University of Applied Sciences and Arts
Northwestern Switzerland

Formative Assessment in Inquiry – Based Science Education

Content

Inquiry – based learning in STEM education: a few definitions

Formative assessment in inquiry – based learning

Preliminary insights from the ASSIST-ME project

(Assess Inquiry in Science, Technology and Mathematics Education)

Peter Gray (2012)

- **Inquiry cannot be reduced to a single 'method'**
- **It is not constructivism, 'hands-on-science', or problem-based-learning**
- **Rather, inquiry is a philosophy of education,
  which values and enhances the ability, curiosity and critical thinking of individuals within social and scientific contexts**

National Research Council (NRC, 1996)

"[Scientific inquiry as] the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work. […]

Scientific inquiry also refers to the activities through which students develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world."

Dietmar Höttecke (2010, S. 5)

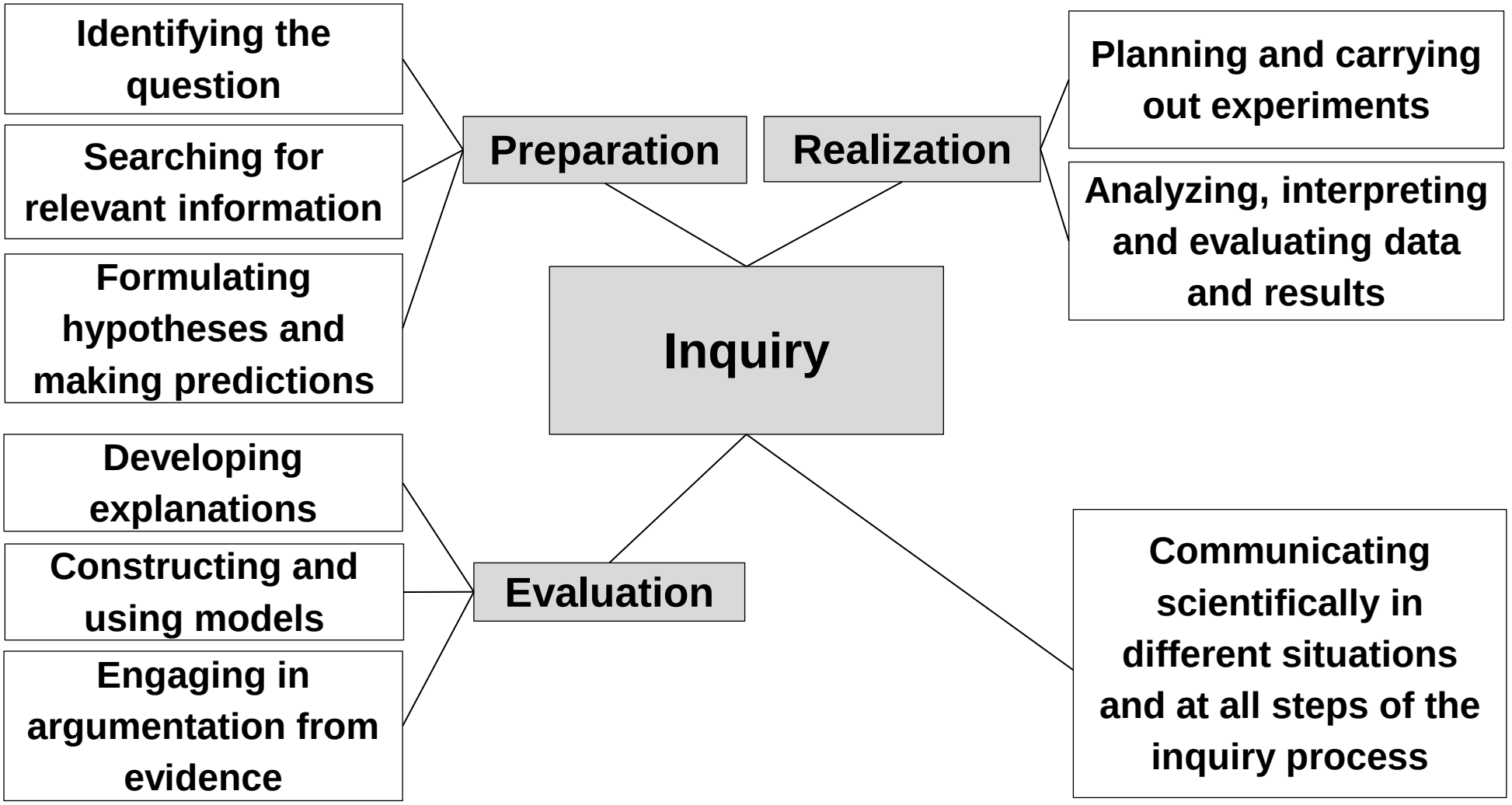
Die Lernenden gehen von (selbst) gestellten naturwissenschaftlichen Fragen oder Problemen aus. Sie explorieren Probleme oder Phänomenbereiche, entwickeln und planen auf dieser Basis eigene Untersuchungen, führen Beobachtungen und Experimente durch, stellen Messergebnisse sachgerecht dar, analysieren und diskutieren sie und erschliessen weitere Informationsquellen.

Sie erklären Phänomene und lösen Probleme im Lichte bereits bekannten Wissens und selbst generierter Evidenz. Sie treffen begründete Vorhersagen und kommunizieren über ihre oft unterschiedlichen Vorgehensweisen und Resultate. Sie generieren und präzisieren neue Fragen oder Probleme, die weiteres forschend-entdeckendes Lernen motivieren.

Marcia C. Linn, Elizabeth A. Davis, Philip Bell (2004)

**“[Inquiry is] the intentional process of
diagnosing problems,
critiquing experiments,
and distinguishing alternatives,
planning investigations,
researching conjectures,
searching for information,
constructing models,
debating with peers and
forming coherent arguments.”**

Inquiry in Science Education (ASSIST-ME)



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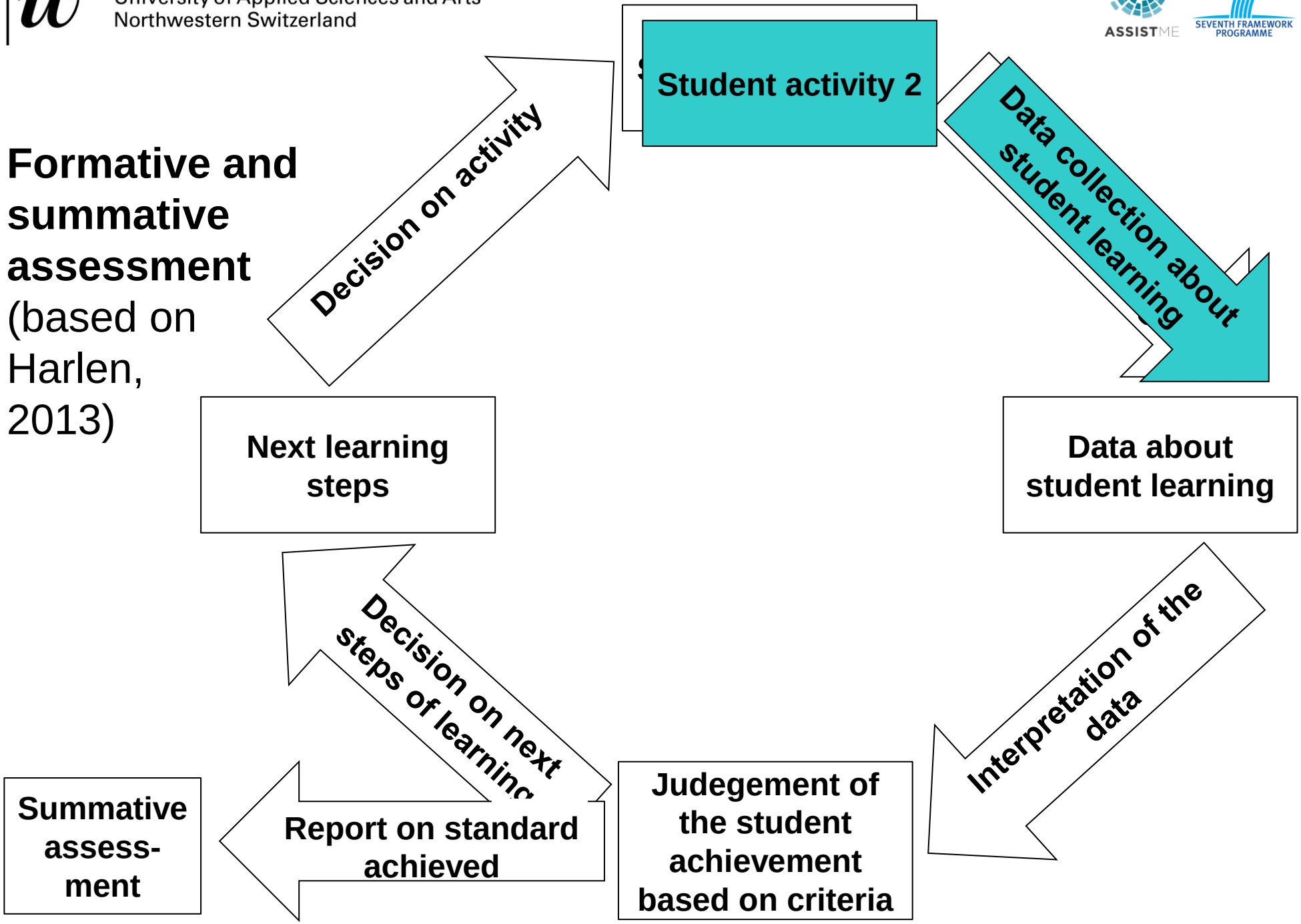
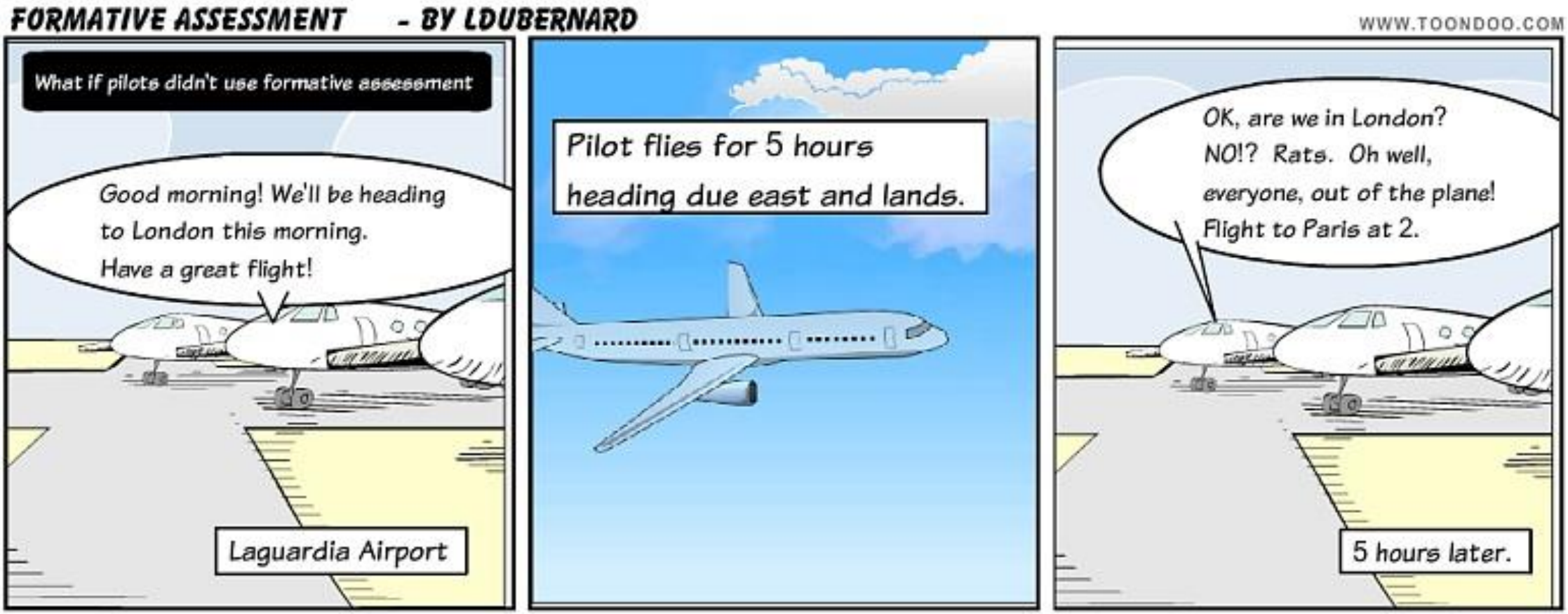
Formative and summative assessment (based on Harlen, 2013)




FORMATIVE ASSESSMENT - BY LDUBERNARD
WWW.TOONDOO.COM
What if pilots didn't use formative assessment
Good morning! We'll be heading to London this morning. Have a great flight!
Laguardia Airport
Pilot flies for 5 hours heading due east and lands.
OK, are we in London? NO!? Rats. Oh well, everyone, out of the plane! Flight to Paris at 2.
5 hours later.

Methods of formative assessment

- **On the fly (Ruiz-Primo & Furtak, 2004; 2006)**
- **Marking including grading and written comments (Smit & Birri, 2014; Black & Harrison, 2004)**
- **Self- and peer- assessment**
- **Open classroom discussions (Black & Harrison, 2004) and structured classroom dialogues (Christensen, 2004)**

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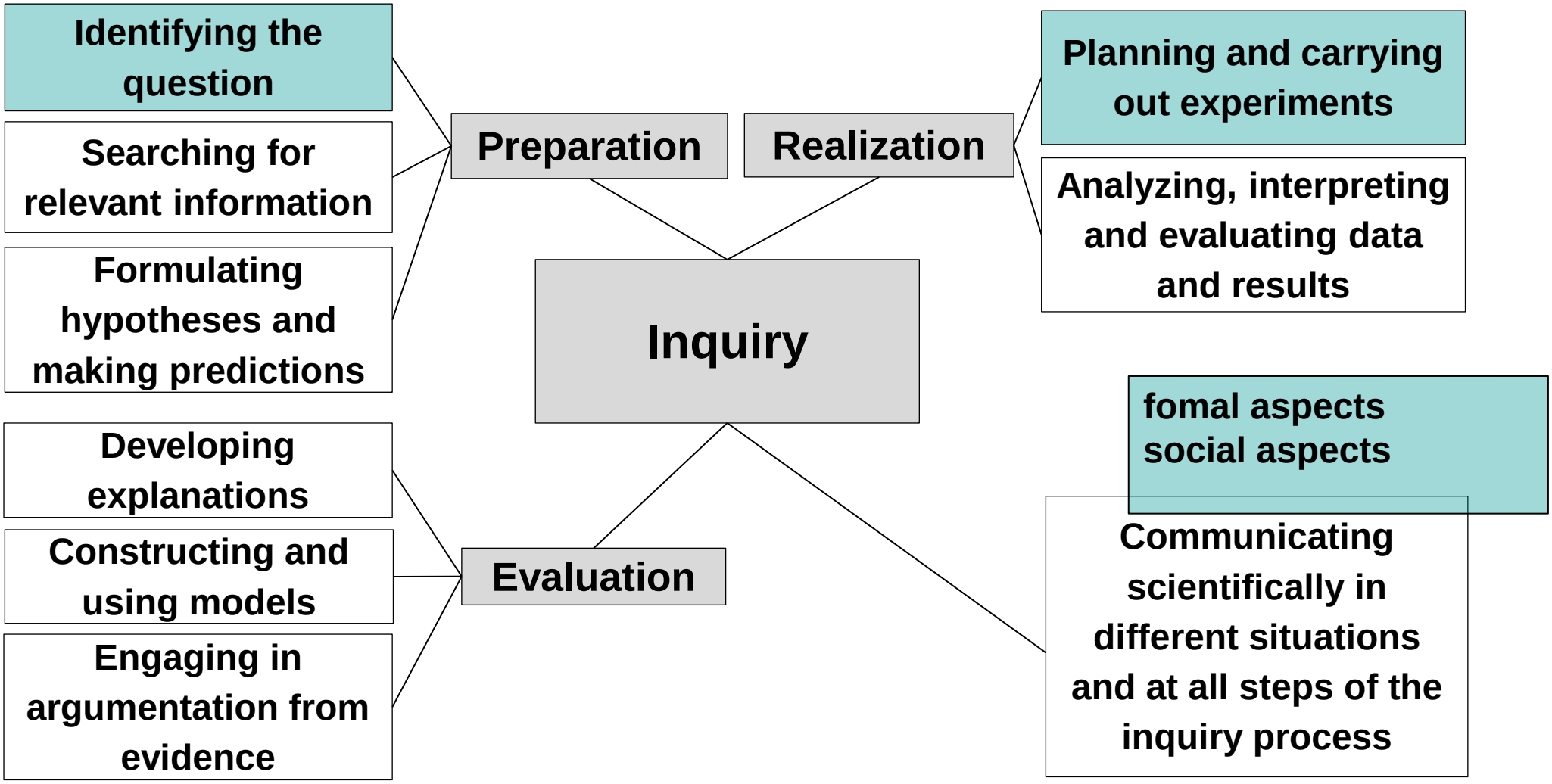
Science Teacher Group

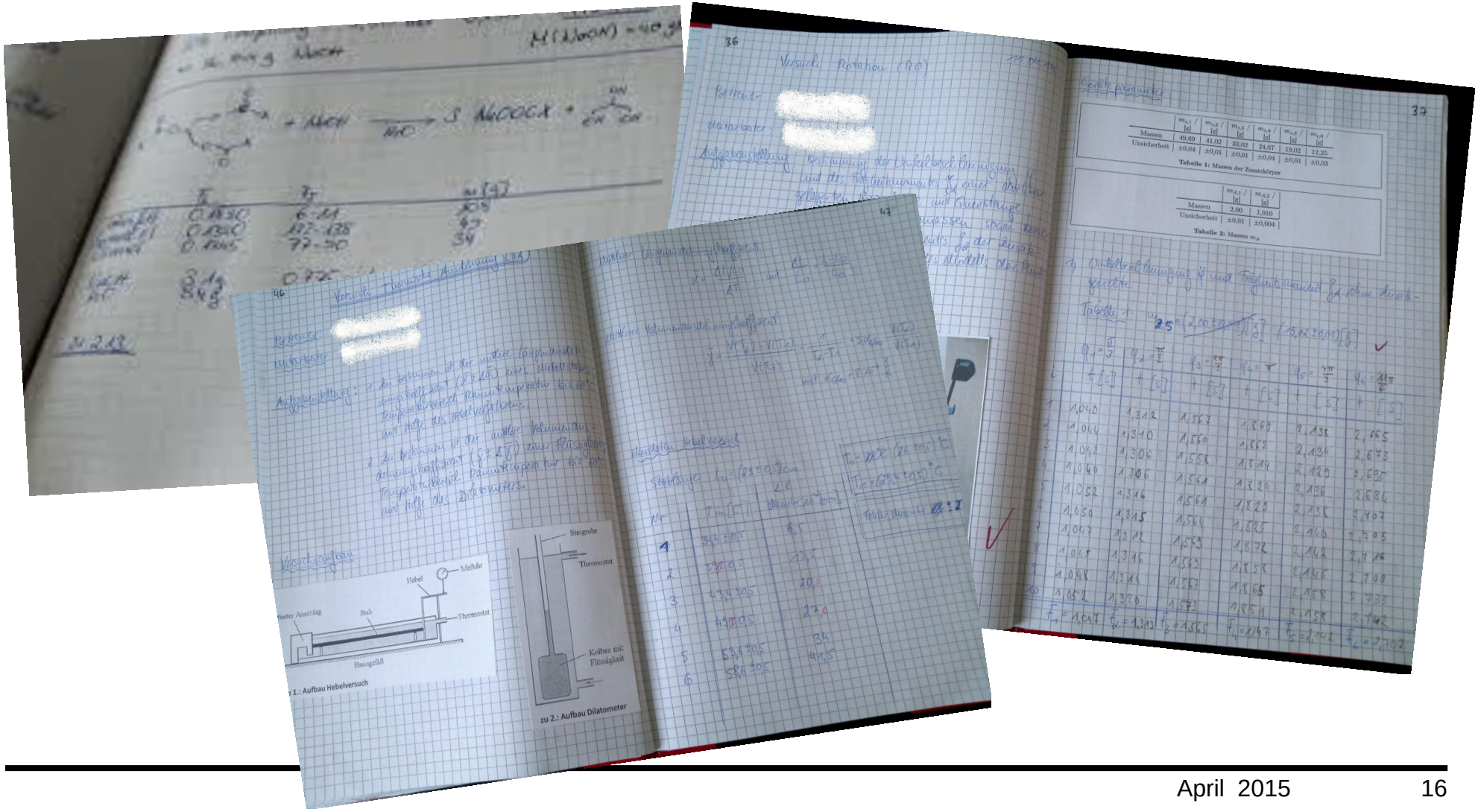
- **9 primary teachers who teach Integrated Science,**
  12 upper secondary Biology / Physics / Chemistry teachers
- **Collaboration in 3 rounds over 1 ½ years, starting from August 2014**
- **Data collection: teaching materials, evaluation forms, interviews**
- **Data analysis: qualitative content analysis**

Inquiry in Science Education (ASSIST-ME)



Example from the first round of implementation (I)

Example from the first round of implementation (II)



Interim conclusion

- **Inquiry-based units combined with formative assessment techniques and assessment criteria that are linked to Swiss standards in schoolbooks / on platforms with teaching materials**

- **Collaboration and exchange of ideas and experiences among teacher groups**

- **Mentoring for very specific, practical problems**

Thank you!

ASSIST-ME: Assess Inquiry in Science, Technology and Mathematics Education
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