LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

ECRICE 2020
Excellence and Innovation in Chemistry Teaching and Learning

DIDAKTIK DER CHEMIE LMU

Authenticity in (out-of-school) learning opportunities

ECRICE 2020 Webinar

July 6th 2020

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LMU Munich

Outline

1. Authenticity
2. Out-of-school learning
3. Research project on language

Outline

1. **Authenticity**
   - Theory
   - Benefits
2. Out-of-school learning
3. Research project on language

Authenticity: theory

- The term **authenticity** is often used to emphasize a close **link** between the **activity** or content and **scientific research** and practical techniques.
- But what are characteristics of this „link“?

“A simplistic notion is that **scientists represent ‚real science‘** and thereby bring an **authentic element** to science communication“.

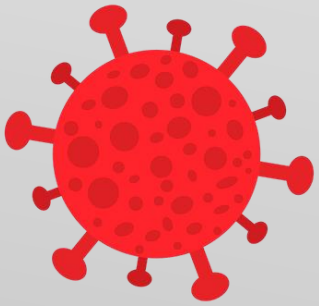
(Laherto et al., 2018).

“[…] improving the authenticity of science learning and communication certainly requires **more than ‘listening to researchers’** (cf. Kapon, Laherto & Levrini, 2016; Buxton, 2006; Rahm et al., 2003)”.

(Laherto et al., 2018)

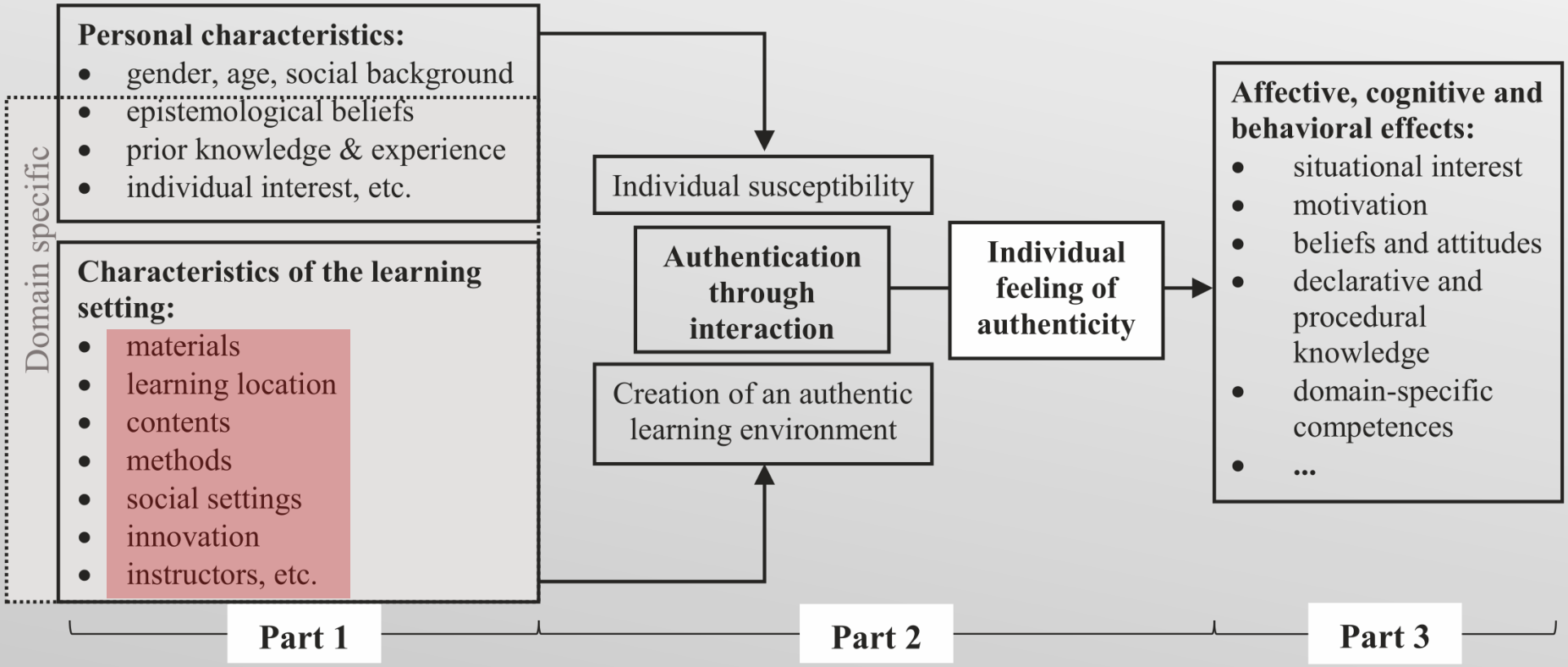
Authenticity: theory

- […], there are different contexts and also possibilities to convey authentic science to schools students, for example through **real data**, **actual materials** and **instruments** and the **contact to scientists** (Pea, 1994, Braund & Reiss, 2006).
- "[…] at least in terms of practical work in school science, that authentic science should provide **experiences** that are more **in line with** the sorts of activities that **scientists and technologists** do in **real world of science** […]" (Braund & Reiss, 2006).
- "[…] authentic inquiry tasks provide opportunities for students to experience **knowledge development** in **actual contexts of use**." (Lee & Butler Songer, 2003).



Authenticity: theory

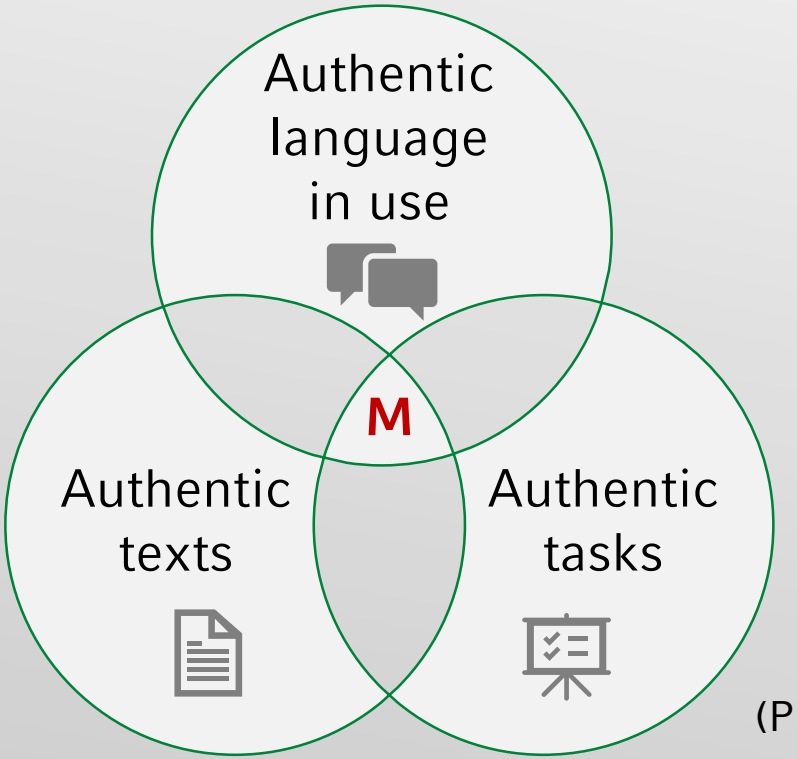
- Model of authenticity in teaching and learning contexts



(Nachtigall et al., 2018)

Authenticity: theory

- More detailed characteristics of the learning setting feature: 'Materials'



(Pinner, 2013)

- **English** as language (of science) **contributes** to perceived **authenticity**

Authenticity: benefits

- Why to foster students' perceived authenticity in out-of-school learning settings?
  - Improves **students' attitudes** towards science and scientific careers
    (Coll & Paku, 2011)
  - Important contributor to positive **science engagement**
    (Woods-McConney et al., 2013)
  - Foster the **engagement** and (situational) **interest** in science (Nachtigall, 2018)

Outline

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1. Authenticity
2. **Out-of-school learning**
   - LMU*chemlab*
   - Experiments
3. Research project on language

Out-of-school learning: LMU*chemlab*

- Science labs for school students, e.g. LMU*chemlab*
- Characteristics of the learning setting:
  - Addresses students from the age of **14 years**
  - **Preparation and follow-up** work in school
  - Lab work at the university on the topic of **modern materials** and **sustainability**

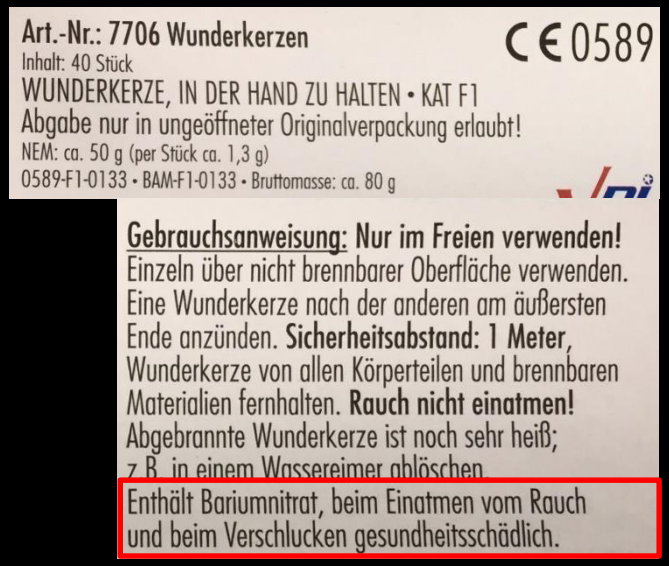
LMU chemlab

Out-of-school learning: experiments

- LMU*chemlab* experiments were **educationally reconstructed** in close cooperation **with chemists** of the department
- Experimental stations on:
  - "Green" **sparkler** (Scheid et al., submitted)
  - Synthesis of a **LED** phosphor (Diekemper et al., 2019)
  - **3D printing** and investigation of filaments (Scheid et al., 2019)
  - Azulene **after sun-care** (Hollweck & Schwarzer, in print)
  - …

Out-of-school learning: experiments

- Starting point: Commercial sparklers contain **barium nitrate** as oxidizer [1], which is harmful to health.


Art.-Nr.: 7706 Wunderkerzen
CE 0589
Inhalt: 40 Stück
WUNDERKERZE, IN DER HAND ZU HALTEN • KAT F1
Abgabe nur in ungeöffneter Originalverpackung erlaubt!
NEM: ca. 50 g (per Stück ca. 1,3 g)
0589-F1-0133 • BAM-F1-0133 • Bruttomasse: ca. 80 g

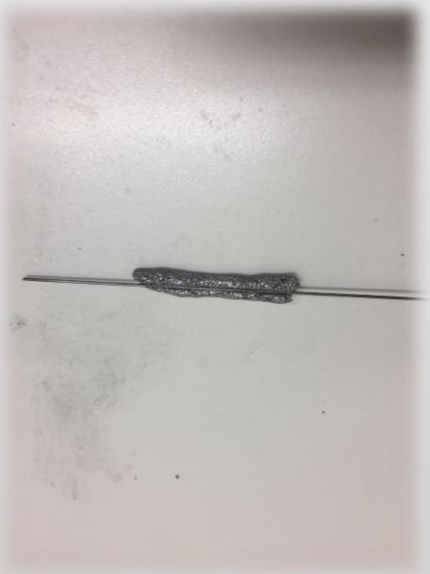
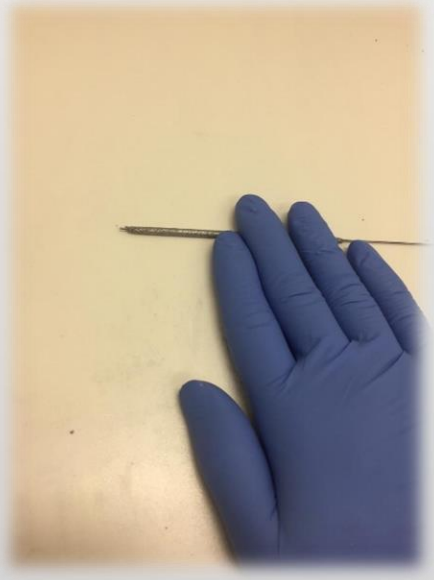
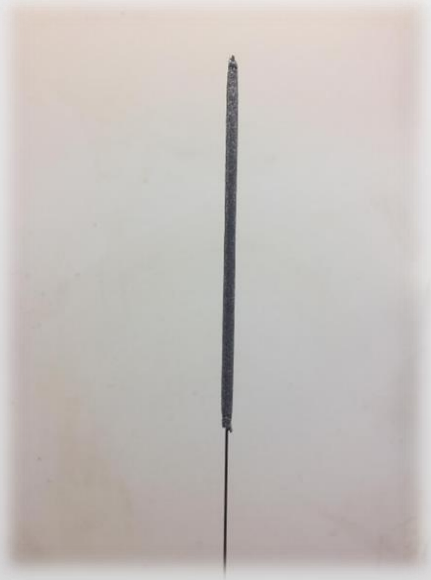
Gebrauchsanweisung: Nur im Freien verwenden!
Einzeln über nicht brennbarer Oberfläche verwenden. Eine Wunderkerze nach der anderen am äußersten Ende anzünden. **Sicherheitsabstand: 1 Meter,** Wunderkerze von allen Körperteilen und brennbaren Materialien fernhalten. **Rauch nicht einatmen!** Abgebrannte Wunderkerze ist noch sehr heiß; z.B. in einem Wassereimer ablöschen.
Enthält Bariumnitrat, beim Einatmen vom Rauch und beim Verschlucken gesundheitsschädlich.

- "Contains barium nitrate, harmful to health if swallowed and smoke is inhalated."

[1] Nico Sparkler, Art.-Nr.: 7706.

Out-of-school learning: experiments

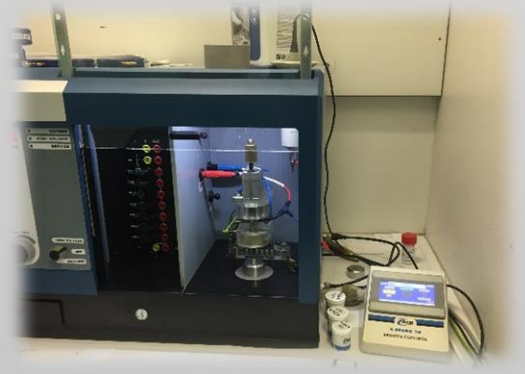
- Production of a barium-free sparkler, using **strontium nitrate** instead (Scheid et al., submitted).

- New developed sparkler is **less threatening for health** and environment ➔ Therefore classified as "green" alternative.

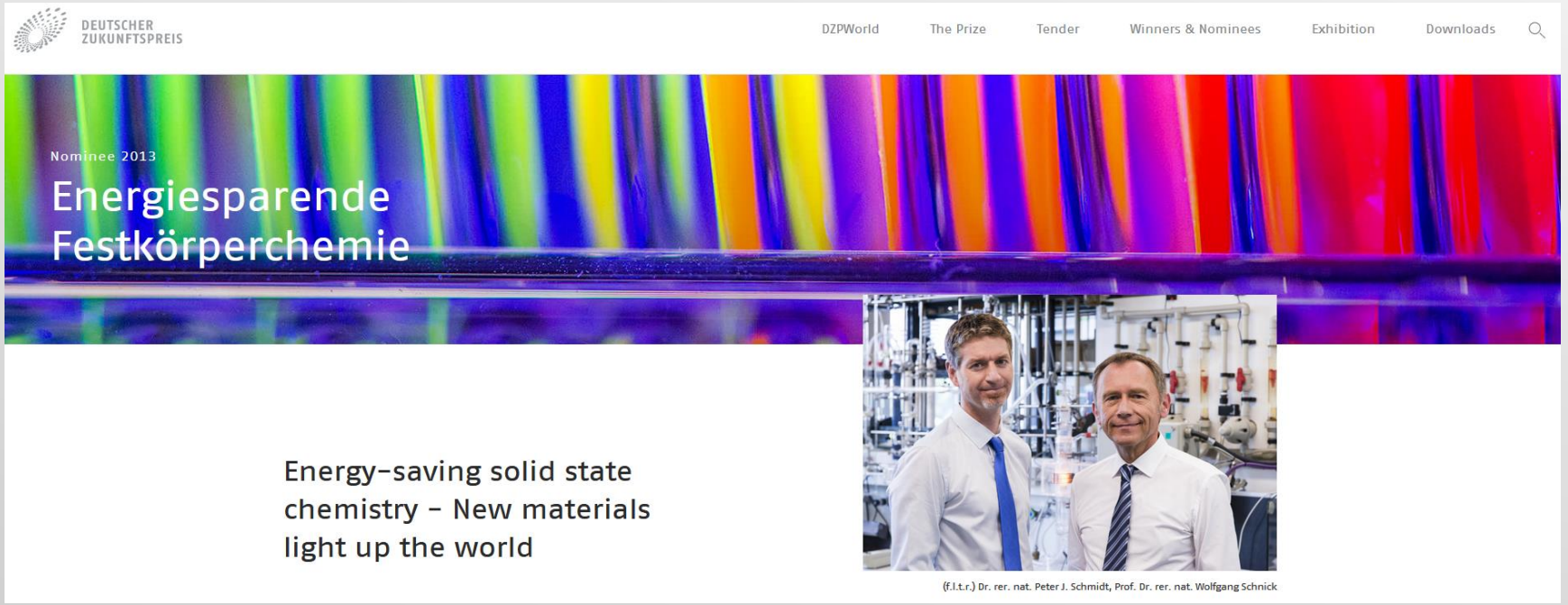
Out-of-school learning: experiments

- Various tests for categorization of the high-energetic sparkler material show: the newly developed chemical composition are **not to be classified as explosive**.
- For the first time school **students are allowed to produce** their own sparklers in school or student lab.



Out-of-school learning: experiments

- Latest research on **LED** and luminescent materials (“phosphor”):

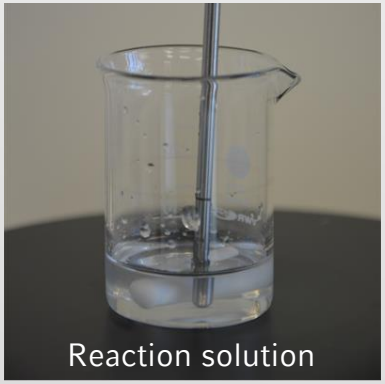


(www.deutscher-zukunftspreis.de/en/team-3-2013)

- Microwave synthesis of a **LED phosphor** with light converting properties for school students.

Out-of-school learning: experiments

- Synthesis of the LED phospor **YAG:Ce** (Diekemper et al., 2019)


Reaction solution


Searching Hotspots


Reaction vessel

$$3\,\mathbf{Y(NO_3)_3} + 5\,\mathbf{Al(NO_3)_3} + 20\,\mathbf{CO(NH_2)_2} \rightarrow\ \mathbf{Y_3Al_5O_{12}} + 20\,\mathbf{CO_2} + 40\,\mathbf{H_2O} + 32\,\mathbf{N_2}$$

Out-of-school learning: experiments

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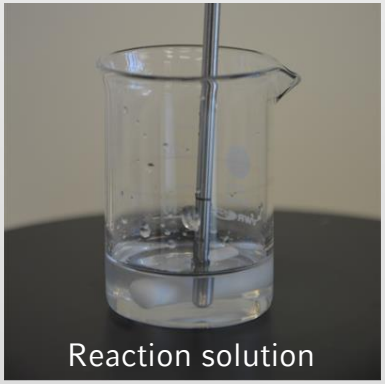
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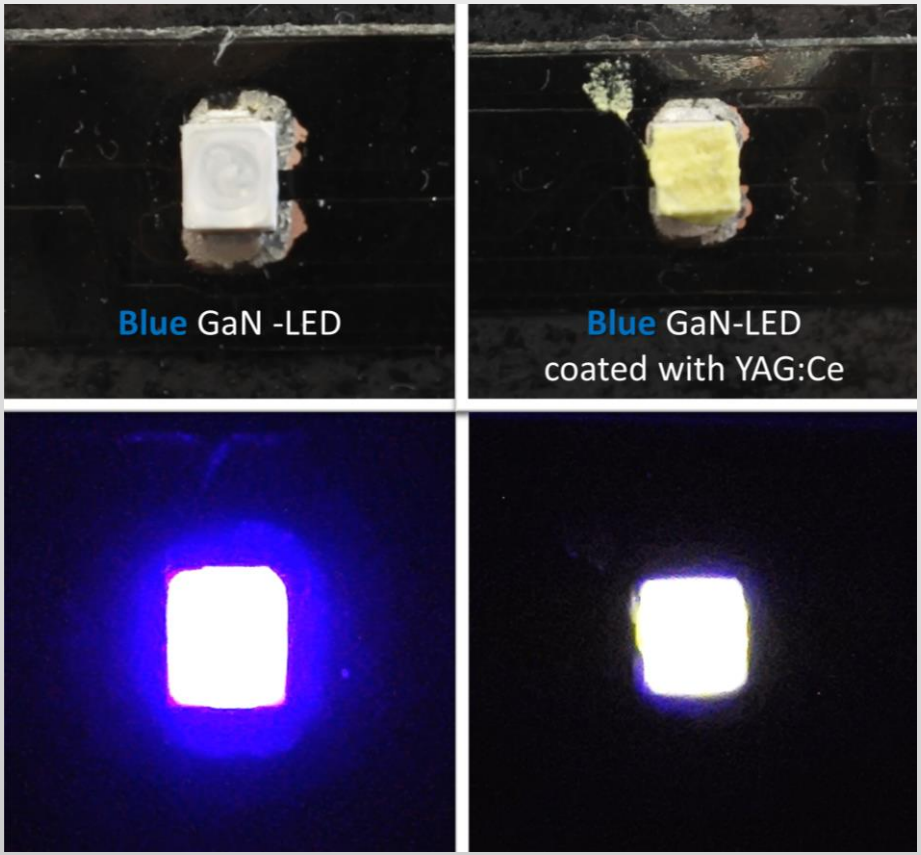
Out-of-school learning: experiments

- Investigation of **colour converting properties** (Diekemper et al., 2019)



- Visible change in colour from **blue to yellow-white**

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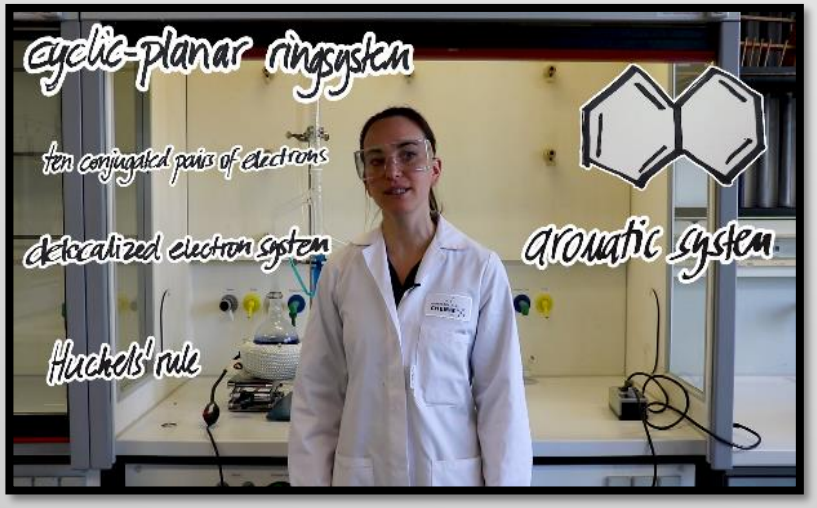
- A content and language integrated learning (**CLIL**) approach in a chemistry lab for school students
- Students work in the foreign language (**language of science**) English ➔ Models of Nachtigall and Pinner
- Introductory **video vignettes** for each experimental station on subject matter content and scientific practice

LMU chemlab



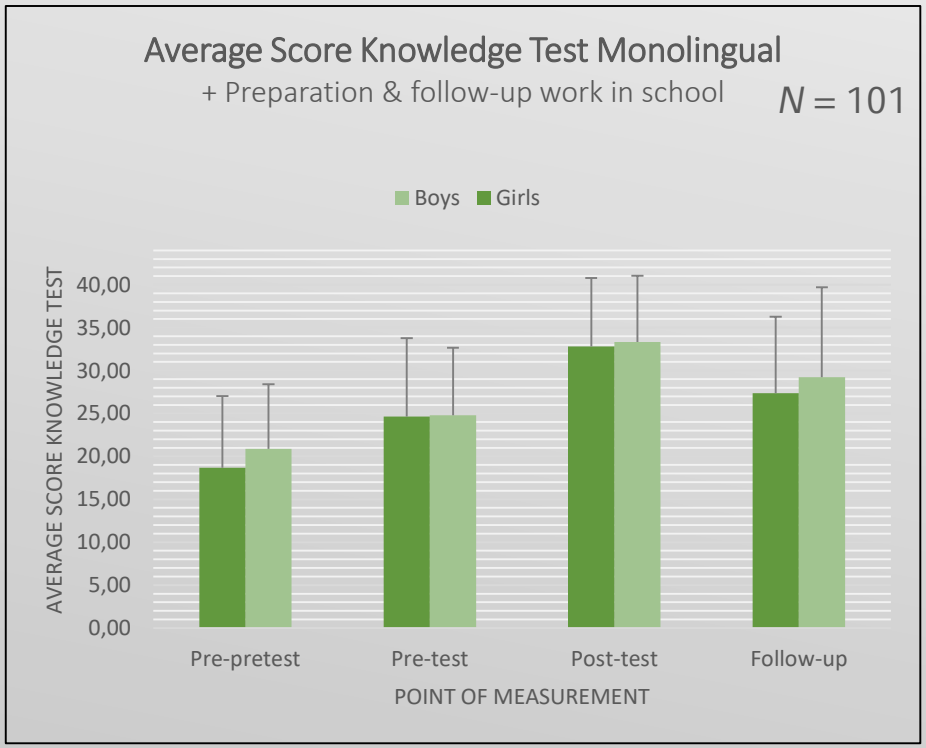
(Hollweck & Schwarzer, in print)

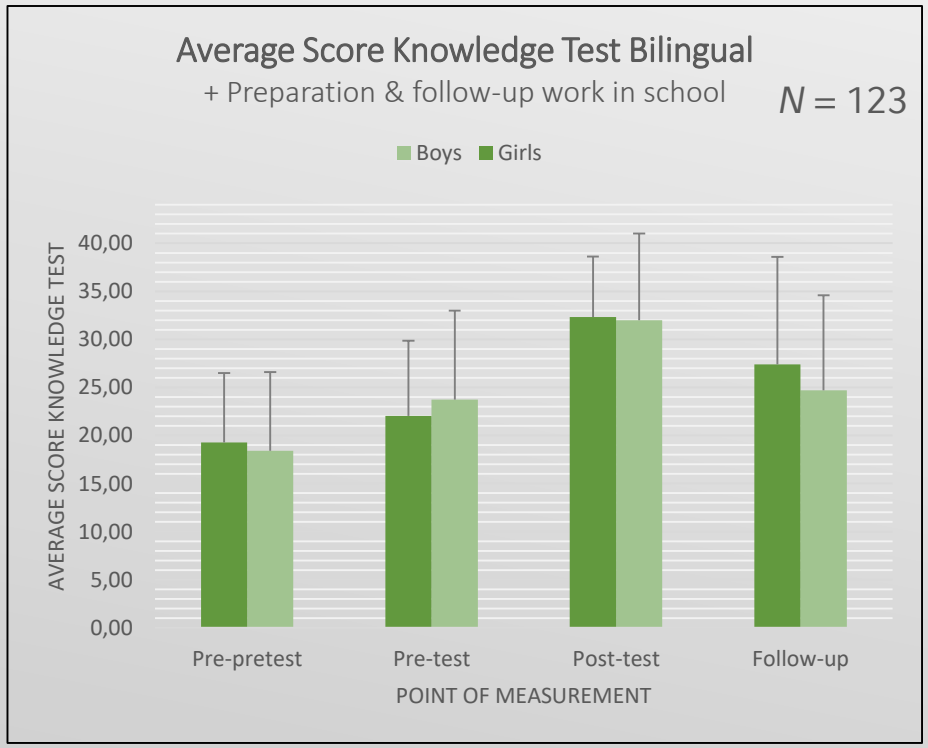
- **Expectations** on a CLIL chemistry student lab setting:
  - Possible benefits for girls and boys, because:

    girls tend to be more oriented towards **languages** (Schmenk, 2004).

    boys appear to show more interest in **sciences and technology** (Gardner 1985; Britner 2008).
- **Fear**: bilingual students acquire **less content knowledge**, due to the additional challenge of a foreign language

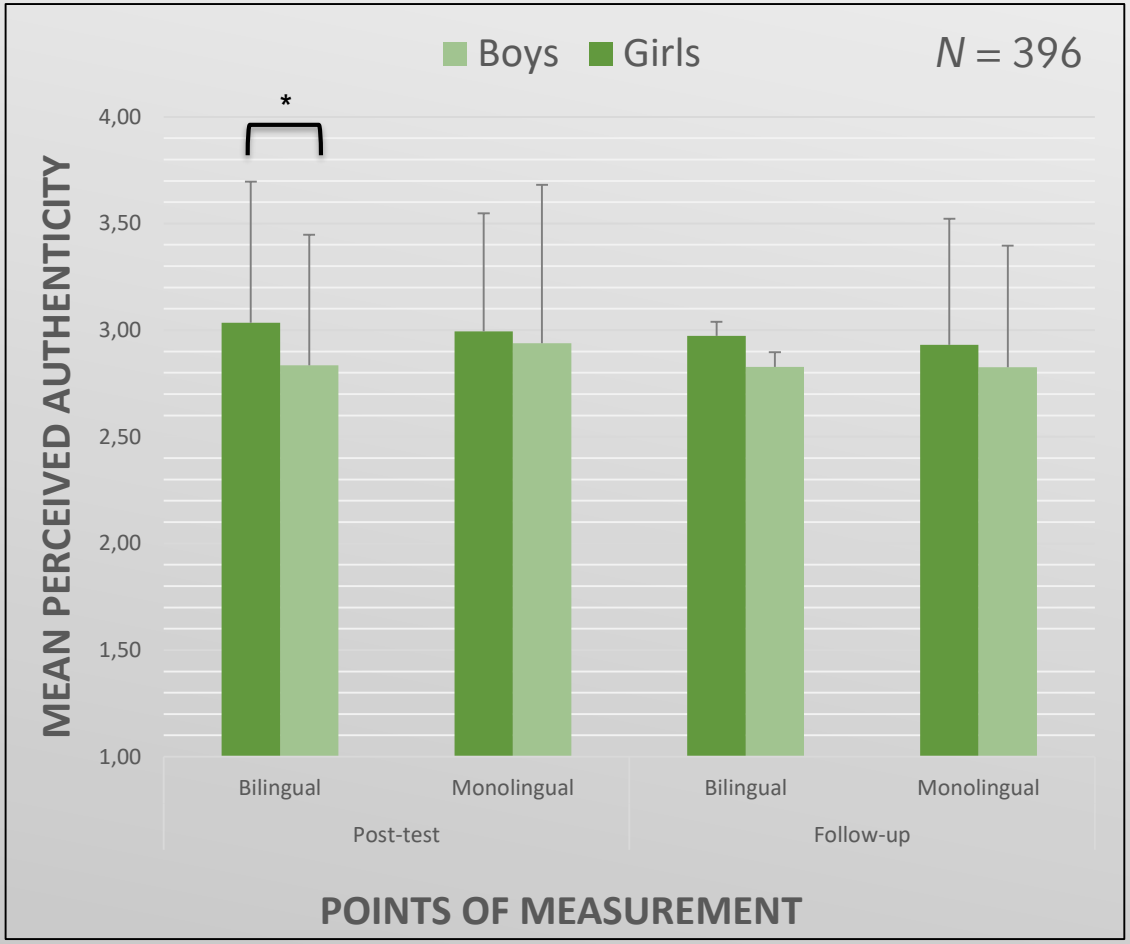
- **No differences** in monolingual and bilingual groups, concerning content **knowledge**.





(Hollweck, unpublished)

- Treatment has a short term **improvement** of the perceived **authenticity of girls** in our bilingual student lab.



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