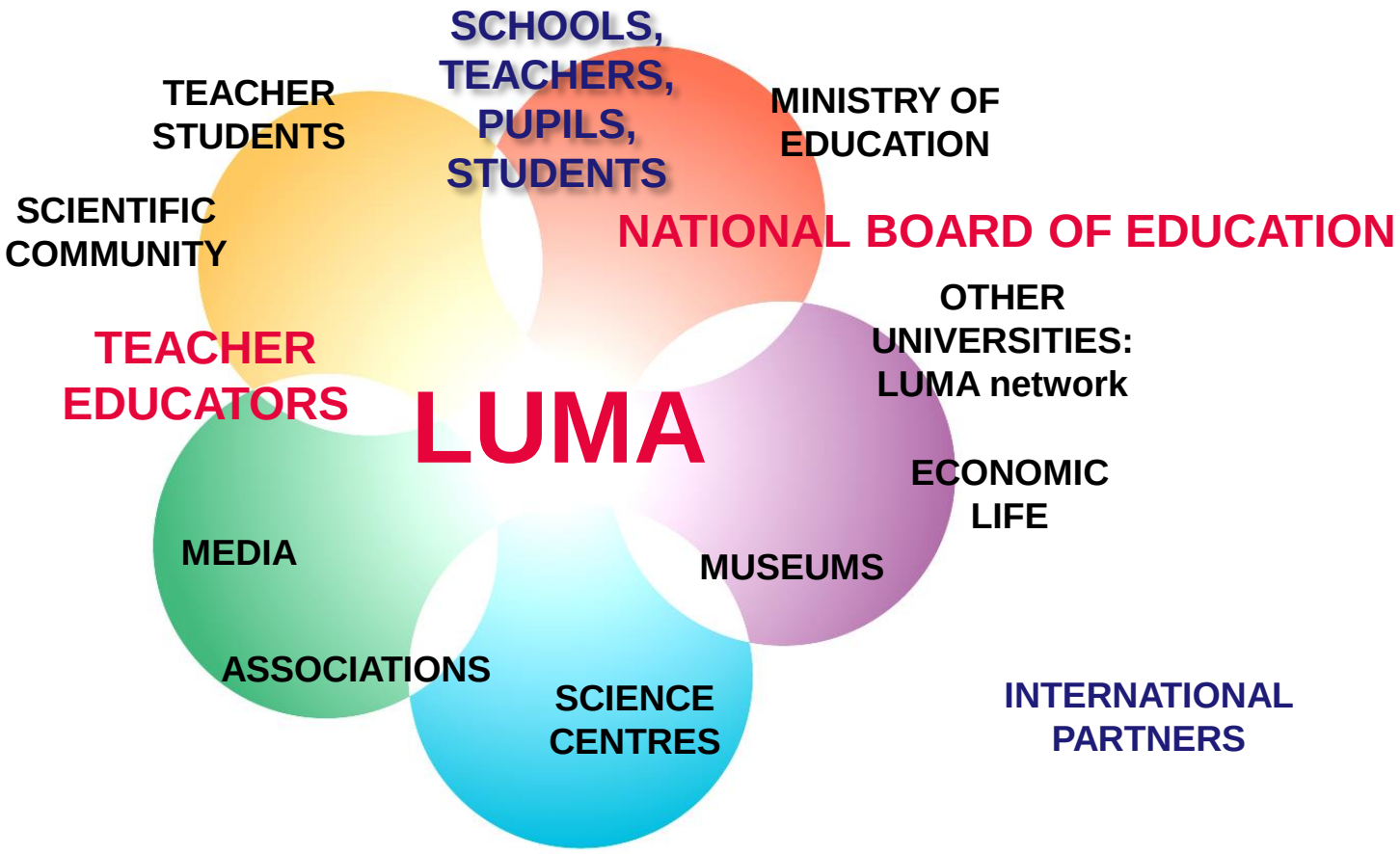
Student-centred assessment:

- Diagnostic
- **Formative**
- Summative

We are preparing students for future skills

"Students must become able to organise and regulate their own learning, to learn independently and in groups and to overcome difficulties in the learning process. This requires them to be aware of their own thinking and learning strategies and methods". (OECD 1999)

GOOD COLLABORATION IS A KEY FOR SUCCESS



COLLABORATION WITH NATIONAL BOARD OF EDUCATION

- The National Board of Education (NBE) is responsible for: developing, monitoring, supporting and evaluating primary and secondary education developing the national core curriculum including goals and **assessment criteria** for use in schools

- Curriculum work supports **local** pedagogic development.

PREPARATION OF NEW NATIONAL CORE CURRICULUM GOING ON

- The renewed core curriculum will be completed by the end of 2014. New local curricula that are based on this core curriculum should be prepared by the beginning of school year 2016–2017.

- Collaborative working: Each working group consists of educational officials, researchers and teachers.

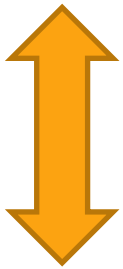
- The preparation of the curriculum is interactive. All education providers can follow the preparation and give feedback at the different phases. They are also encouraged to involve pupils and their parents in the process.

COLLABORATION WITH CURRICULUM WORK

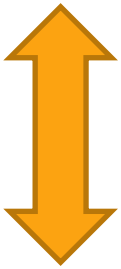
Developing new innovations **with schools and teachers**

Continuous feedback from the teacher is very important.

CURRICULUM



ASSESSMENT



PEDAGOGY

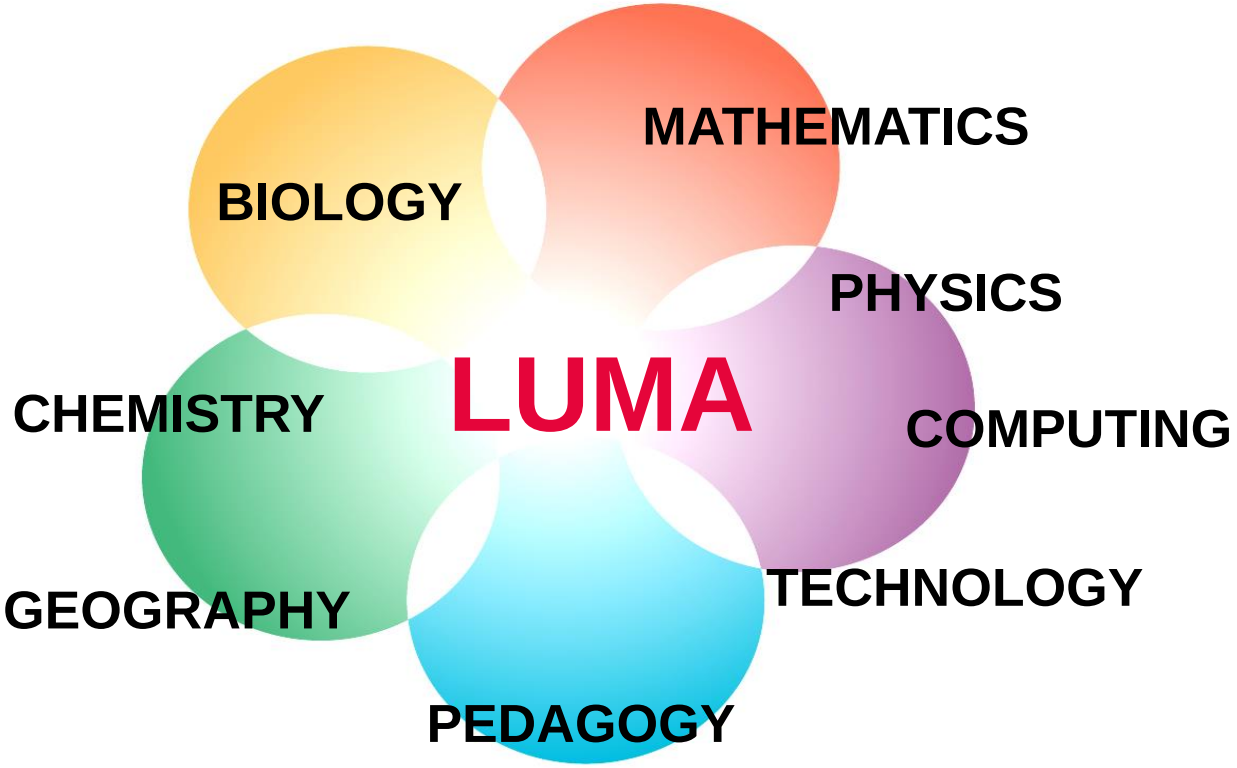
In the core curriculum pupil assessment is divided into assessment during the course of studies and final assessment.

SELF-ASSESSMENT CENTRAL IN FINNISH SCHOOLS

- The purpose of this is **to support the growth of self-knowledge and study skills and to help the pupil to learn to be aware** of her or his progress and learning process.

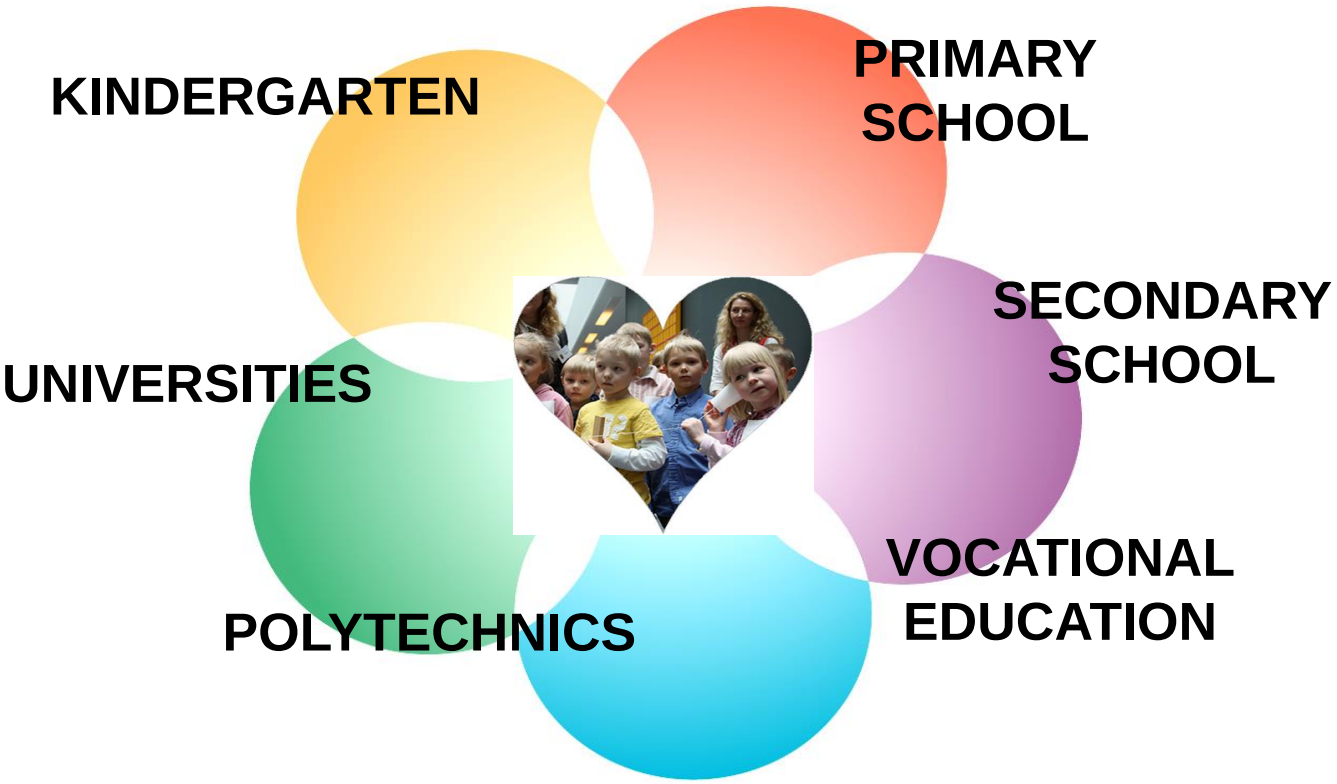
(NBA,2013)

MATH, SCIENCE AND TECHNOLOGY EDUCATION



In addition, multidisciplinary topics: e.g. Education for Sustainable Development

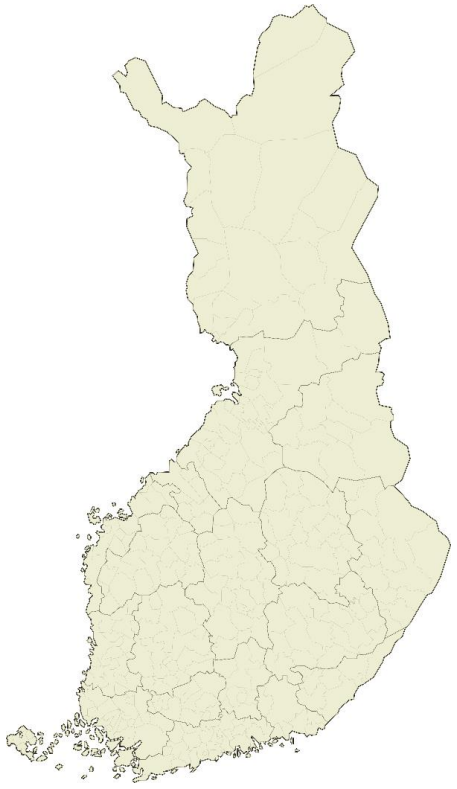
SCIENCE FOR ALL:
Supporting Assessment at all levels



In addition, different activities with e.g. parents, e.g. Science Days

National LUMA network of LUMA centres since 2010

- **Finlands' Science Education Centre, LUMA centre in Helsinki**
  - coordinates the LUMA network of 10 centres
- other LUMA centres in
  - **Espoo**
  - **Joensuu**
  - **Jyväskylä**
  - **Kokkola**
  - **Lappeenranta**
  - **Oulu**
  - **Tampere**
  - **Turku**



A national strategy and a steering group for collaboration.

Opportunities for Improving Learning:

LUMA activities for kids and young people

- Science days for children and families
- **Four modern free learning environments** at university campus: science classes in chemistry (Gadolin), physics (F2k), mathematics (Origo) and computing science (Linkki)
- Science clubs
- Science webmagazines
  - One for children
  - Three for young people
- Science camps (15-20 camps every year)

Science with joy of learning and achievement

Little Jippo clubs for children aged 3–6

Emotion and cognition

Encourage for questions: why and how?

The developed model **combines** science, technology, art, and emotions through stories, inquiry, role-playing, and music.

Math clubs for children

The most important goal is to give positive experiences within mathematics

Jippo science day for children aged 7–12

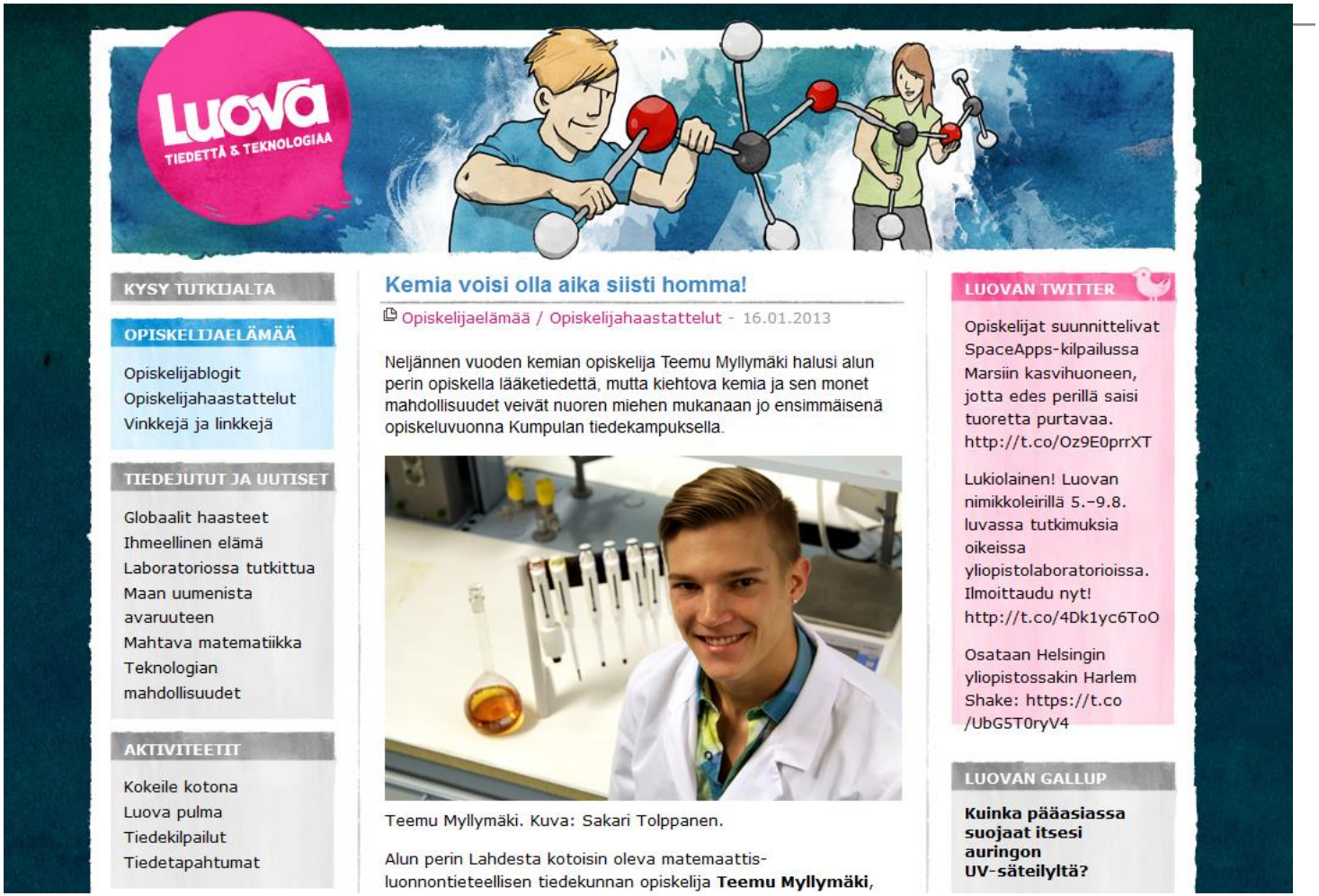
Different tasks with parents

15-20 camps each year

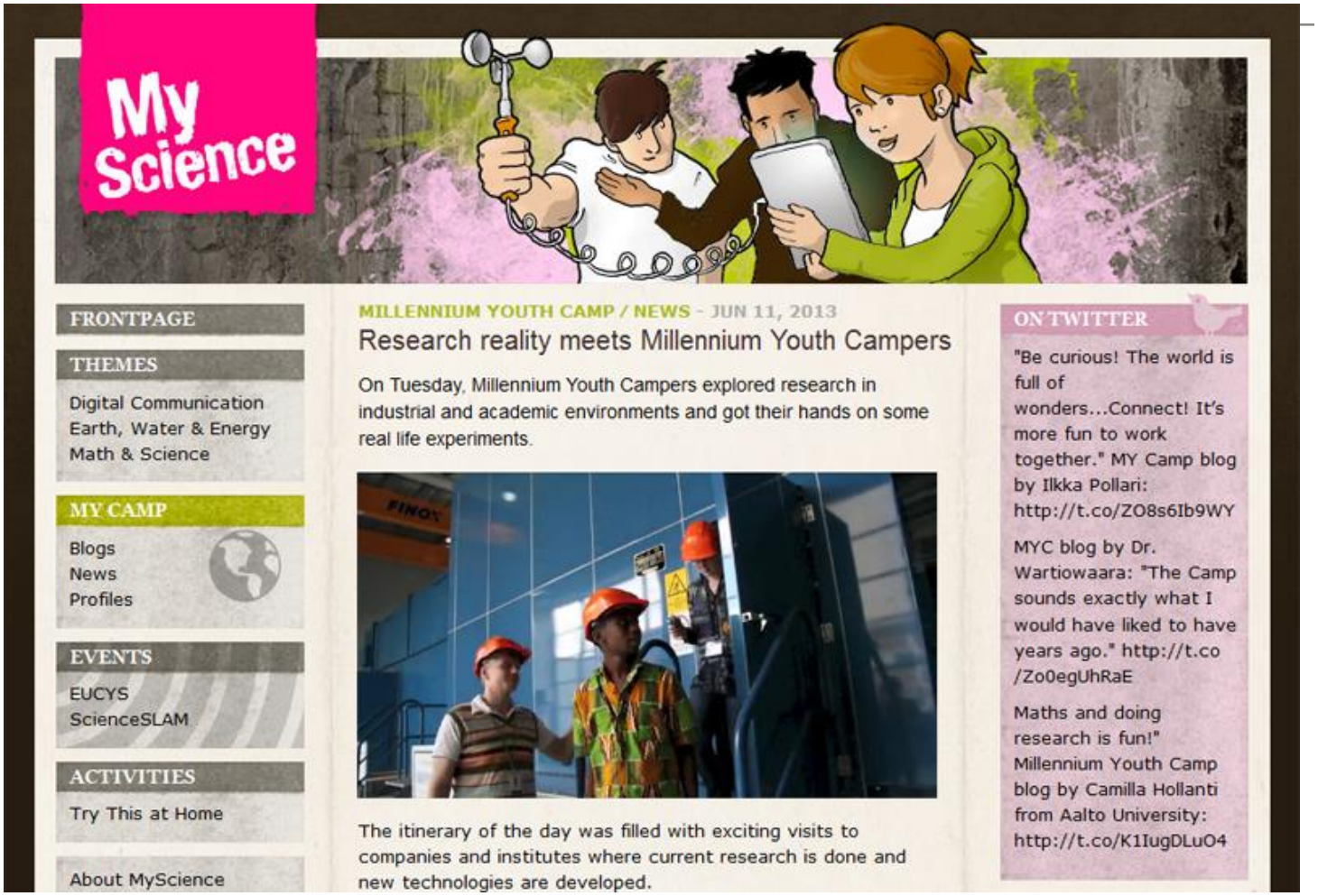
National webmagazine Jippo for children & parents

Hands-on activities, videos, stories…

National webmagazine Luova for youth



FREE! International webmagazine MyScience for youth

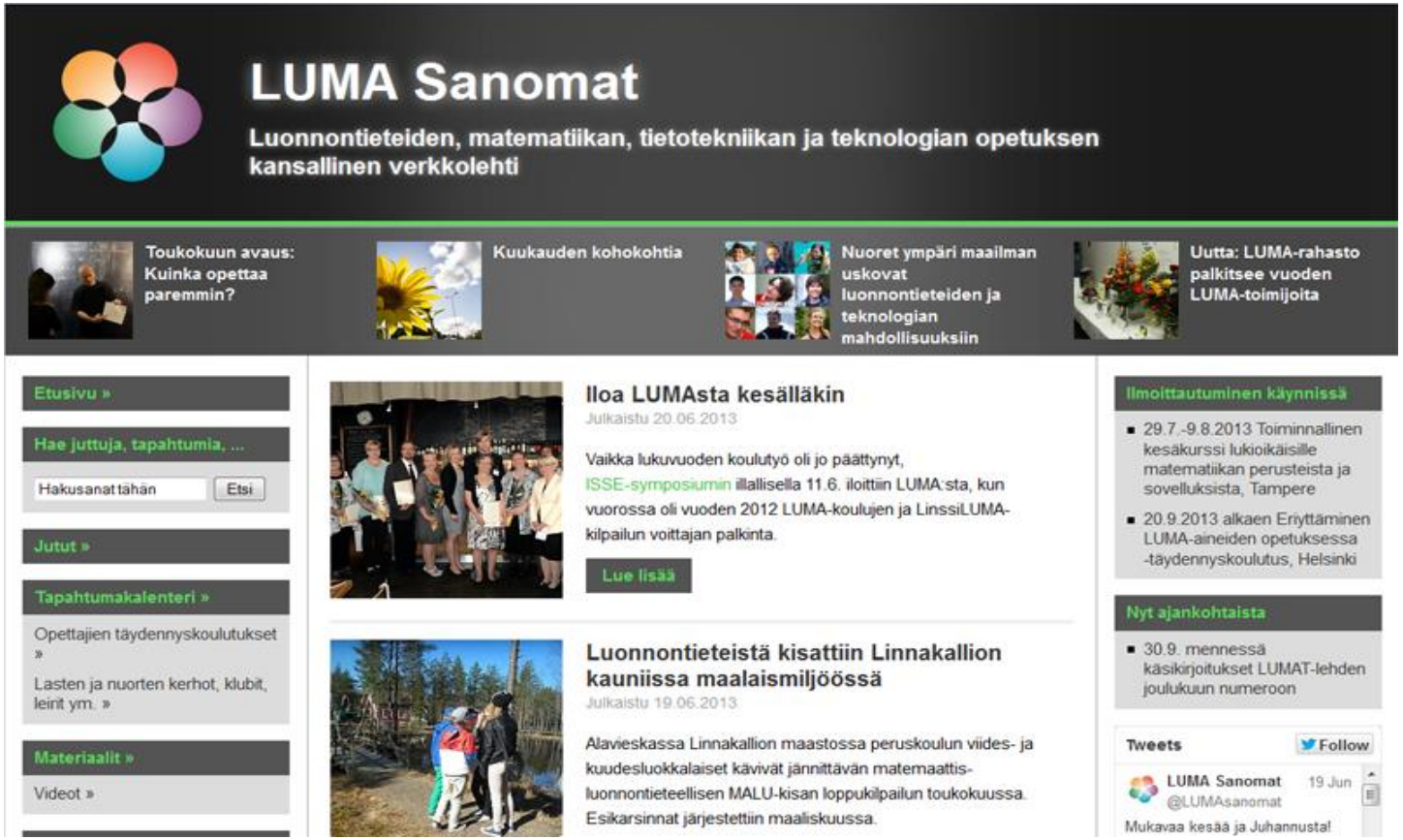


Peer-reviewed journal EJYSE for young researchers aged 14–21

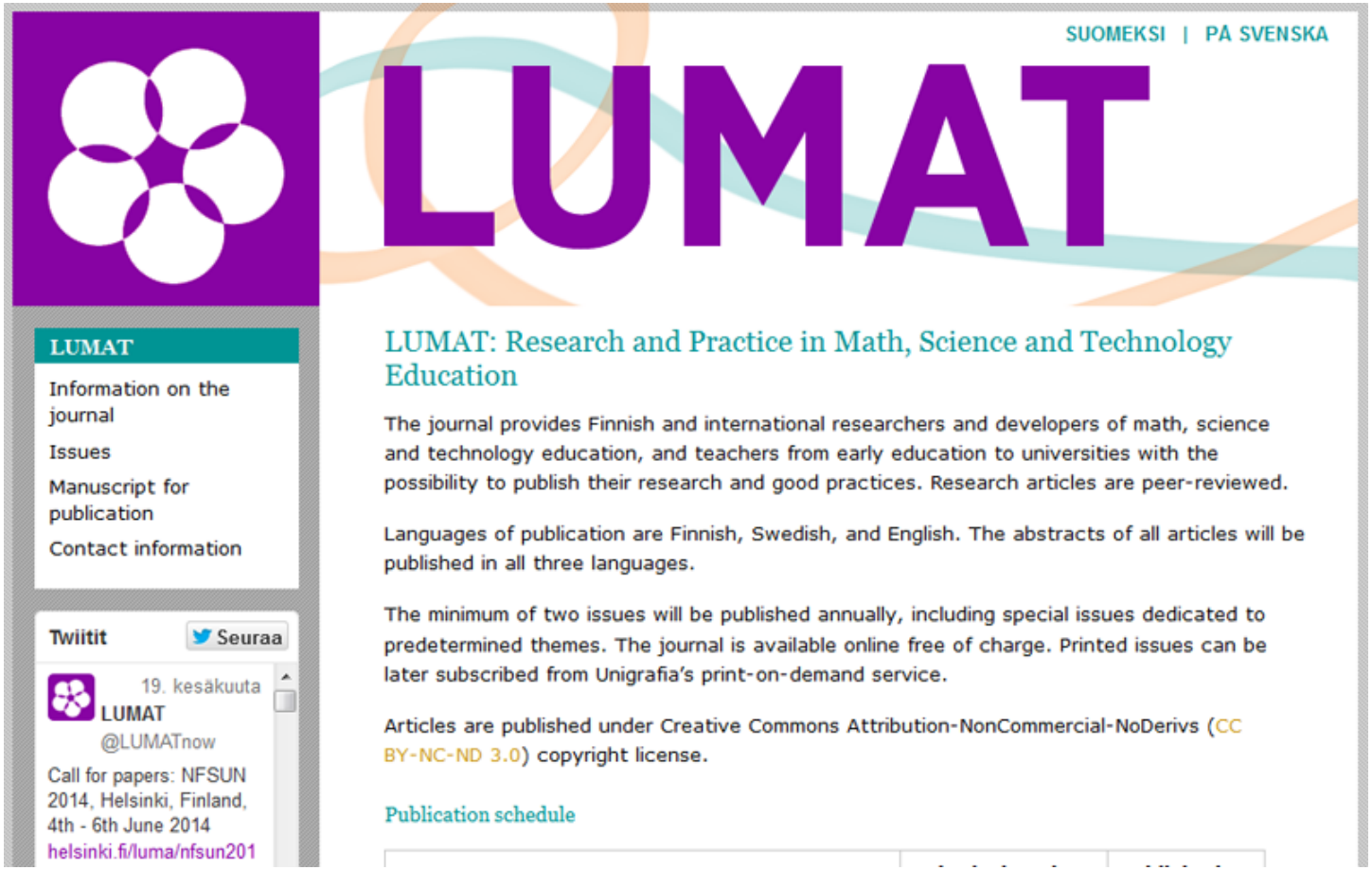
Activities and services for teachers

to support them in their everyday work and lifelong learning

National webmagazine LUMA Sanomat: Assessment is one of key topics



Peer-reviewed international journal LUMAT for publishing research findings & best practices



40-50 in-service training courses and events per year

How to support different learners e.g. gifted and talented students, and low-achievers?

Research and development:
Opportunity to visit authentic science labs at campus

New materials

Example:

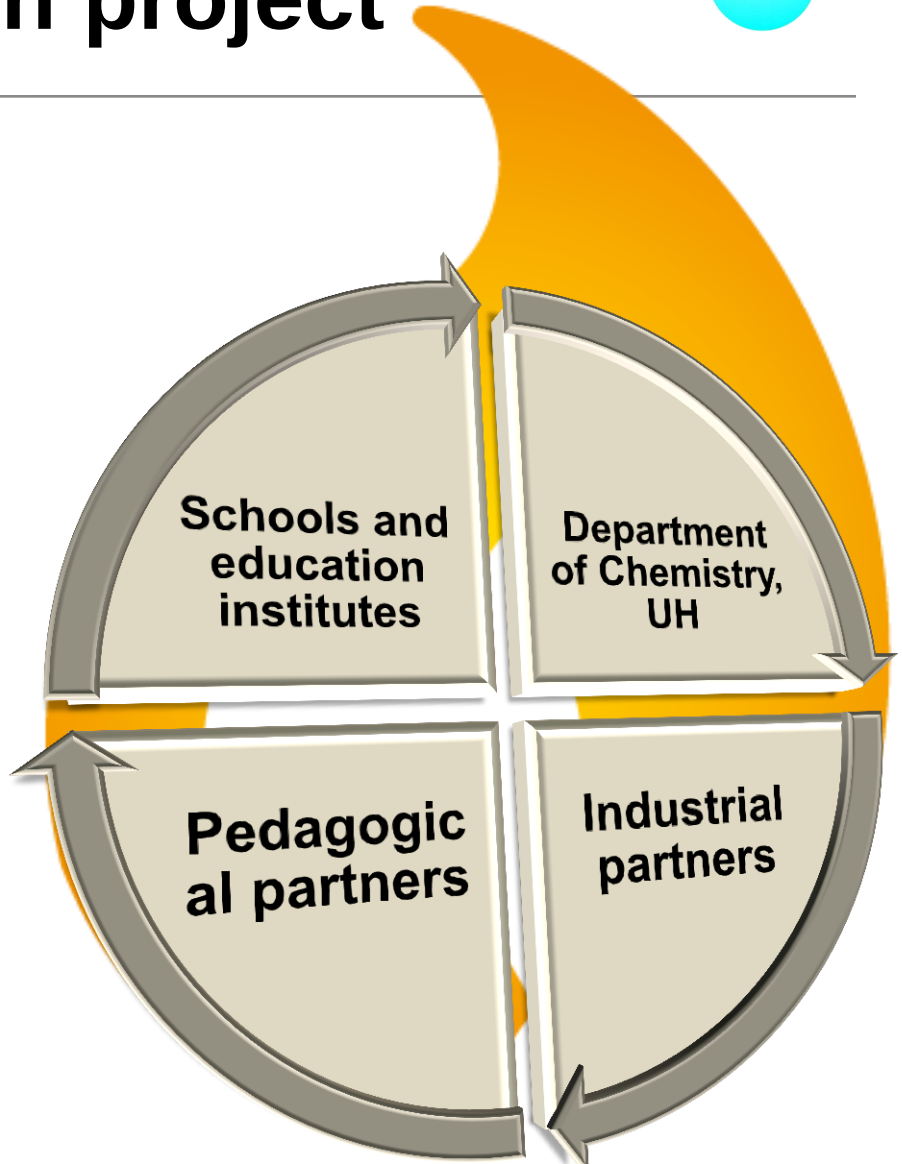
ChemistryLab Gadolin

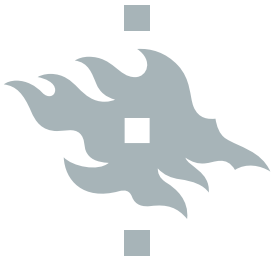
Kemma Chemistry Centre

Department of Chemistry
University of Helsinki
Finland

Gadolin is a collaboration project

- ChemistryLab Gadolin was founded in 2008.
- 21 partners
- It is free of charge for schools.





HELSINGIN YLIOPISTO

Kemian laitos &
Farmasian tiedekunta

NESTE OIL

BASF
The Chemical Company

OPETUSHALLITUS
UTBILDNINGSSTYRELSEN

kemira

Helsingin kaupunki
Opetusvirasto

A Member of
The Linde Group

AGA

BOREALIS

KEMIANTEOLLISUUS RY

PLD
FINLAND

VWR

SUOMEN BIOTEOLLISUUS
FINNISH BIOINDUSTRIES

Metrohm
Nordic

Vernier
Suomi

Thermo
SCIENTIFIC

SUOMEN KEMIAN SEURA
Kemiska Sällskapet i Finland - Association of Finnish Chemical Societies

IS·VET

3M

BRUKER

Goals

- To support chemistry teaching and learning.
- To rise the youth's interest in natural sciences.
- To support the potential future professionals, i.e. to introduce career possibilities in the field of chemistry.
- **To bring out the up-to-date information on the versatile applications of chemistry, and its important status in industry and in the society.**
- To promote the positive image of chemistry.
- To support the goals of schools, university departments of chemistry, enterprises and other partners.

Visits to ChemistryLab Gadolin

- Over 4000 visitors from schools / year

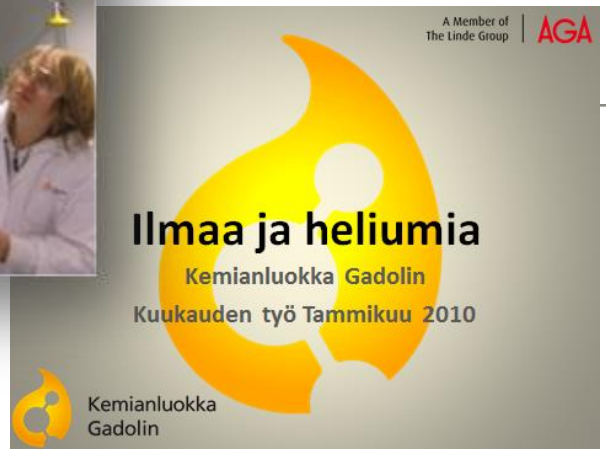
- Visits include (1-8 hours / visit)
  - Introduction of ChemistryLab Gadolin, The Department of Chemistry, The UH and The Campus
  - Laboratory work
  - Molecular modelling
  - Visits to research groups

Encouraging experiences through new educational innovations !

Meeting scientists

Gadolin offers student groups the opportunity to meet scientists at the Department of Chemistry, the University of Helsinki and to discuss with them about chemistry and visit their research laboratories.

Collaborating with chemical industry

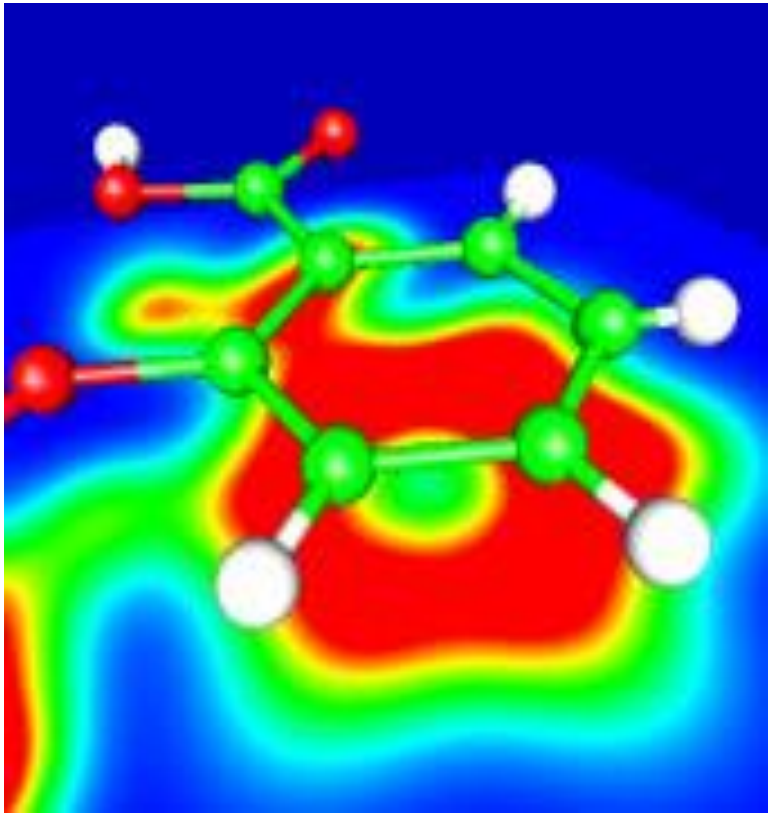


Using design research for developing new educational innovations

- ChemistryLab Gadolin also is a research laboratory for chemistry learning and teaching
- It is collaborating with the Unit of Chemistry Teacher Education in the Department of Chemistry
- Activities are developed through design research
- M.Sc. thesis and other publications

II News from Finnish Assessment

- The tests of national A-levels exams (the Matriculation Exam) of the Finnish upper secondary schools will be **gradually digitalized** in the years 2016-19.



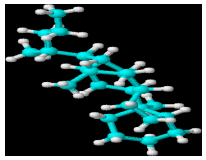
III An Example in Details How to Improve Learning through Assessment

- How to Support Students' Higher-Order Thinking towards Meaningul Learning? (Aksela, 2005)
- An analysis of Finnish chemistry matriculation examination questions according to cognitive complexity (Tikkanen & Aksela, 2012) **using Refined Bloom's Taxonomy** (Krathwohl & Anderson, 2001)
- Design of Tasks and Materials for Using Higher-Order Thinking Skills Towards Meaningful Learning
- **Pre-Service and In-Service Training for Teachers**

ROTE-LEARNING in SCIENCE EDUCATION

- Learning too often occurs only by rote-learning of factual knowledge (e.g. Entwistle & Ramsden, 1983; Gabel, 1999).
- Instead of only focusing on what to think in chemistry, should also be focused more on how to think in chemistry.
- To obtain meaningful chemistry learning requires more focus on student higher-order thinking skills (HOCS) and also in teacher education (Aksela, 2005).

THINKING LEVELS IN CHEMISTRY



Makroscopic

Human

Mikroscopic

Symbolic

NaOH,
n=m/M

Gabel et. al 1987, Johnstone 1991, Nakhleh & Krajcik, 1991

2-DIMENSIONAL TAXONOMY: KNOWLEDGE DIMENSION

(Anderson & Krathwohl, 2001)

Table 3.3 Major types and subtypes of the knowledge dimension (Anderson & Krathwohl, 2001, page 46). Examples are drawn from chemistry by this researcher.

Major Type and Subtypes	Examples from Chemistry
Factual Knowledge 1a) Knowledge of terminology 1b) Knowledge of specific details and elements	e.g. formulas of compounds, definitions of atom, electron, molecule, chemical reaction, names of elements, biographies of chemists, dates of their innovations
Conceptual Knowledge 2a) Knowledge of classifications and categories 2b) Knowledge of principles and generalizations 2c) Knowledge of theories, models, and structures	e.g. Periodic table, atomic theory, ideas of chemical reactions
Procedural Knowledge 3a) Knowledge of subject-specific skills and algorithms 3b) Knowledge of subject-specific techniques and methods 3c) Knowledge of criteria for determining when to use appropriate procedures	e.g. Skills used in practical work and in inquiry, use of computer-based environments, scientific methods
Metacognitive Knowledge 4a) Strategic knowledge 4b) Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge 4c) Self-knowledge	e.g. Knowledge of the design of experimental work, knowledge of the cognitive demands of different tasks in chemistry, awareness of one's own strengths and weakness in chemistry knowledge

HIGHER-ORDER THINKING SKILLS (HOCS)

Table 3.2.1a Bloom's original Taxonomy (1956) compared to the revised taxonomy (Anderson & Krathwohl, 2001).

Bloom's Orginal Taxonomy	Level of Thinking	The Revised Taxonomy
Knowledge	lower-order	Remember
Comprehension	lower-order	Understand
Application	higher-order	Apply
Analysis	higher-order	Analyze
Synthesis	higher-order	Evaluate
Evaluation	higher-order	Create

HOCS ITEMS

- HOCS items are **quantitative or qualitative, ill-defined/structured, or open-ended questions, mostly unfamiliar to the student**, which require for their 'solution' much more than just knowledge
and/or application of known algorithms
- They may **require analysis, synthesis, system thinking, decision making, problem-solving capabilities**, but mostly the making of connections, and critical evaluative thinking.

(Tsaparlis & Zoller, 2003, p.51)

LOCS ITEMS

- LOCS items are knowledge questions **that require simple recall of information or a simple application of known theory or knowledge to familiar situations and context.**
- They can also include the so called 'problems', not necessarily understood by the 'solver', which are already familiar to the learner through previous specific directives, or long-term practice, or both.

(Tsaparlis & Zoller, 2003, p.51)

Questions according to cognitive complexity (Tikkanen & Aksela, 2012)

KNOWLEDGE	LOWER-ORDER THINKING SKILLS (LOCS)			HIGHER-ORDER THINKING SKILLS (HOCS)		
	60 (23 %)			197 (77 %)		
	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge	-	-	-	-	-	-
Conceptulal knowledge	-	**33** (13 %)	-	**4** (2 %)	-	**17** (7 %)
Procedural knowledge	-	-	**27** (11 %)	**85 (33 %)**	**40** (16 %)	**51** (20%)
Metacognitive knowledge	-	-	-	-	-	-

SUMMARY

- ”A Student is in our heart! ”
- The use of different kind of assessment is central for meaningful learning
- Refined Taxonomy is **a tool** for designing activities and materials for higher-order thinking skills towards meaningful learning
- **Teachers and their collaborative networking** is a key for success, also in improving assessment

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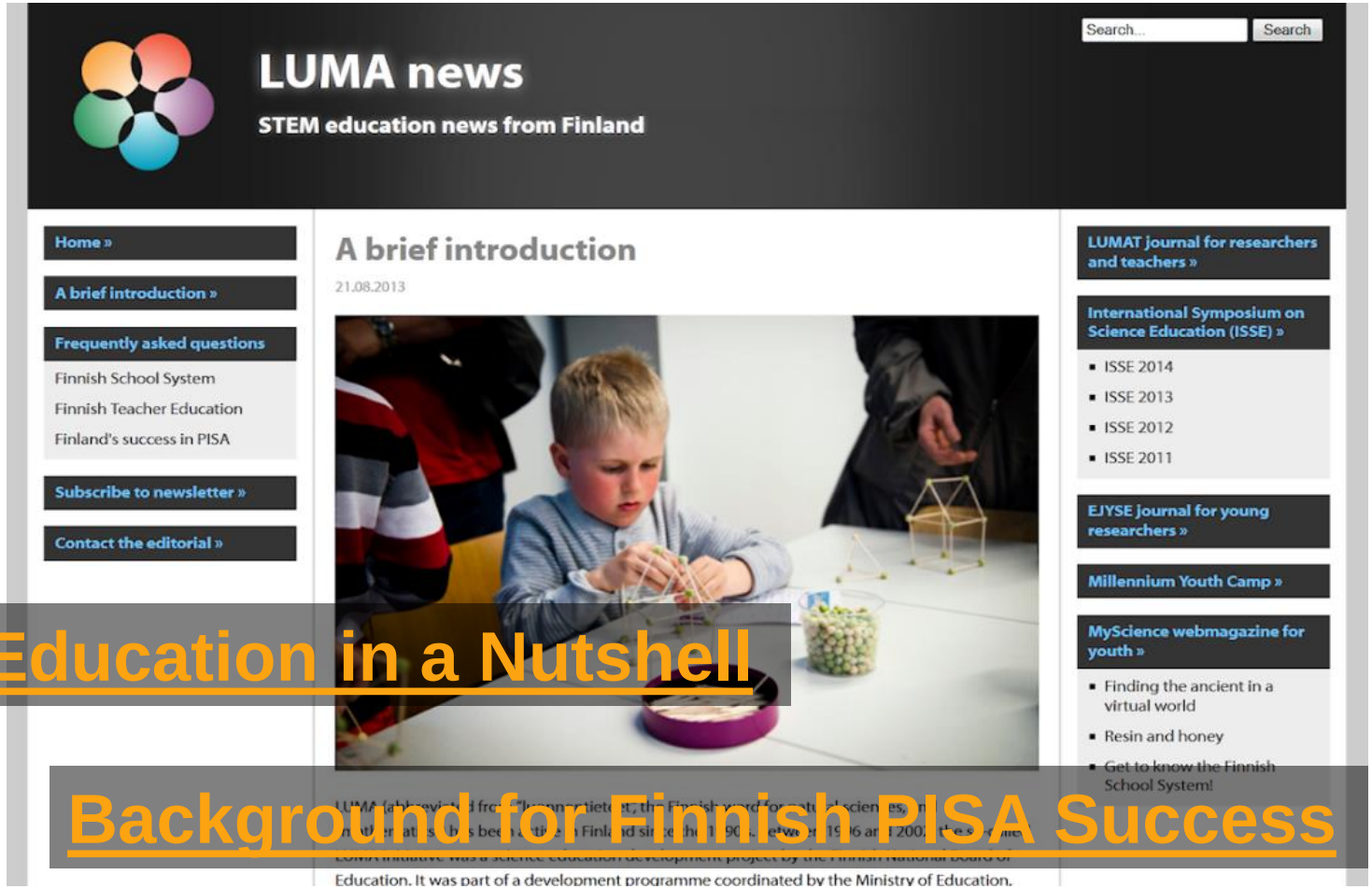

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