



Biology education to bridge the gap between science and society:

Citizen science by monitoring and protecting wild bees and wasps

Yelva Larsen, Maurice Kalweit, Denis Messig, Felix Fornoff







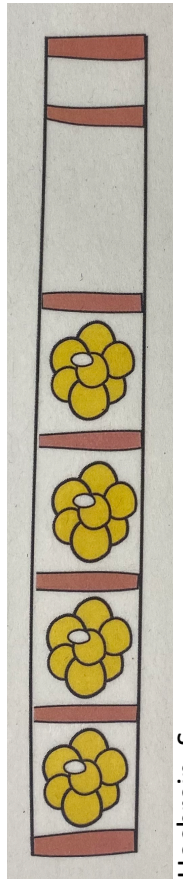


pollen
willowherb

nectar
blackberries

nesting material
willowherb

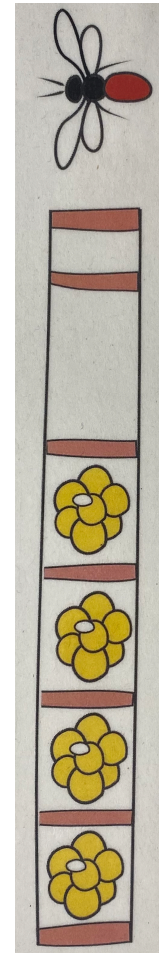
nesting cavities
insect feeding tubes
in dead wood



2017: How it started at the University of Freiburg ...



Fornoff, F.



Hochrein, S.

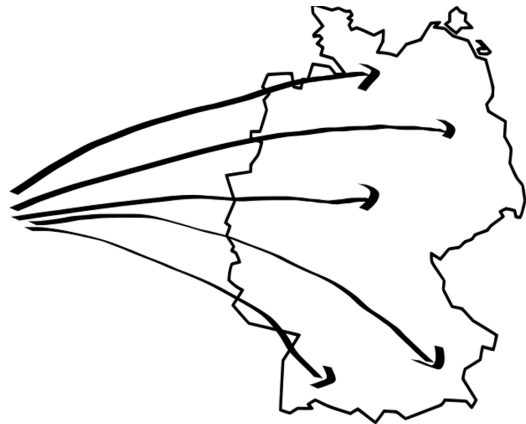
2019: Pupils as citizen scientists

adapted from Fornoff, F., et al.
Schulinsektenhaus (2019)

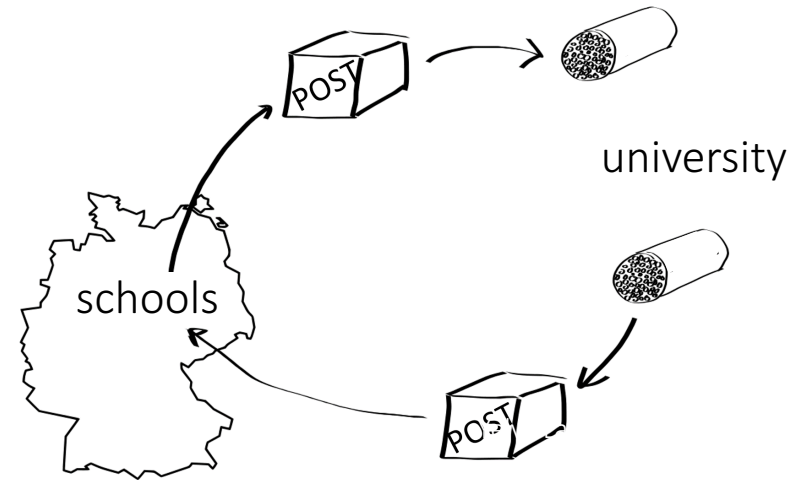
nesting aids



university

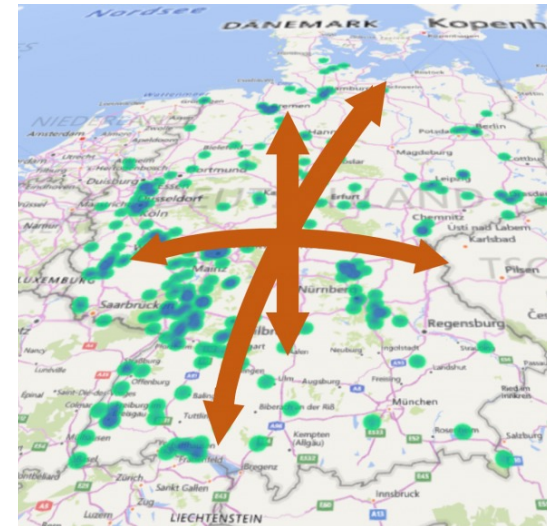


321 schools



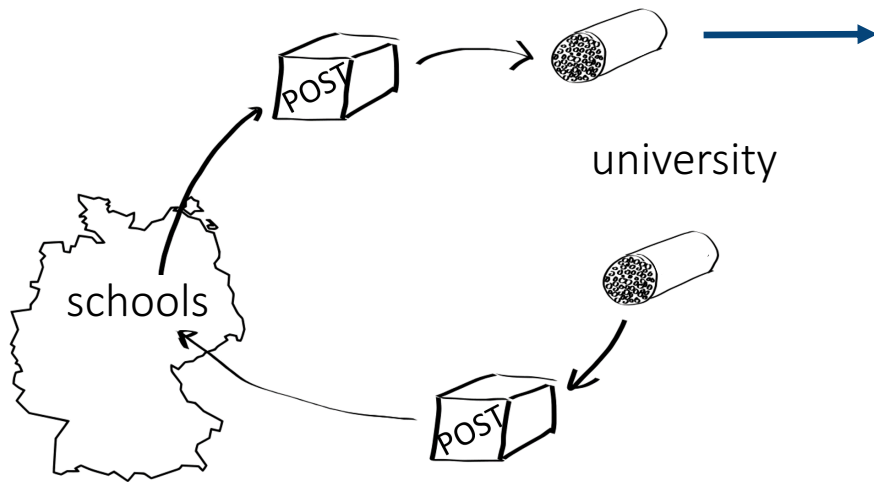
2019: Pupils as citizen scientists

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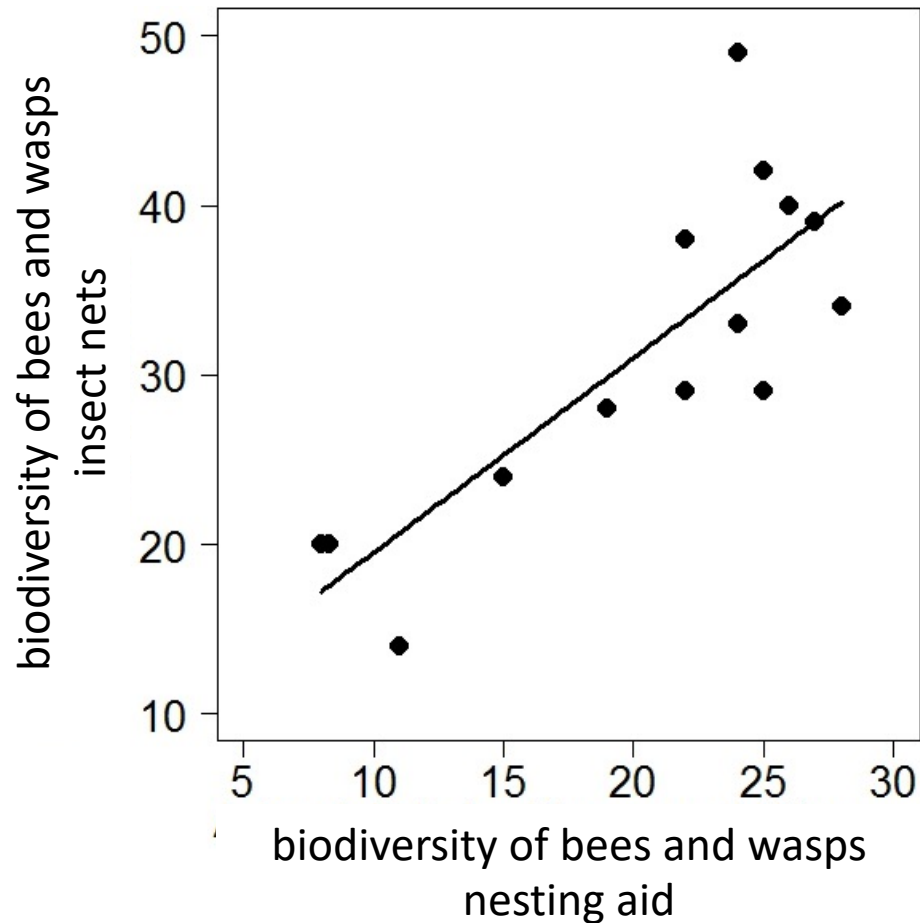
2019: Pupils as citizen scientists

adapted from Fornoff, F., et al.
Schulinsektenhaus (2019)



Scientific significance of nesting aids

adapted from Fornoff, F., et al.
Schulinsektenhaus (2019)
graph based on Tschardt et al.
(1998)



- ✓ increase in species diversity of bees and wasps can be recorded in equal measure using both survey methods
- ✓ species diversity observed is representative of bee and wasp diversity in the area
 - although less than 10% of native wild bees use this type of nesting aid

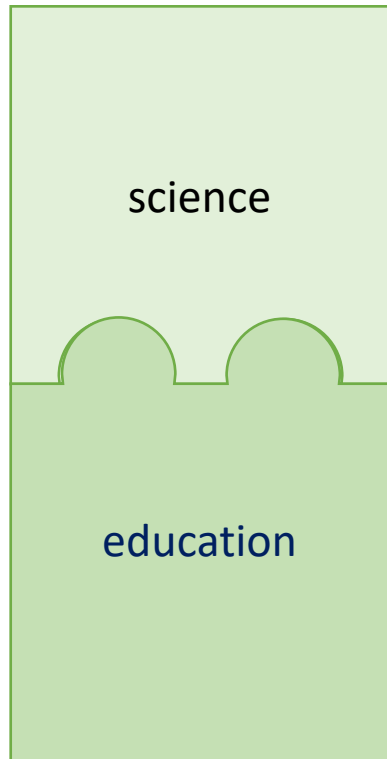


2019 – 2024 ... The story goes on

1. Research question



„public participation in scientific research“



1. From data providers to junior researchers by increasing species knowledge
 - How can learners be enabled to identify bee species by their nesting aids?
 - What requirements must a reliable identification tool meet to enable pupils to identify bee and wasp species?

Method: From data providers to junior researchers



Fornoff, F., et al.,
Schulinsektenhaus (2019)

Method: Development of an identification app

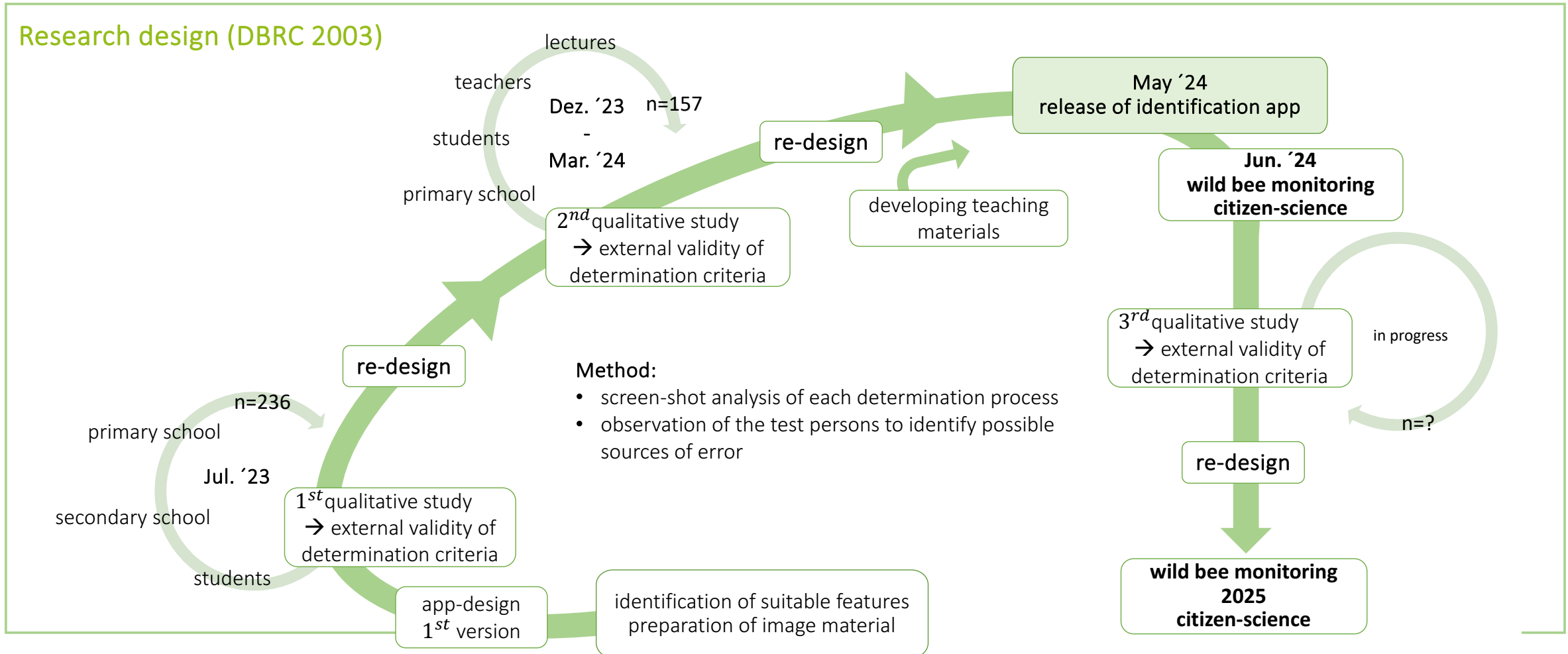
The app interface consists of several screens:

- Question 1:** "Welchen Innendurchmesser hat der Nisteingang?" (Which inner diameter does the nest entrance have?). It features a circular diagram with a red double-headed arrow indicating diameter. The answer options are: klein 3-4 mm, mittelgroß 5-6 mm, **groß 7-10 mm** (highlighted with a red arrow), and sehr groß > 10 mm.
- Question 2:** "Welche Nahrung wurde pro Brutzelle eingelagert?" (Which food was stored per brood cell?). It features a cylindrical diagram with a red arrow pointing to a jagged hole. The answer options are: Pollen, Spinne, Raupen, and Grashüpfer/Grillen (highlighted with a red arrow). A "keine" (none) option is crossed out with a large 'X'. A red arrow points from a "?" icon to the text "short explanatory video".
- Answer Screen:** "Die Bestimmung ist beendet!" (The determination is finished!). It includes instructions: "Finde und überprüfe Dein Ergebnis mit Hilfe der Bilder in der Artenliste." and "Um eine neue Bestimmung zu starten, bitte auf NEU drücken." A red arrow points from the "Isodontia mexicana" entry in the species list to this screen.
- Species List:** "Artenliste" with columns for Häufigkeit, Name, Wiss., and Familie. It shows "Isodontia mexicana" (Stahlblauer Grillenjäger) with a small image.

if several species/genera:
result by comparing the profiles

Method: Development of an identification app

Research design (DBRC 2003)





Method: Development of identification app

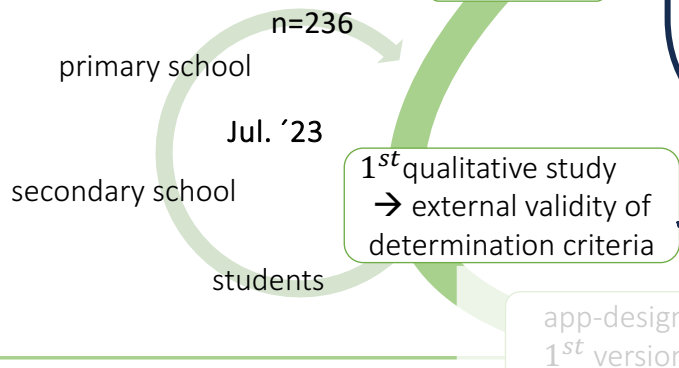
Research design (DBRC 2003)

„sad but true“

33% specification tries were **successful**

results show that **correct specification partly relies on the user's age**

- "stored food": 23%
distribution: 7-10 years: 55%; 11-12 years: 39%; students: 5%
➤ approx. 50% of these cases: bee larvae were misidentified as stored food
distribution: 7-10 years: 63%; 11-12 years: 37%; students: 0%
- "nest closure": 14%
distribution: 7-10 years: 55%; 11-12 years: 45%; students: 0%

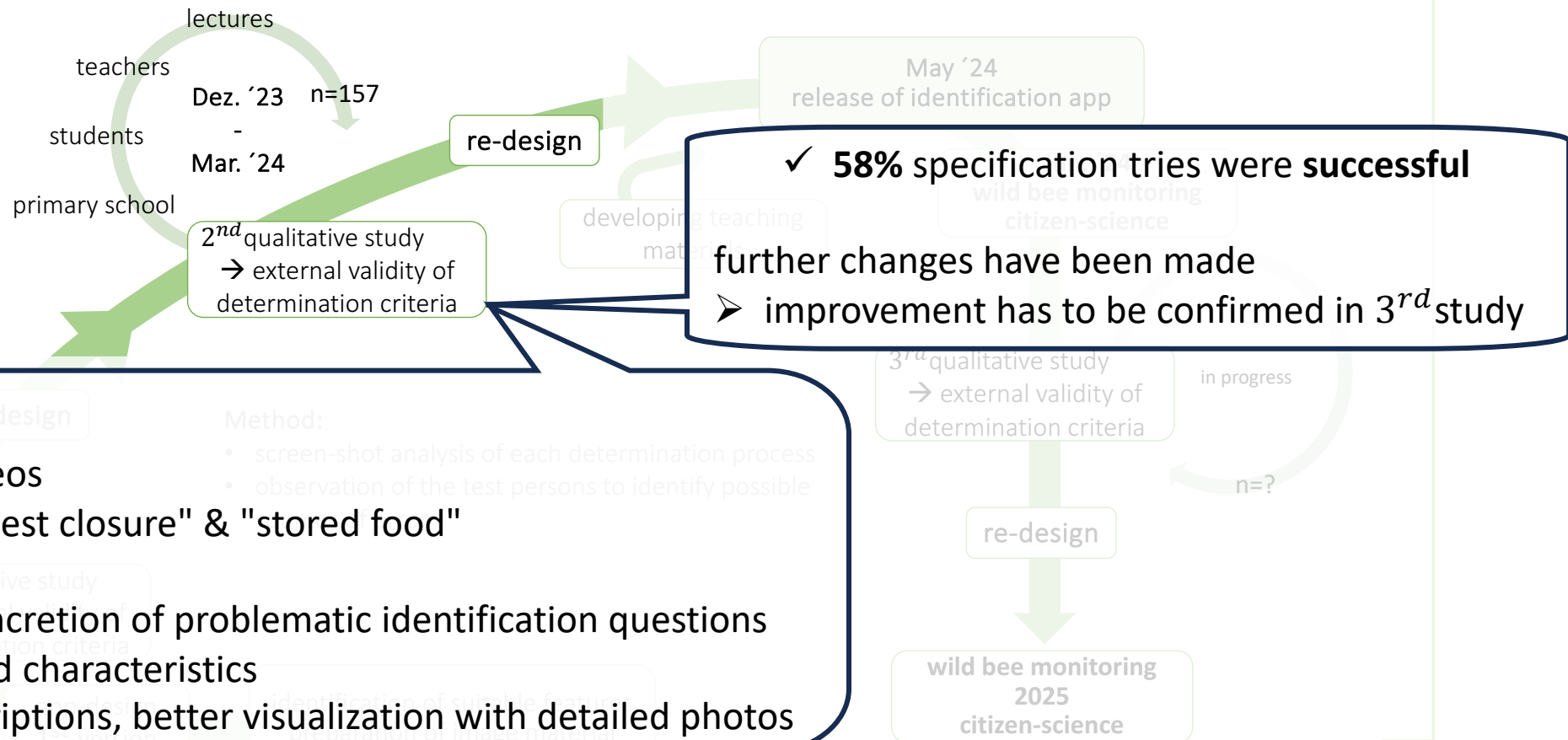


wild bee monitoring
2025
citizen-science



Method: Development of identification app

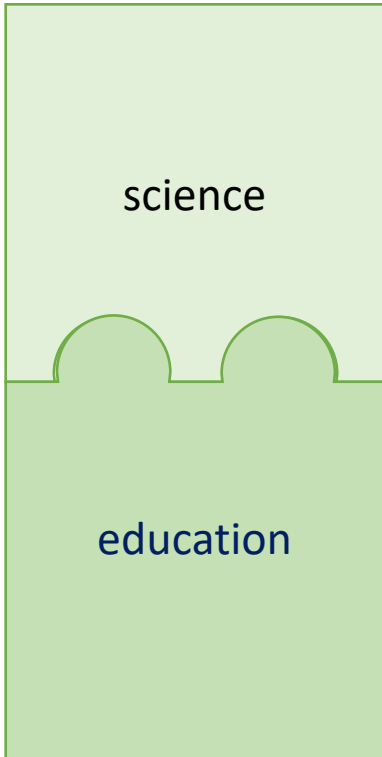
Research design (DBRC 2003)



Results



„public participation in scientific research“



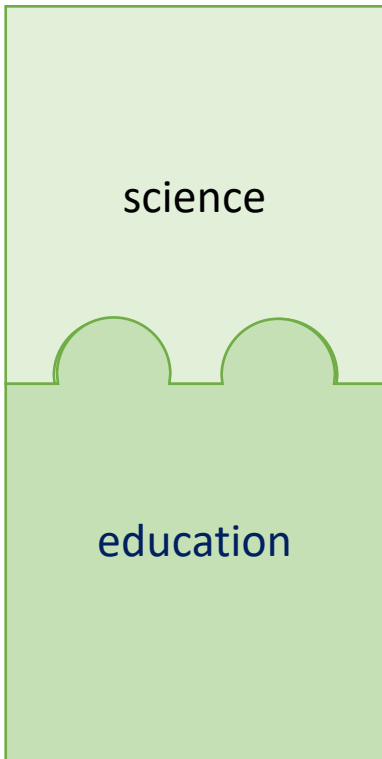
1. From data providers to junior researchers by increasing species knowledge
Can learners be enabled to identify bee species by their nesting aids?


The correct species identification rate increased from 33% to 58%! ✓

2. Research question



„public participation in scientific research“



1. From data providers to junior researchers by increasing species knowledge
Can learners be enabled to identify bee species by their nestings?

2. Bridging the gap from knowledge to action:
How does the species distribution in the nestings change in time and space?



Megachile lapponica

pollen
willowherb

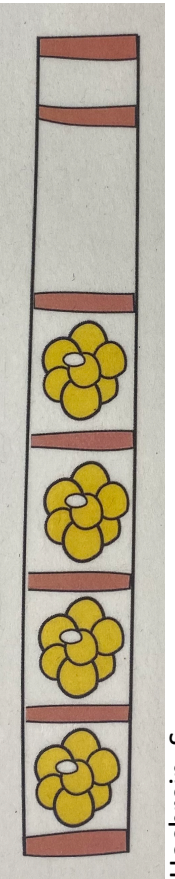
nectar
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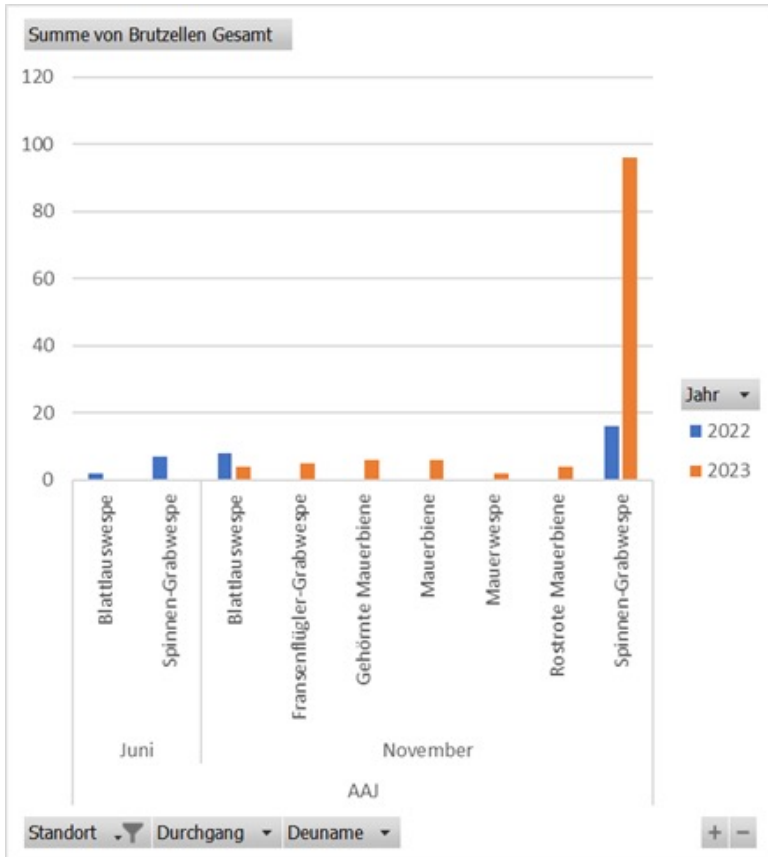
Fornoff, F.



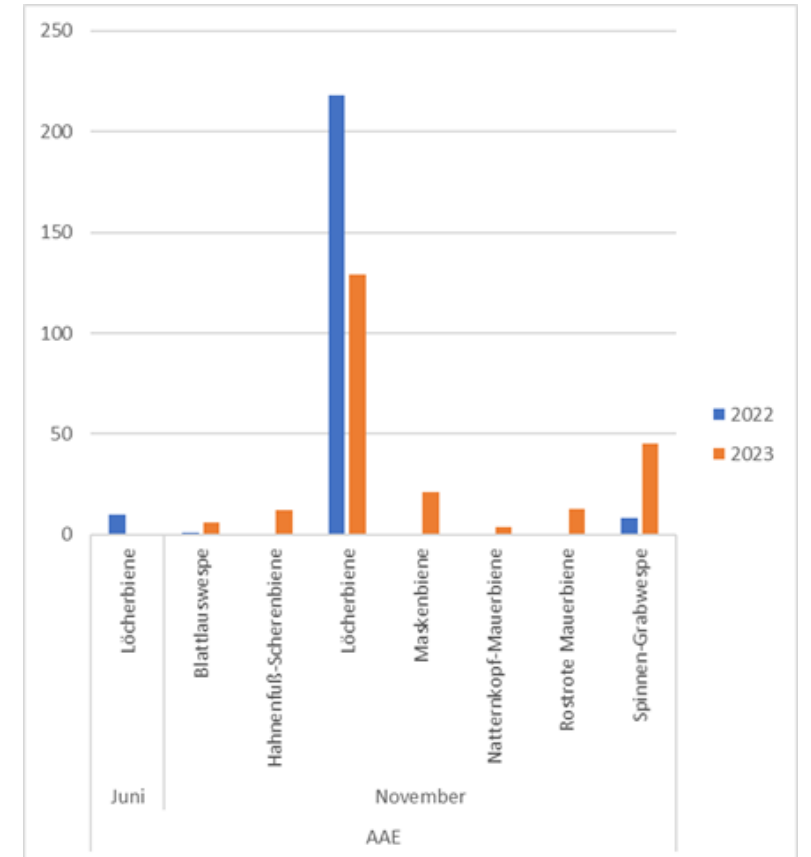
Hochrein, S.

First results

adapted from Fornoff, F., et al. Schulinsektenhaus (2019)



School: Bad Staffelstein

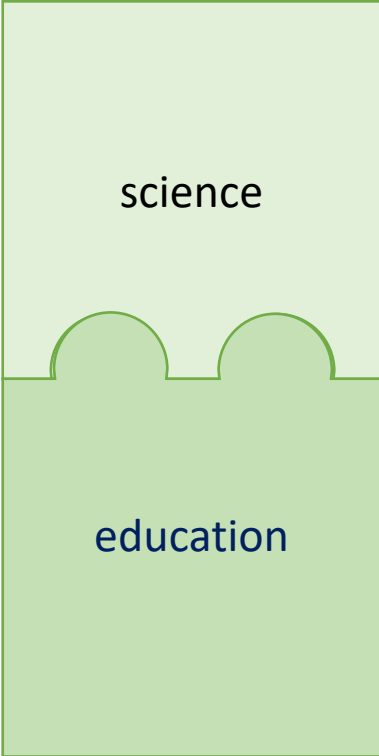


School: Ebensfeld

First results



„public participation in scientific research“



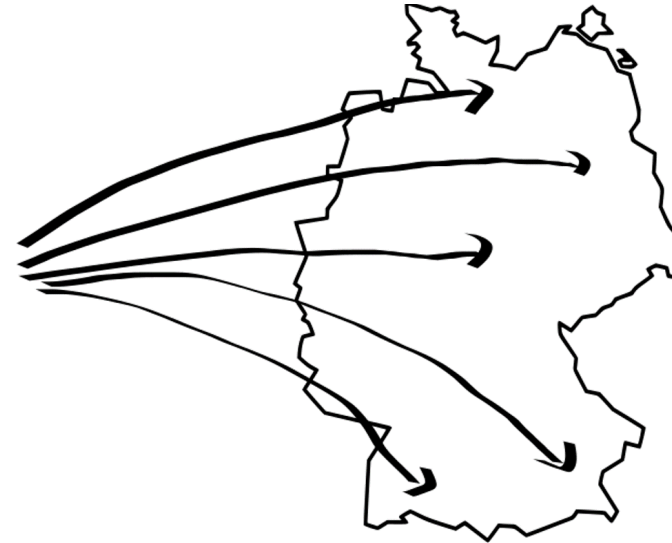
- 2. Bridging the gap from knowledge to action:
How does the species distribution in the nesting aids change in time and space?
- The diversity of wild bee species increases over time!
- A change in behaviour can be measured indirectly!



What's next?

adapted from Fornoff, F., et al.
Schulinsektenhaus (2019)

nesting aids



2024

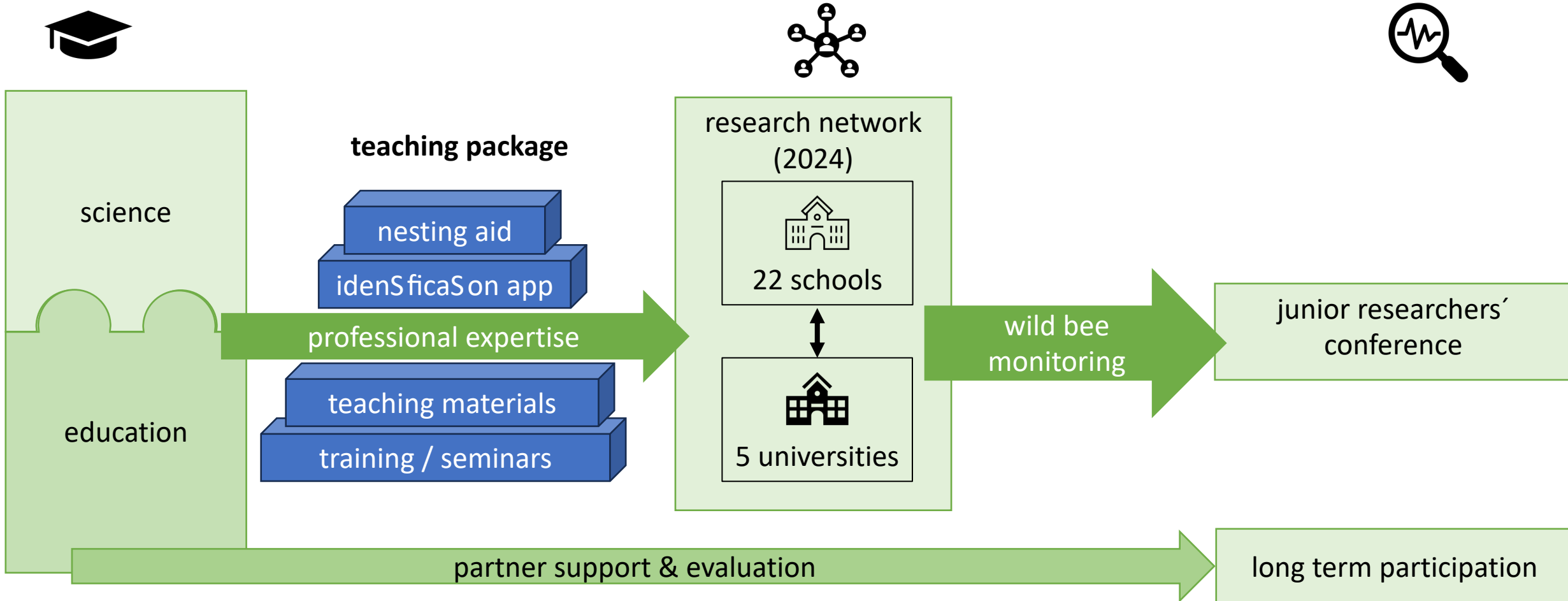
2025 -

pilot study

German-wide
wild bee monitoring



Method: Longterm wild bee monitoring



Become a part of it!

ready for download:



ID-Logics

<https://id-logics.com>



Google Playstore



Apple Appstore

Thank you !

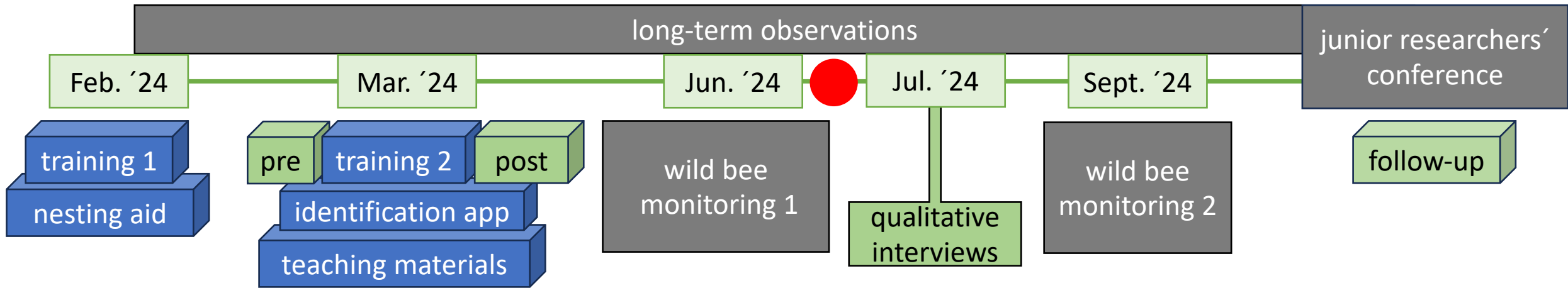
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Method: Longterm study - nesting aid project



student activity questionnaires for teachers

intervention for participating teachers: multipliers

References

Illustration cover sheet: Dr. Felix Fornoff

Design-Based Research Collective (DBRC). (2003). Design-based research: An emerging paradigm for educational inquiry. *Educational Researcher*, 32(1), 5-8.
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Tscharntke, T., Gathmann, A., & Steffan-Dewenter, I. (1998). Bioindication using trap-nesting bees and wasps and their natural enemies: community structure and interactions. *Journal of applied ecology*, 35(5), 708-719.

