



# ASSESSMENT AS A TOOL FOR PROMOTING STEM EDUCATION

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3. Three models of assessment
4. Examples of assessment
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# THE MAIN AIM OF LUMA CENTRES

To engage children and young people – both girls and boys – from age 3 to 19 in science, technology, engineering, and mathematics and teachers at all levels in life-long professional development.

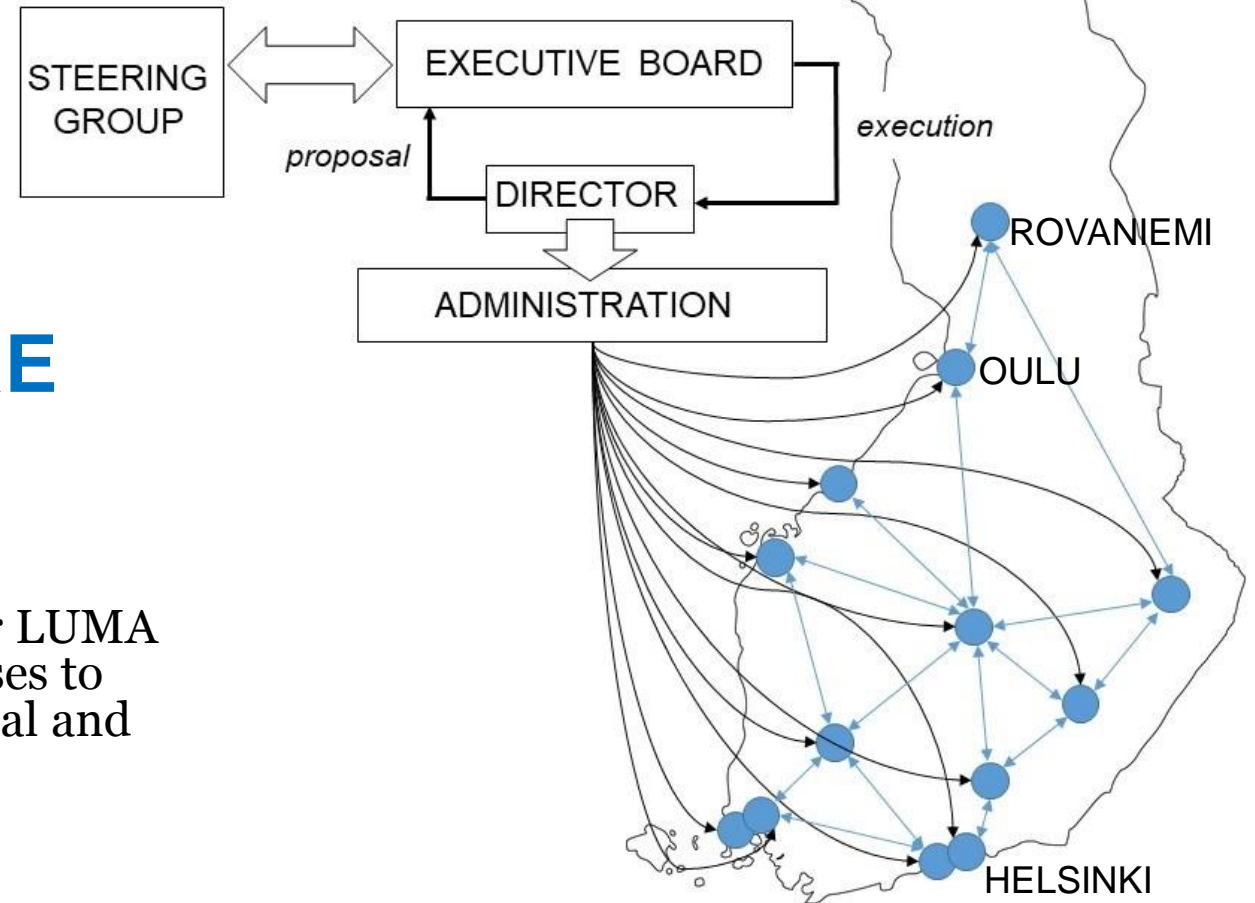
**Promoting curiosity, creativity and learning through collaboration.**





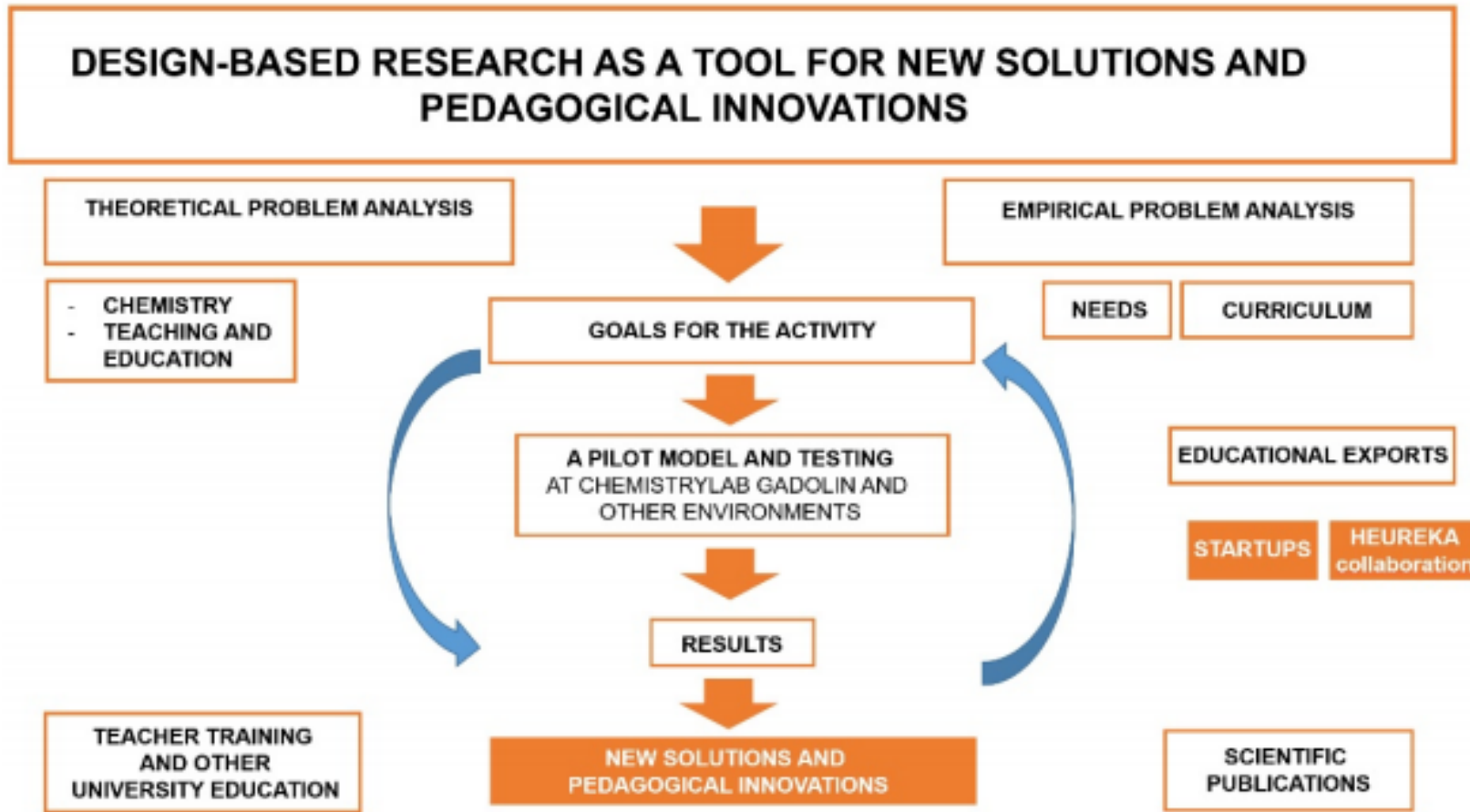
# SCIENCE EDUCATION CENTRE IS PART OF LUMA CENTRE FINLAND

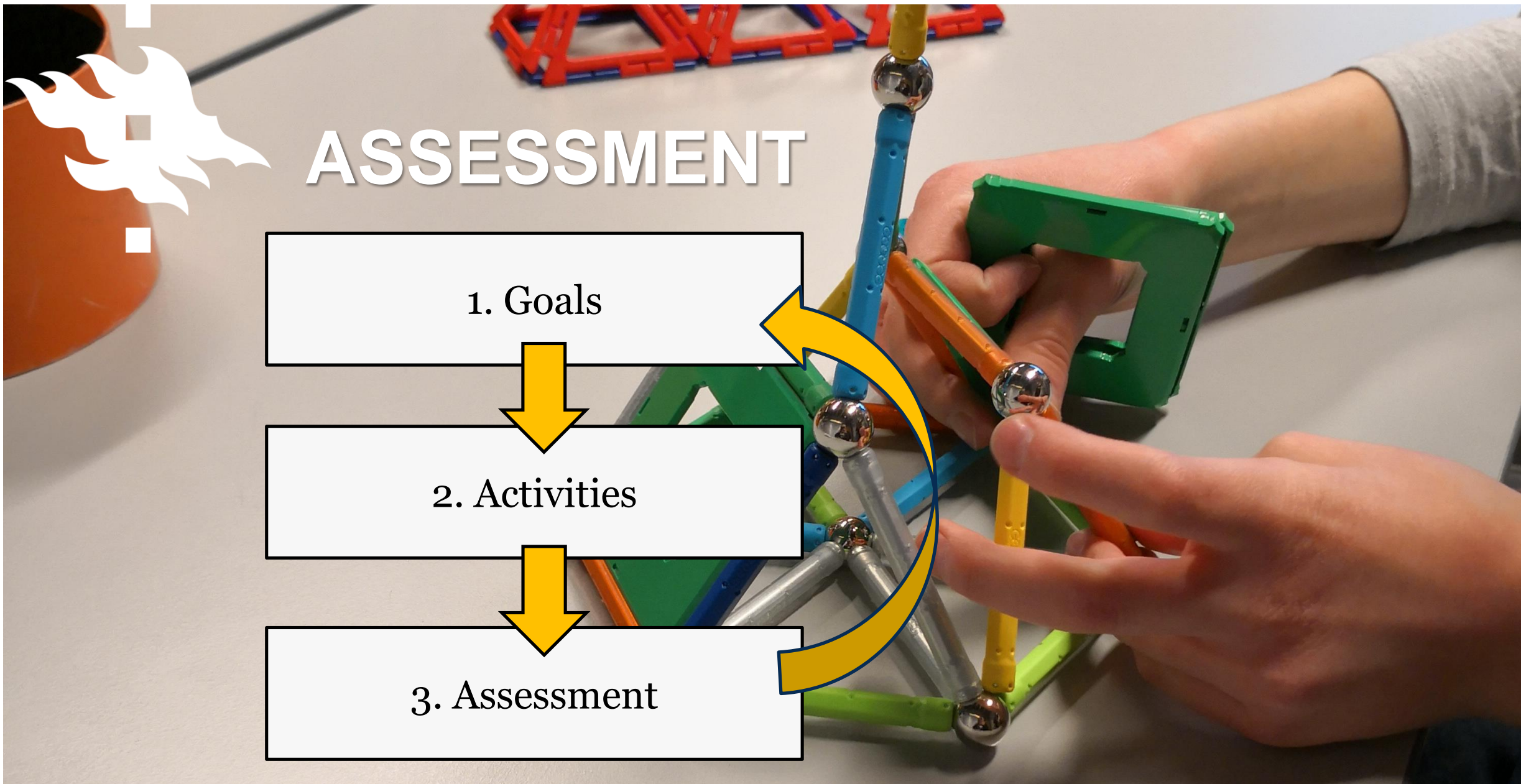
LUMA Centre Finland is an umbrella organization for LUMA Centres in Finnish universities and university campuses to strengthen and promote their collaboration on national and international level.



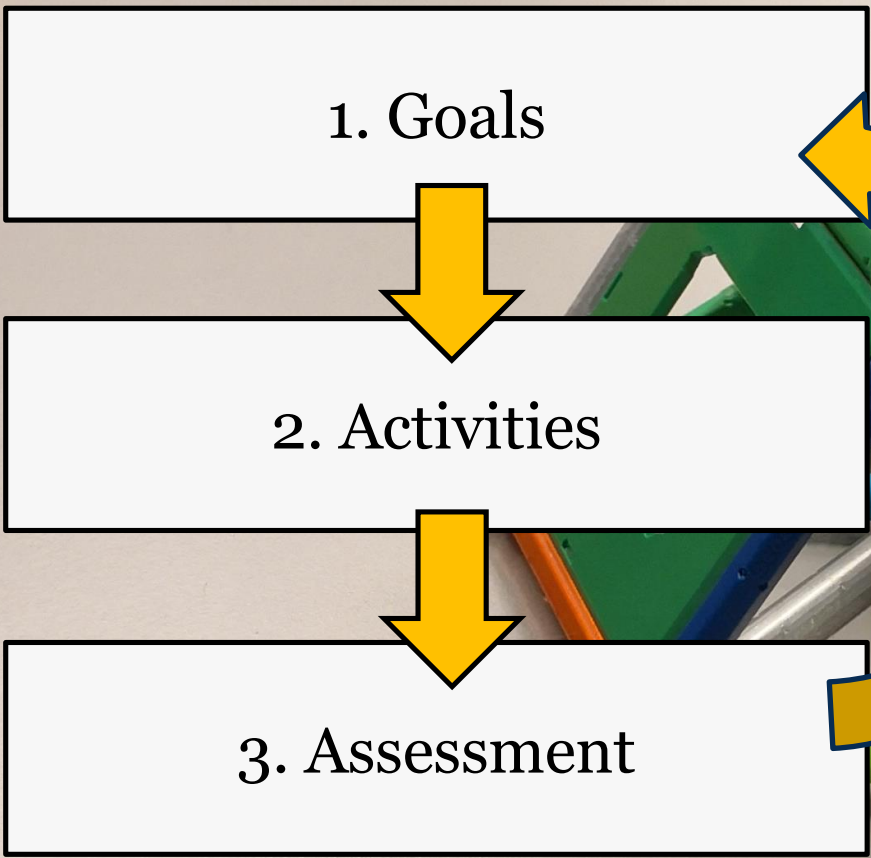


# CREATING NEW SOLUTIONS AND PEDAGOGICAL INNOVATIONS THROUGH DESIGN-BASED-RESEARCH





# ASSESSMENT







## THREE MODELS OF ASSESSMENT

1. Diagnostic Assessment
2. Summative Assessment
- 3. Formative Assessment**



# THREE MODELS OF ASSESSMENT

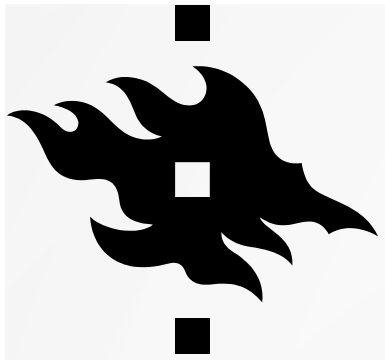
## 1. Diagnostic Assessment

- A form of pre-assessment that allows a teacher to determine students' individual strengths, weaknesses, knowledge, and skills **prior to instruction**.
- It is primarily used to diagnose student difficulties and to guide lesson and curriculum planning.

## 2. Summative Assessment

- Assessment of participants where the focus is on the outcome of a program.
- The goal of summative assessment is to evaluate student learning **at the end of an instructional unit** by comparing it against a standard or benchmark.





# THREE MODELS OF ASSESSMENT

## 3. Formative Assessment

- Formative assessment involves a **continuous way** of checks and balances in the teaching learning processes (Jeri, 2018).
- The method allows teachers to check their learners' progress as well as the **effectiveness of their own practice**. Use of **self assessment** and **peer assessment**.
- The aim is to modify teaching and learning activities to improve student attainment. It typically involves **qualitative feedback** (rather than scores) for both student and teacher that focuses on the details of content and performance.
- **Moves focus away from achieving grades** and onto learning processes, in order to increase self efficacy and reduce the negative impact of extrinsic motivation.
- Improves students' metacognitive awareness of how they learn.
- Formative assessment is **recommended in the national curriculum of primary school and high school education**.



# HOW TO USE FORMATIVE ASSESSMENT?

Examples and Ideas for teaching





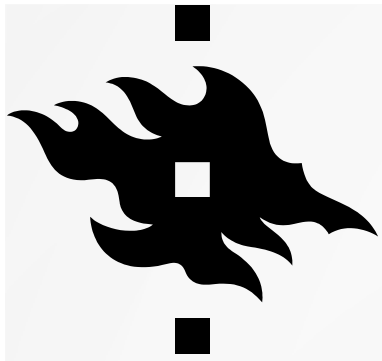
# HOW TO USE FORMATIVE ASSESSMENT IN TEACHING

## 3-2-1 Method

- Three - After the lesson, have each student record three things he or she learned from the lesson.
- Two - Next, have students record two things that they found interesting and that they'd like to learn more about.
- One - Then, students record one question they still have about the material.
- Review - Teacher reviews the students' responses. Information can be used to develop future lessons and determine if some of the material needs to be taught again.

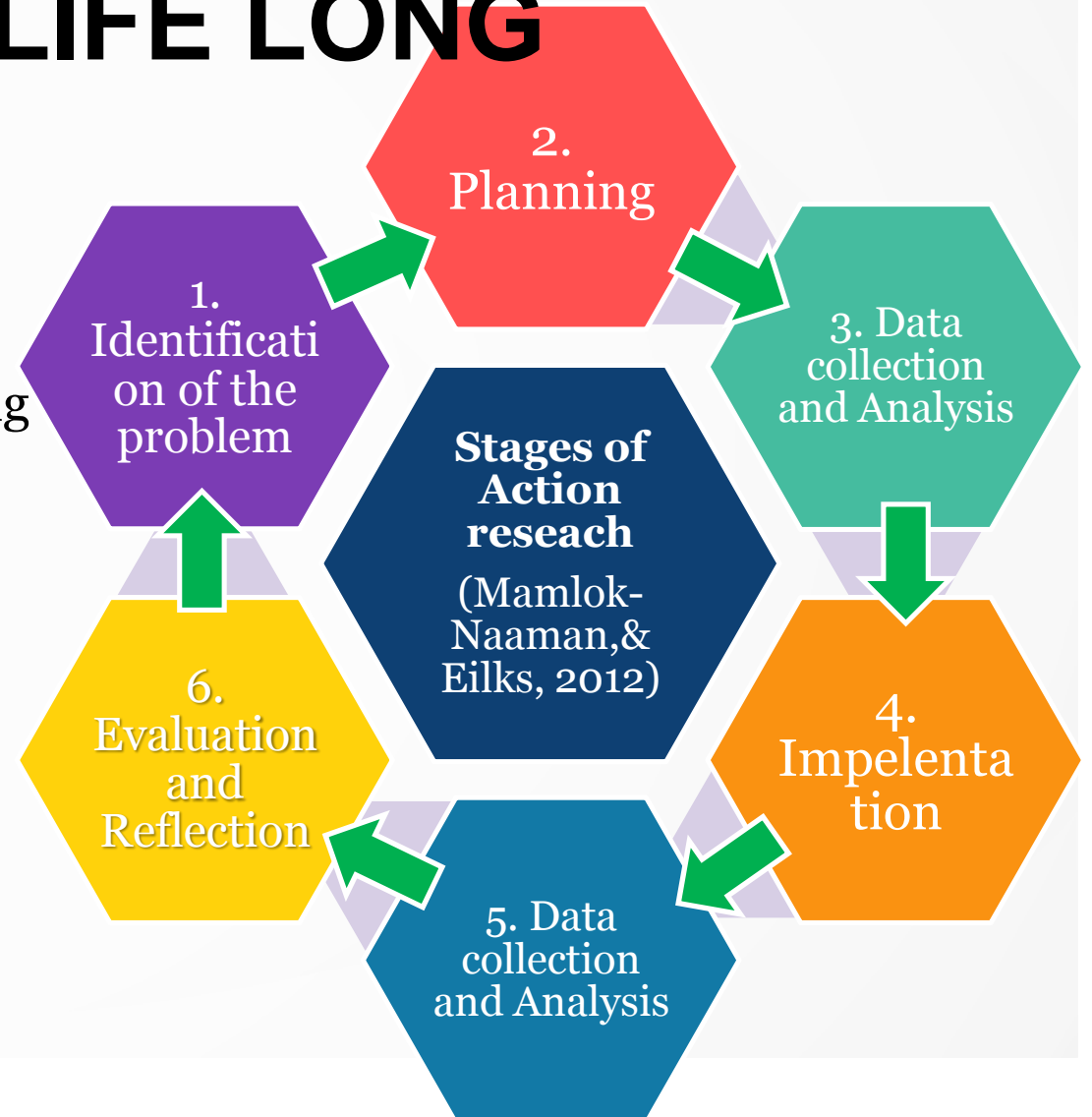
## The Fact First Method

- The Fact First method challenges students to consider the causes of the phenomenon.
- Students easily remember the facts but do not understand the phenomenon behind the fact.
- The purpose of the method is to consciously shift the focus of teaching from remembering to understanding things.



# HOW TO USE FORMATIVE ASSESSMENT IN LIFE LONG LEARNING

- LUMA Centres are providing courses for teachers to implement formative assessment to their teaching. The model is part of LUMA Centres Continuing Professional Development (CPD) and life long learning program.
  - The program was carried out by action research method that collaborated with teachers, schools and researchers.
1. Analysis about the use of formative assessment at schools.
  2. Teacher training course (Fact First -method)
  3. Study: Teachers and students both find formative assessment meaningful and useful.







# HOW TO USE FORMATIVE ASSESSMENT IN PRACTICE

## Example: How Fact first –method was used in teaching after the CPD-course and what were the outcomes

- Two upper secondary groups (7th grade)
- Many students in the groups who did not speak Finnish as their first language and/or who received support for their studies.
- Subject: Factors affecting the speed of chemical reaction
- Facts (factor written in a claim) were given to the groups first. After that they experimented and argued together if the claim was true.

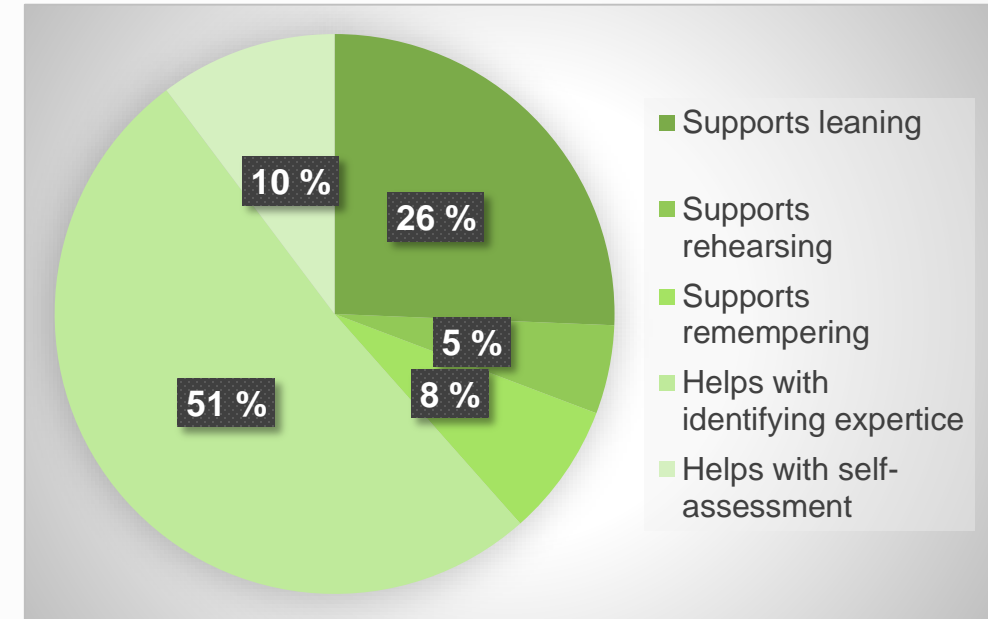
## Implementation

1. Students studied the chemical reaction factors that affect speed (reagents, concentration, finesse, mixing and temperature) in small groups.
2. Students studied three claims about chemical reaction speed in small groups and explained why the claims were true.
3. The results of the studies were presented to other students and argued.
4. Other students presented questions about the claims and arguments.



# EXAMPLE: FACT FIRST RESEARCH - MASTER'S THESIS STUDY

- After the in-service training (2016), the teachers participated in the development process in a research project (2017 and 2018), during which they used their own teaching in continuing education.
- In this thesis, students' answers to formative assessment have been studied in multidisciplinary research.
- The research showed that learners liked being given personal feedback. In addition, learners felt that the Fact First method helped identifying their own learning.



Learners experienced The Fact First Assessment Method helps you to identify your own expertise, ie. what you should learn or have learned. In addition, the respondents felt the evaluation method helped in remembering and in self-evaluation.





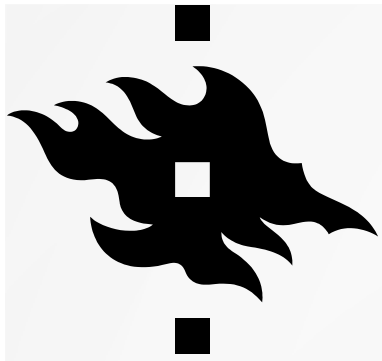
# OTHER METHODS FOR FORMATIVE ASSESSMENT

## A. Questions and answers

- Questions help teacher to follow the thinking and cognitive level of students.
- For children, asking questions is a natural form of learning.
- Teaching can be adapted to the interest of the learners.
- Questions help the learner to build their knowledge based on their previous experience (scaffolding).

## B. Mind maps

- Learners build a mind map to answer the question: "What have I learned on this lesson?" (Wehry, Monroe-Oss, Cobb & Fountain (2012).
- Mind maps can be used in groups also or for gathering the learning experience of the whole classroom.
- Online tools such as [Cmap](#)



# HOW TO USE ICT IN FORMATIVE ASSESSMENT

- Online mind map tools such as **Cmap**
- Online quiz-tools like **Kahoot.it**
- Evaluation tools **ForAllRubrics** (data collecting) & **Nearpod** (online lectures)
- Groupwork tools like **Google Forms**







HELSINGIN YLIOPISTO  
HELSINGFORS UNIVERSITET  
UNIVERSITY OF HELSINKI



## Literature and research about formative assessment

Black, P., & Wiliam, D. (2009). Developing the theory of formative assessment. *Educational Assessment, Evaluation and Accountability*, 21(1), 5-3.

Brookhart, S. M. (2010). *Formative Assessment Strategies for Every Classroom*. Alexandria, VA: ASCD.

Cowie, B., & Bell, B. (1999). A model of formative assessment in science education. *Assessment in Education: Principles, Policy & Practice*, 6(1), 101-116.

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OECD. (2004). *Formative Assessment: Improving Learning in Secondary Classrooms*

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# NEW APPROACHES: SCIENCE IN SOCIETY

A collaboration where we develop new education models with industry and schools

- ✓ Teachers meet industry leaders and share needs and aims.
- ✓ Teachers visit industry to update their knowledge and gain new ideas for their teaching.
- ✓ Pre-service teachers gather the ideas of the in-service teachers and produce pedagogical models for schools
- ✓ Pre-service teachers get credits, income & connections with schools and industry.
- ✓ In-service teachers gain new information, connections and new education models

**KEMIA  
YHTEISKUNNASSA**

HELSINGIN YLIOPISTO

LUMA-KESKUS  
SUOMI

**NESTE** **kemira** **ThermoFisher** SCIENTIFIC A Member of The Linde Group **AGA** **BOREALIS** Keep Discovering

**KEMIAN TEOLLISUUS**



# LINKS – LEARNING THROUGH INNOVATION AND NETWORKING IN STEM

The LINKS project (Learning from Innovation and Networking in STEM – science, technology, engineering and mathematics, see <https://www.fondation-lamap.org/en/links-project> ) aimed at improving inquiry-based STEM teaching through the continuing professional development (CPD) of teachers and their educators, both at primary and secondary levels.

The project collected best practices and recommendations from 5 countries. The results and recommendations on following themes are presented in the publications of the project:

- Working with the scientific community
- Working with the schools
- Working with the industry
- Building comprehensive partnerships and alliances for sustained CPD
- **Quality assurance and evaluation of the impact**





# MASTER'S PROGRAMME FOR TEACHERS OF MATHEMATICS, PHYSICS AND CHEMISTRY



Degree structure for 120 credits:

Discipline-specific studies (at least 60 cr)

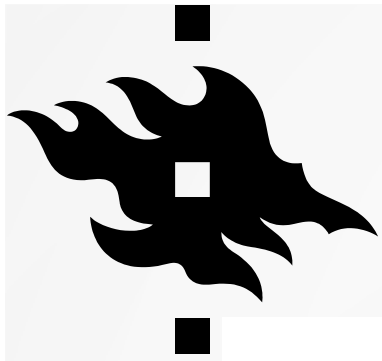
- Compulsory and optional studies (i.e. Master's Thesis for Chemistry Teachers)

Subject Teacher Education Programme

- Basic Studies 25 cr (i.e. Basic Practice 10 cr, Planning, Implementation and Assessment of Teaching)
- Intermediate Studies 35 cr (i.e. Advanced Practice 10 cr, Teacher as a Researcher Seminar)

Personal study plan





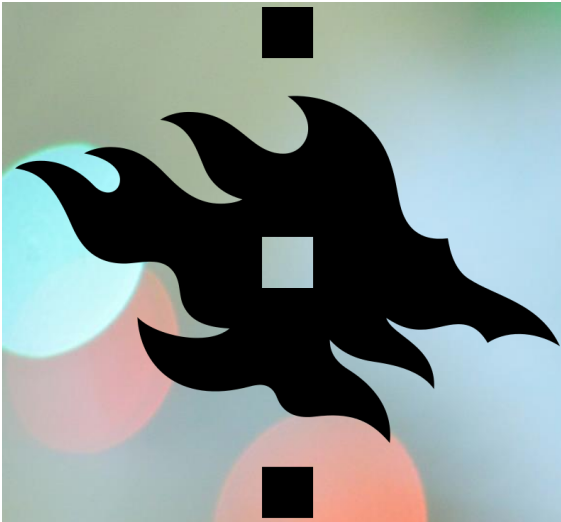
# MORE INFORMATION



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