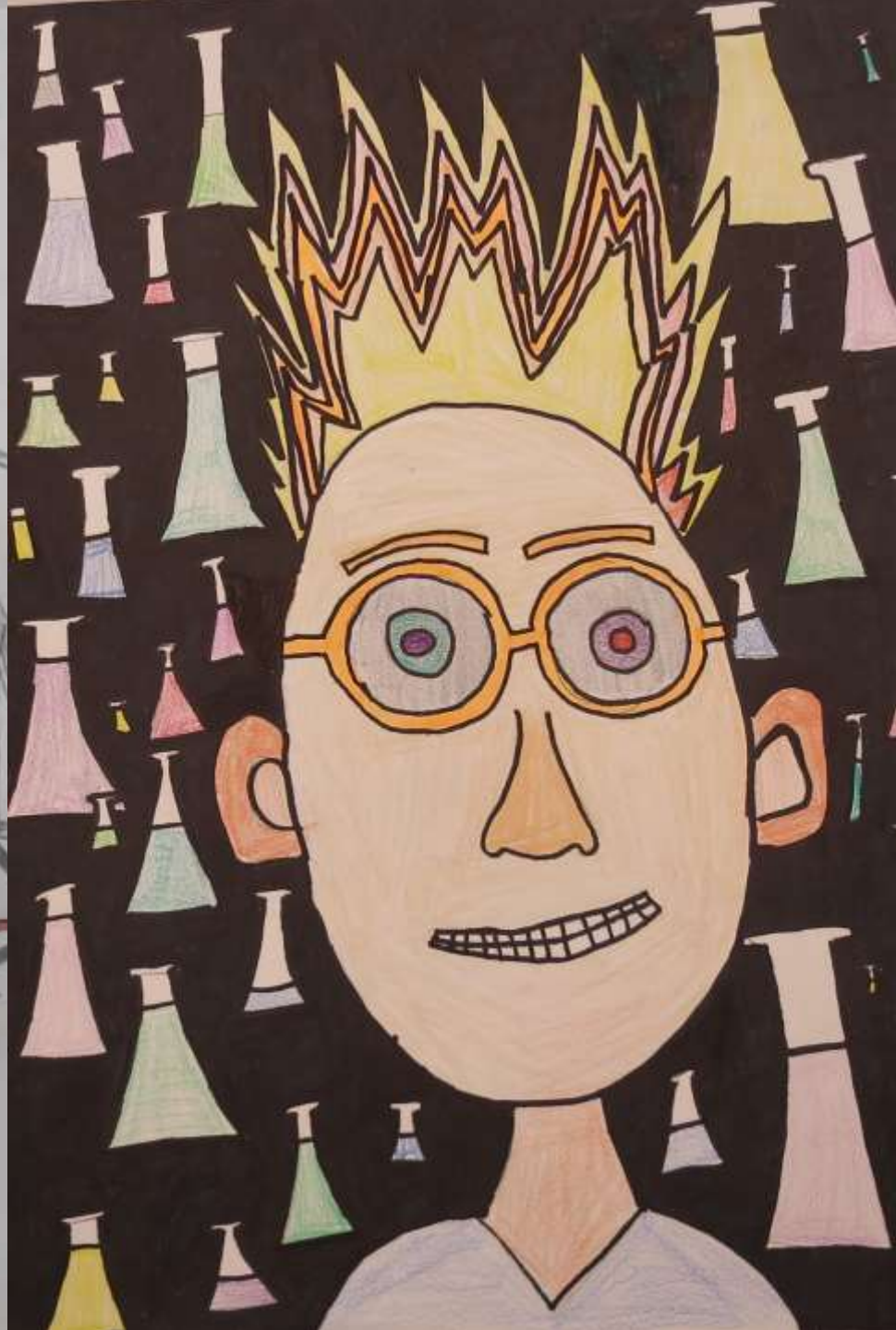


Pädagogische Hochschule Wien

Inquiry Based Learning in the primary science classroom

The importance of high-quality teacher professional development

ISTA, May 2017

Christian Bertsch

Reforms demand IBSE/IL

MINT

DER UNTERRICHT VON MORGEN

Auf dem Weg zu mehr Zukunftsqualifikationen für Österreich

Im Auftrag

bm:uk des Bundesministeriums für Unterricht, Kunst und Kultur

BMWF des Bundesministeriums für Wissenschaft und Forschung

LehrerInnenbildung NEU.
Die Zukunft der pädagogischen Berufe.

Sparkling Science >
Wissenschaft ruft Schule
Schule ruft Wissenschaft

Die Empfehlungen der ExpertInnengruppe.

Endbericht

bmwfw

….for more than 100 years

"Science has been taught too much as an accumulation of ready-made facts with which students are to be made familiar, not enough as a method of thinking"

„ …. science teaching in Austria is currently focussing on imparting factual knowledge. Both, conceptual understanding and the understanding about the nature of science are underdeveloped"

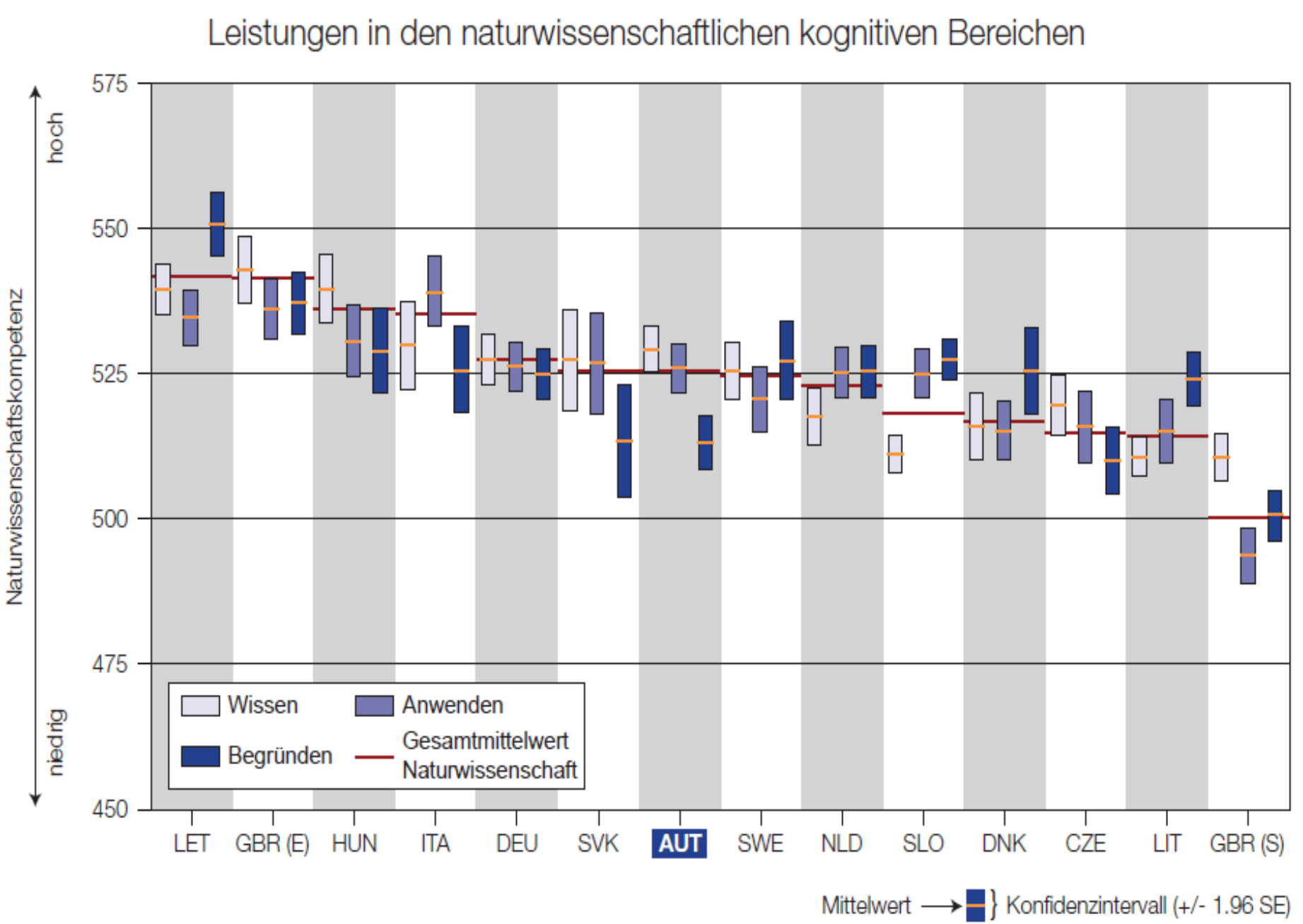
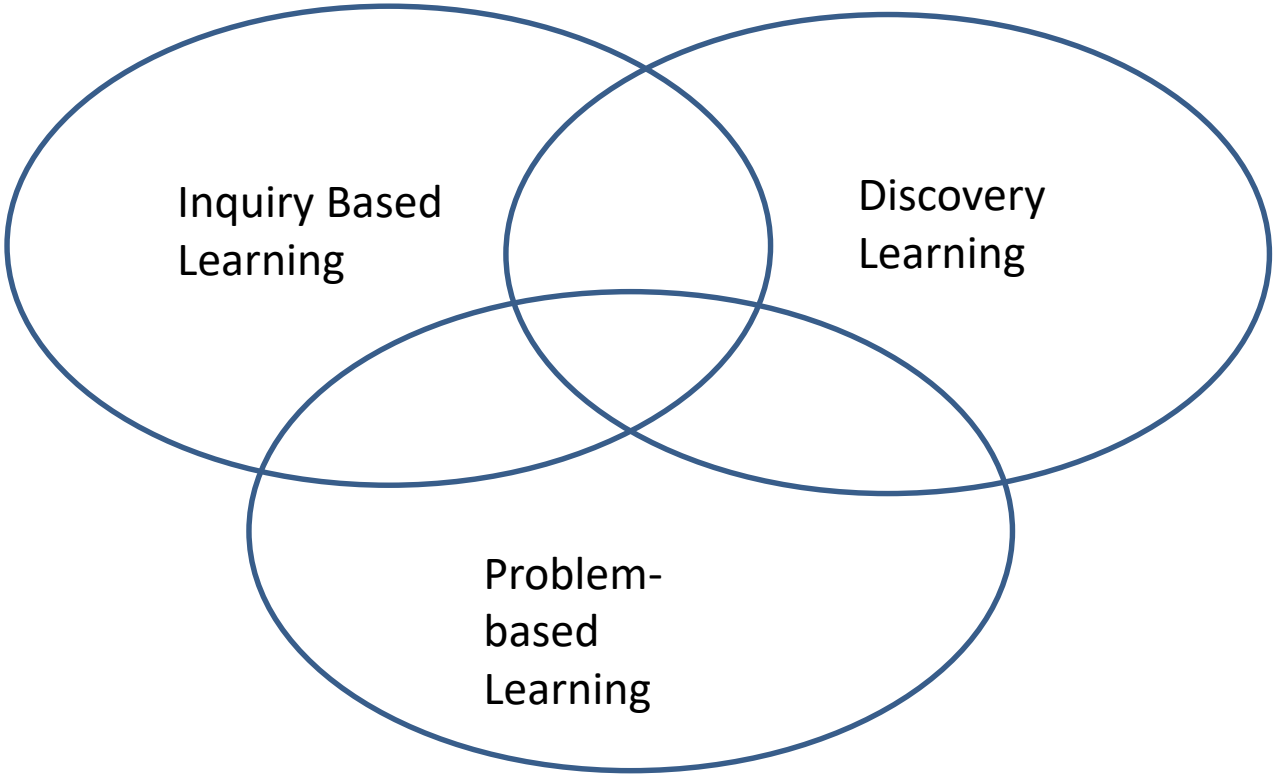


Abbildung 1.2.5: Leistungen in den naturwissenschaftlichen kognitiven Bereichen Wissen, Anwenden und Begründen im europäischen Vergleich (TIMSS 2007)

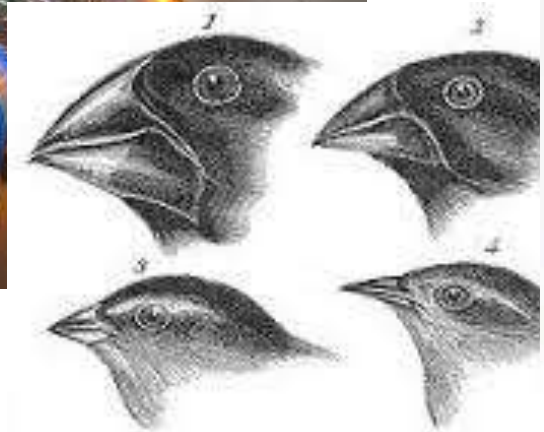
IBSE

"Not surprisingly, in the world of science education, there is not a current unified view of precisely how inquiry should be defined [..]."

Magee & Meier (2011)



IBSE mimics scientific practice



Finches from Galapagos Archipelago

*"Science has many methods of investigation, but all are based on the notion that **some form of evidence is the basis for defensible conclusions"** (Abd-El-Khalick 2004)*

IBL = evidence-based learning

- S. engage actively in the learning process with emphasis on observations and experiences **as sources of evidence.**
- S. practice and develop the skills of systematic observation, questioning, planning and recording **to obtain evidence.**
- S. participate in collaborative group work, interact in a social context, **construct discursive argumentation** and communicate with others as the main process of learning.

- **Teacher scaffolds and guides learning, facilitates negotiation of ideas and highlights criteria for formulating classroom knowledge.**

Does IBSE foster conceptual understanding?

Not better than teacher-centered methods (Hattie, 2010)

→ impact on process-knowledge, but not on conceptual knowledge

„Doing not better than seeing“. IBSE is focussing learners attention towards immediate aims (What am I doing). More complex aims (Why am I doing this) are overlain (Steffens, 2007)

“… as far as science concept understanding is concerned, our conclusion is that expertly designed instructional units, sound ***active-engagement lessons*** *and good teaching are as important as whether a lesson is cast as inquiry or direct*” (Coburn et al, 2010)

Does IBSE foster conceptual understanding?

"…. if students get the opportunity to engage in active thinking and are subsequently asked to draw conclusions from data they are more likely to understand the inherent scientific content" (Minner et al. 2010)

Focussing exclusively on hands-on aspects does neither foster conceptual understanding nor understanding about the nature of science!

IBL= evidence-based learning

- S. engage actively in the learning process with emphasis on observations and experiences as sources of evidence.
- S. practice and develop the skills of systematic observation, questioning, planning and recording to obtain evidence.
- S. participate in collaborative group work, interact in a social context, **construct discursive argumentation** and communicate with others as the main process of learning.

- **LINKING HANDS-ON and MINDS-ON**

- ***Fosters both conceptual understanding and epistemological understanding (Bertsch, Kapellari and Unterbruner, 2014)***

Analysis of science experiments in schoolbooks at primary level

56% no question visible

79% cookbook like experimental setup

8% formulating a hypothesis (what do you think?)

7% systematic observation

6% develop experiments on their own

8% looking for explanation on their own

1% encourages students to formulate a question

(Greinstetter 2011)

Primaryschool-teacher concepts about IBSE

What are the most important elements of IBL?

(n=20 teachers taking part in CPD on IBL, Pretest)

„Being active, doing, autonomous acting without specifications"

„Active involvement"

„The buzzword is trial, trying, doing it on your own"

„Hands-on! Doing experiments. Being active!"

The importance of high-quality teacher professional development

High quality Professional Development on IBL

1: High quality Professional Development must immerse participants in inquiry, questioning and experimentation

Modeled inquiry forms of teaching for the most important science topics in the Austrian primary school curriculum

2: Professional Development must be both intensive and sustained. There should be long-term, coherent professional development plans

40 hours over a period of two years

3: PD must engage teachers in concrete teaching tasks and allow personal experiences

Teachers were asked to put into practice what we discussed in the workshops between the training sessions and discuss their experiences with the other participants

High quality professional development on IBL

4: Professional development must focus on subject-matter knowledge and deepen teachers' content skills.

5: Primary school teachers normally lack authentic research experience. Therefore we added a workshop focusing explicitly on the nature of science to support teachers in learning about inquiry and the nature of science.

> Teachers had opportunities for *learning through inquiry* and *learning about inquiry.*

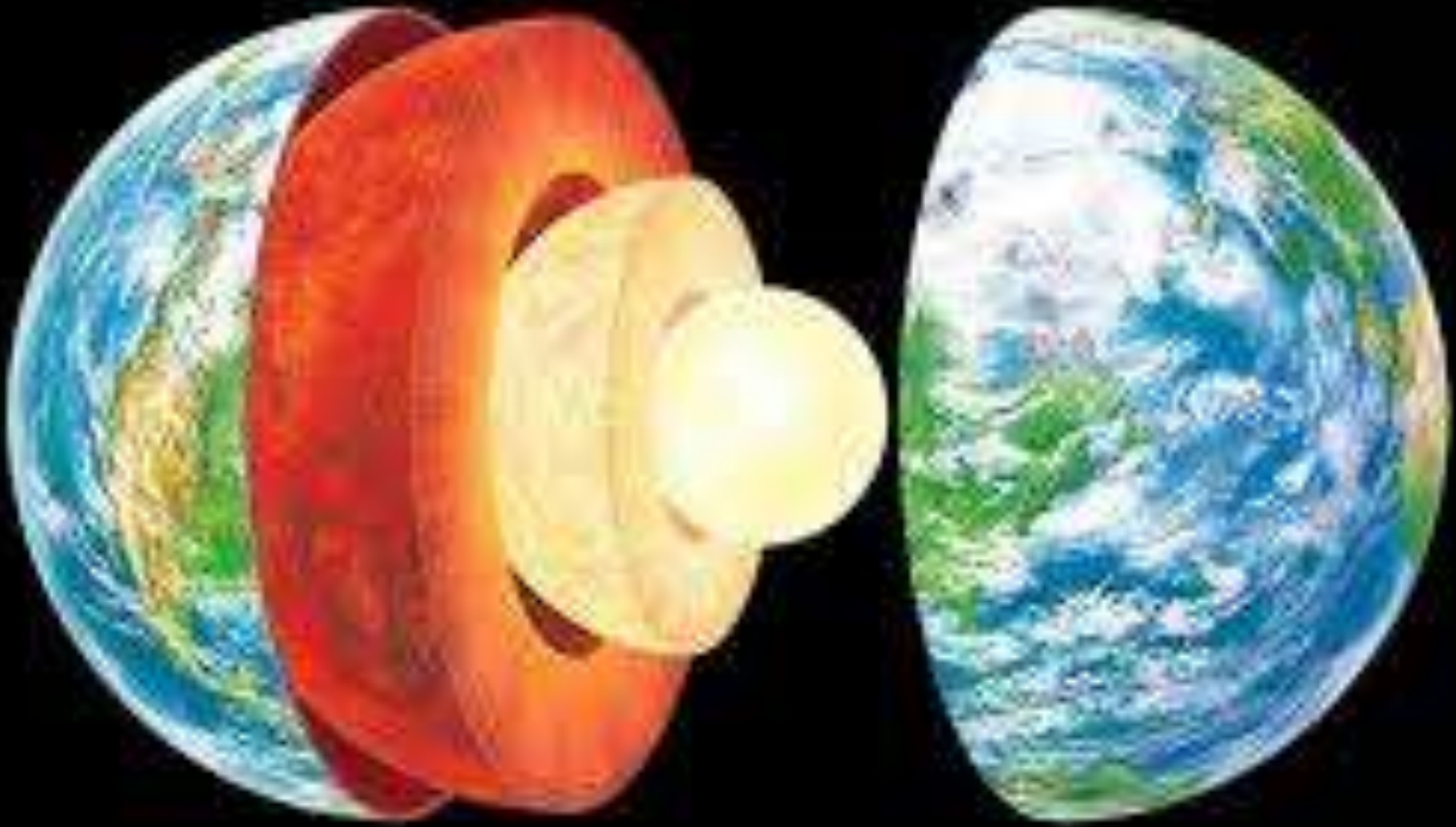
NOS in the primary science classroom

Scientific knowledge is based on or derived from observations of the natural world.

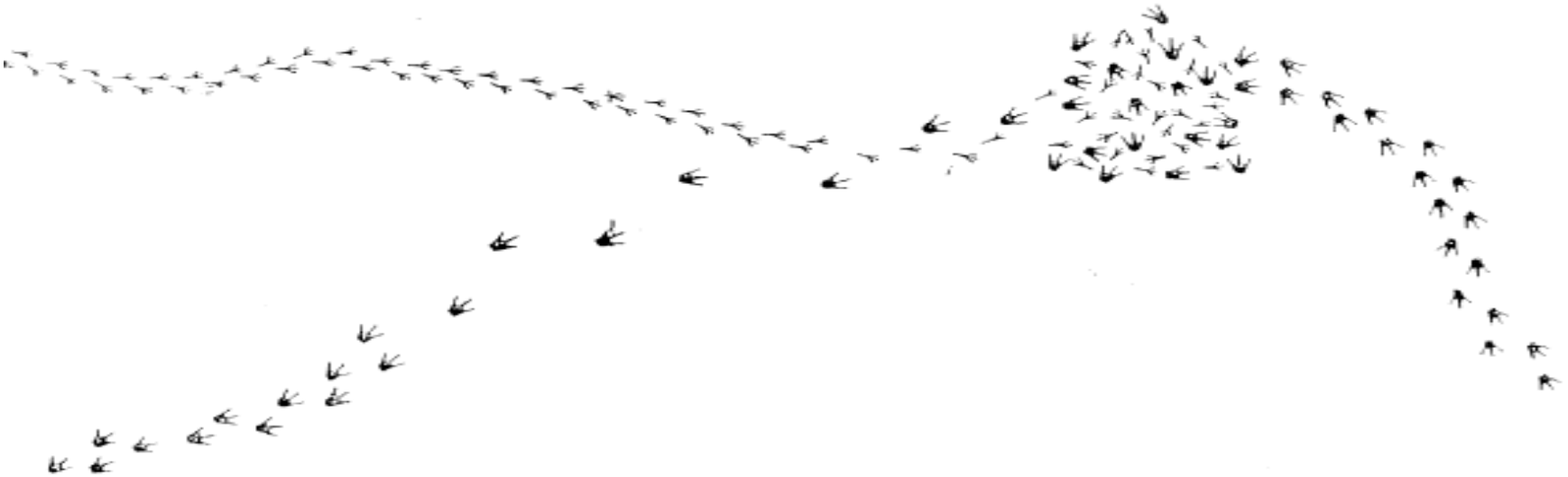
Although scientific knowledge is empirically-based, it nevertheless involves human imagination and creativity.

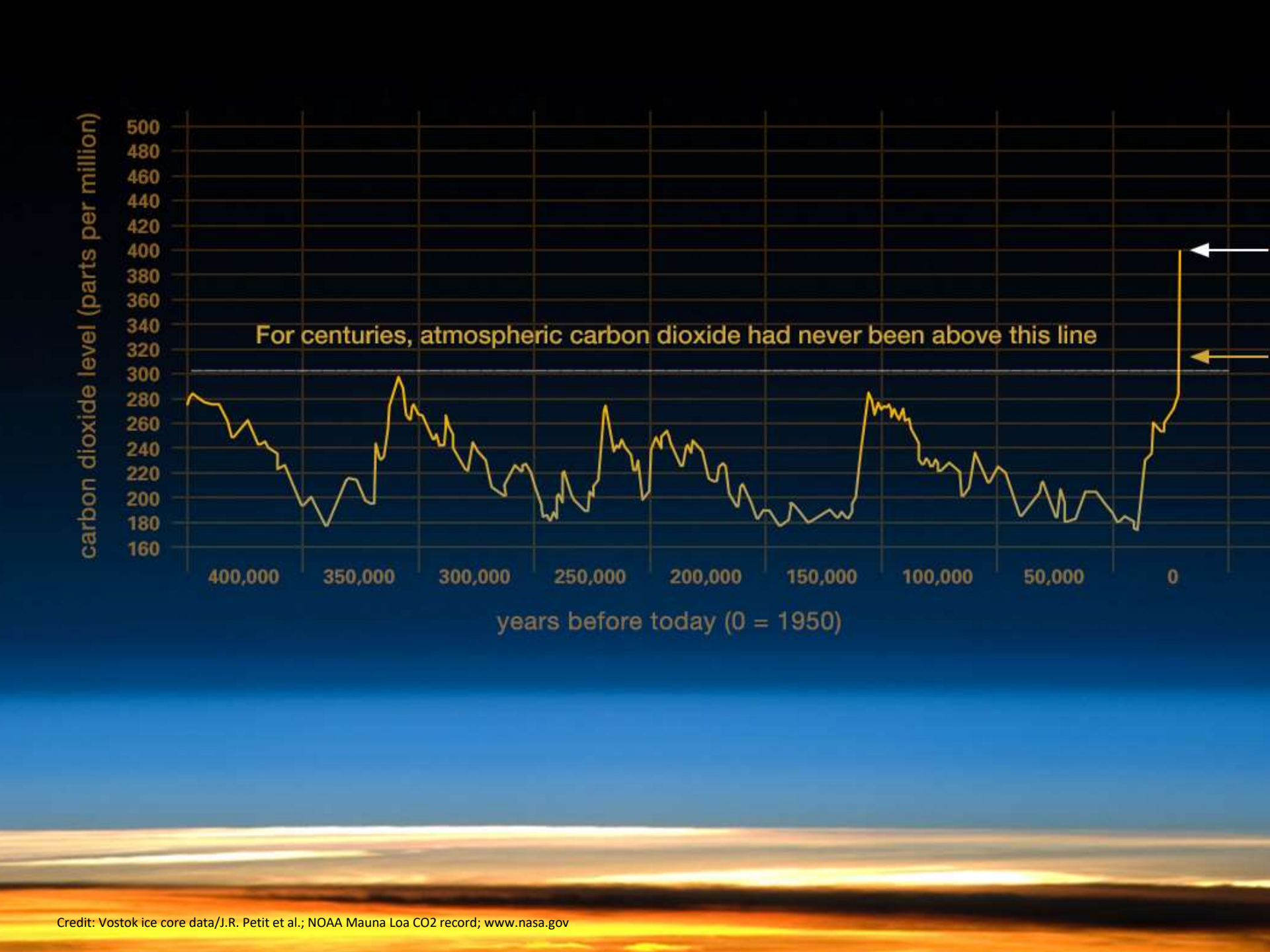
Scientific knowledge is tentative and subject to change.

Scientific evidence is collected through various methods. These methods follows certain criteria (fair testing, replicable,…)



Observation - Inference





Credit: Vostok ice core data/J.R. Petit et al.; NOAA Mauna Loa CO2 record; www.nasa.gov

... look for patterns and try to convince a critical audience

Scientific evidence for global warming of the climate system is compelling.

ipcc
INTERGOVERNMENTAL PANEL ON climate change

Donald J. Trump
@realDonaldTrump

Folgen

The concept of global warming was created by and for the Chinese in order to make U.S. manufacturing non-competitive.

CPD - Testing and Evaluation

CPD for 60 primary school teachers (Wien, Graz, Salzburg)

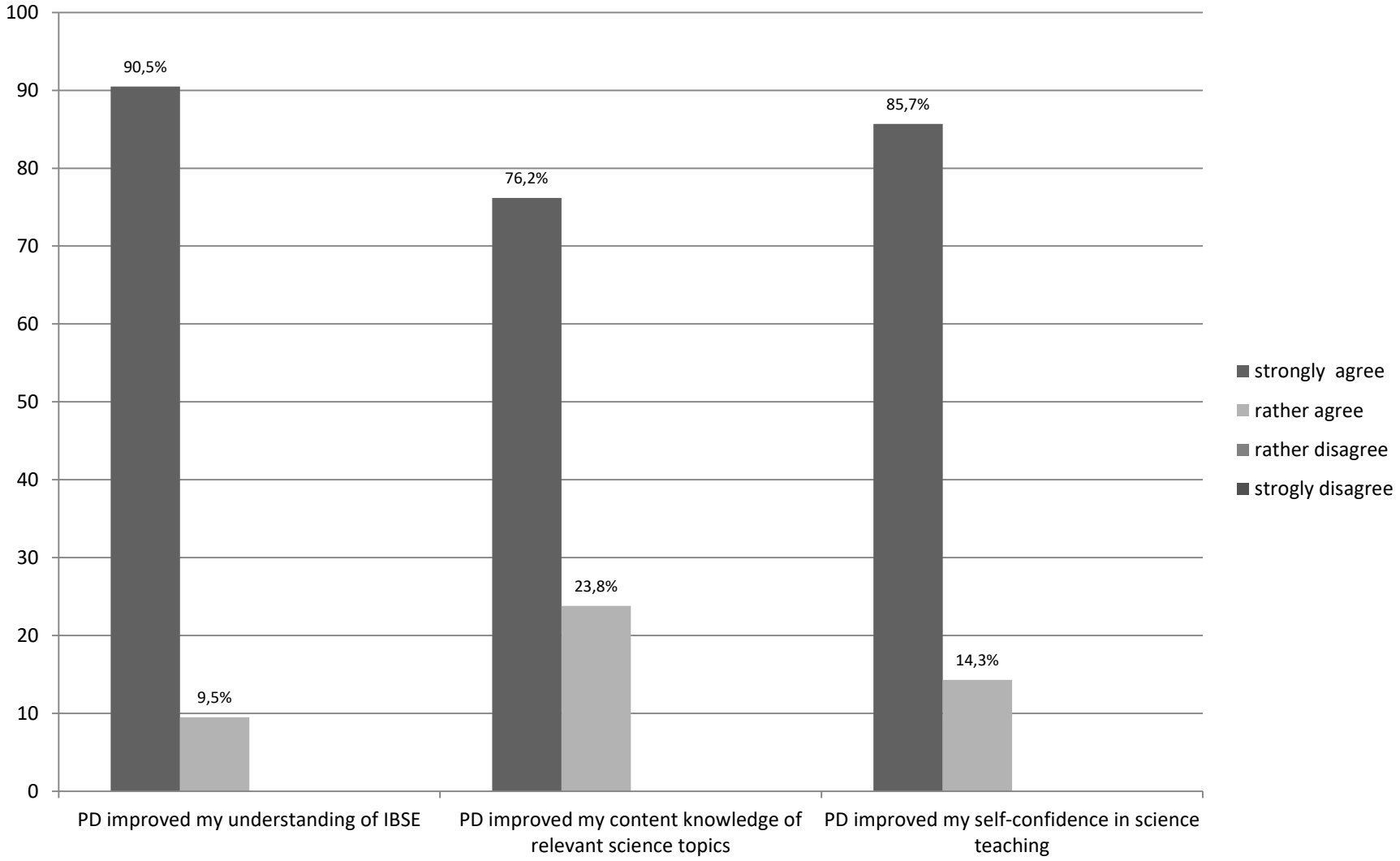
8 days in two years

Questionnaire: Pre/Post

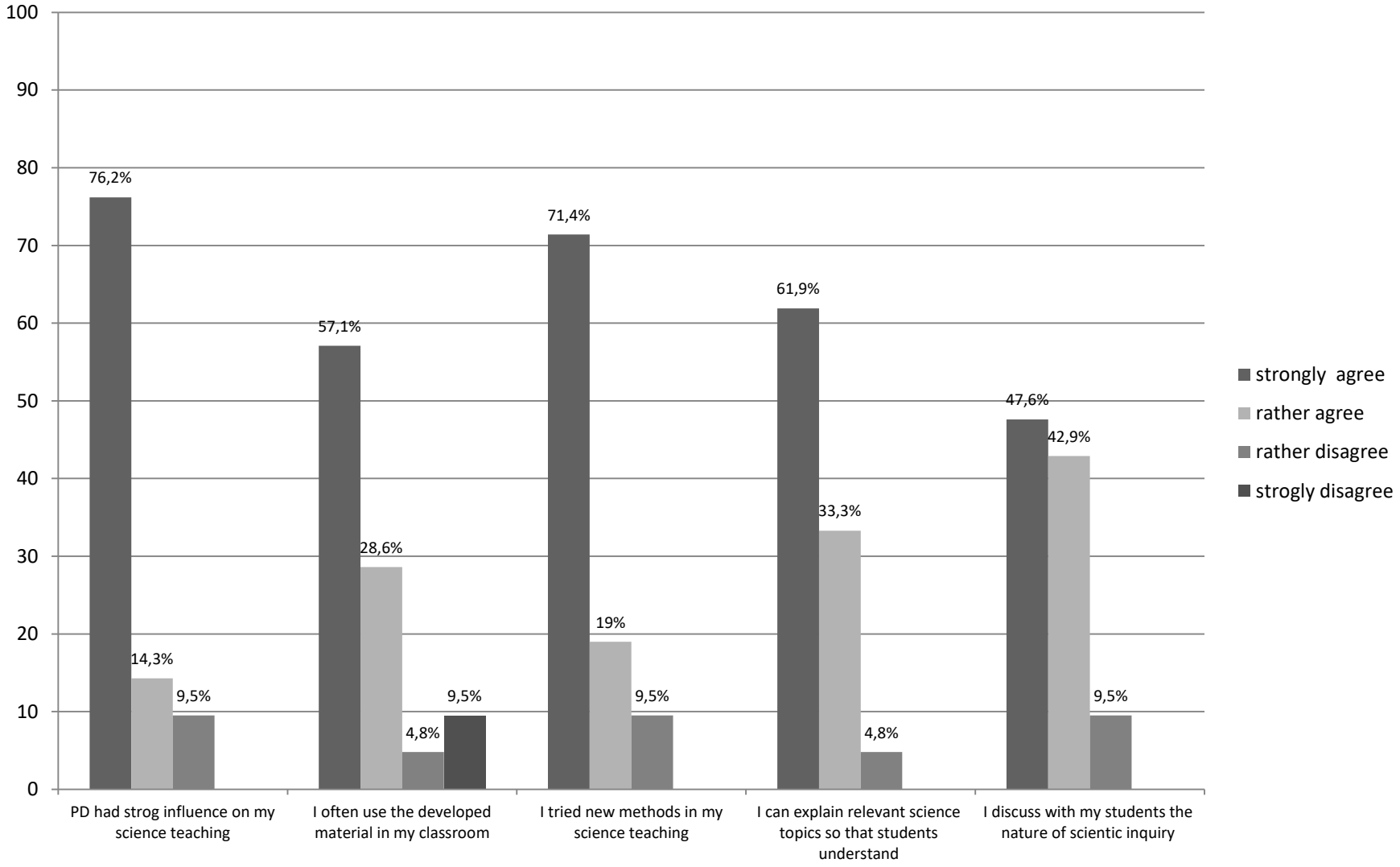
Interviews with 20 participants: Pre/Post

Analysis of developed teaching material

Evaluation: Impact on teacher knowledge and self-confidence



Evaluation: Impact on science teaching



Participants concepts about IBL

What are the most important elements of IBL?

(n=20 teachers taking part in CPD on IBL, Posttest)

„Hands-on must be followed by Minds-on!“

„Even if the students don‘t like it very much. I insist that they write down what happens and why the think it happens“

„Students draw conclusions on the basis of their observations and write them down. Even if they are not necessarily correct.

„I stopped working at stations (each group working with different experiments). Now I focus my science teaching on direct observation and group discussion. Very easy experiments are sufficient to engage students in focused observation.“

„Together we work on explanations for the observations we made“

Conclusion

“Science has been taught too much as an accumulation of ready-made facts with which students are to be made familiar, not enough as a method of thinking”

21st century skills: creative problem-solving, critical reflection of information, communication and collaboration, distinction between facts and opinions, media- and information-literacy.

IBL actively addresses these skills.

Quality of teachers is the major determinate of educational systems.

Invest in high-quality CPD to support teachers. One-off courses must be questioned.


Sand

Thank you!

christian.bertsch@phwien.ac.at

www.science2school.at

science learning network

www.mintschule.at