Refocusing labs: from cookbook to open inquiry – a webinar recap

On Tuesday, December 2nd 2025, Present-day Practicals hosted its third webinar:

🌟 **Refocusing labs: from cookbook to open inquiry** 🌟

The webinar explored how shifting to open inquiry can empower students to act as genuine researchers. The webinar was presented by members of the **S^3OIL** (Supporting Students' Scientific Open Inquiries in Labs) team: Dr. Forrest Bradbury (Amsterdam University College), and students Julia Burzyńska, Eva Steultjens, and Noor Schrofer (University of Amsterdam).

Topic of this webinar

The central questions addressed were: **What does it take to move lab assignments from prescriptive recipes to authentic, student-driven investigations,** and **what are the pedagogical requirements for this transition?**

The S^3OIL team introduced the importance of moving along the **Levels of Inquiry** continuum, which ranges from highly structured activities where students merely confirm known results, to fully **Open Inquiry** where students formulate their own questions, design methods, and draw conclusions—truly mirroring the scientific process.

Why open inquiry?

The presenters highlighted the major motivations for embracing open inquiry models, emphasizing student agency and critical thinking:

- **Authenticity and Ownership:** Open inquiry allows students to engage in "real science," fostering a deep sense of ownership over their projects and results. It moves the focus from procedural compliance to generating new knowledge.
- **Developing Critical Skills:** This approach actively trains students in scientific reasoning, critical evaluation of data, and experimental design—skills that are essential for future researchers.
- **Integrating Knowledge:** By requiring students to manage the entire research cycle, open inquiry forces them to integrate theoretical knowledge from lectures with practical skills learned in the lab.

Implementation and Challenges

The team openly discussed the significant challenges inherent in adopting open inquiry, followed by practical solutions developed.

Key challenges identified:

1. **Logistics:** Managing diverse, student-led projects presents major issues in scheduling, material resource planning, and safety supervision.
2. **Assessment:** Grading open-ended research requires a shift in focus from "the right answer" (impossible in open inquiry) to process, argumentation, and reflection.
3. **Staff and resources:** Teaching assistants (TAs) and faculty require special training to shift from being procedural instructors to supportive coaches and facilitators.

Implementation examples: Molecular Neurobiology and Maker Lab

The team shared experiences from their Molecular Neurobiology and Maker Lab courses, providing concrete examples of how open inquiry is managed in different scientific contexts. These case studies showed that with the right structure, students can successfully tackle complex, multi-week projects, leading to rewarding student experiences and higher-quality learning outcomes.

The implementation of these courses highlighted three crucial factors for success:

- **Support:** A critical component is the **(emotional) support** provided to student teams as they inevitably struggle and learn from their own wrong assumptions and failed measurements. This guidance is vital for fostering resilience and a growth mindset.
- **Process-oriented assessment:** The success of these open labs hinges on an assessment that values the scientific process. This requires the necessity of rubrics which assess the inquiry process—including reflection and iteration—and these rubrics must be published to students in advance.
- **Authentic communication:** Open inquiry inherently fosters authentic communication—students are communicating information (like their research aims and hypotheses) that the teachers and classmates do not already know. This larger focus on student communication (and the frequent small group meetings with instructors) also makes free-riding much more apparent, thus acting as a deterrent, though it does not fully solve free-riding.

Interaction with the international audience

The webinar included active participation from the international audience through chat questions and theme-based breakout rooms, focusing on the practical transition to open-ended labs.

Chat questions and audience responses

Q - Inquiry openness level: What inquiry openness level do your lab courses reach?

The audience responded to the inquiry openness level question, showing that the majority of current lab courses fall under Guided Inquiry:

- **Confirmation:** 5% (2 respondents)
- **Structured Inquiry:** 21% (8 respondents)
- **Guided Inquiry:** 51% (19 respondents)
- **Open Inquiry:** 18% (7 respondents)
- **Other openness categorization:** 2% (1 respondent)

Q - Guidance: What guidance do you find necessary for open-ended labs?

The participants emphasized the need for targeted scaffolding that manages complexity while providing critical freedom. Key themes included:

- **Structure and Feasibility:** Guidance must include defining deliverables, setting a realistic timescale, and ensuring proper documentation of results and protocols. One crucial suggestion was checking the feasibility of student proposals.
- **Supportive Information:** Participants recommended a "Frame of available items" and Just-in-Time delivery of supportive information and good learning material (if students need it) to prevent unnecessary delays.
- **Routine Skills and Safety:** Essential support involves giving enough attention for routine skills (so experiments don't fail due to incorrect technique, e.g., incorrectly made gel) and clear explanation of techniques, especially regarding safety issues.
- **Coaching and Reflection:** The consensus was that instructor roles must shift to coaching and providing feedback. This includes guiding students on planning, analyzing, and reporting their work.
- **Career Stage Dependence:** The type and amount of guidance necessary depends on where the students are in their career (i.e., less experienced students need more structure initially).

- **Building Confidence:** Strategies like a Flipped classroom were highlighted as effective ways to build confidence and awareness, noting the critical importance of offering students the opportunity to try and fail in a safe environment—and then the time to repeat after troubleshooting.
- **Student Experience:** It was noted that too little guidance can divide students: some love it, some hate it, underscoring the necessity of finding the right balance.

Breakout room discussions

The discussion in the breakout rooms focused on different areas of open inquiry implementation:

1. **Introducing open inquiry early**: The audience questioned how early the open inquiry journey can begin, with the consensus being that while foundational skills (like basic communication) are necessary, the practice can start remarkably early. Participants noted successful implementation with students as young as 15-year-olds and even 12-year-olds. Personal anecdotes highlighted that inquiry-based activities can be adapted even to primary school levels (e.g., counting traffic light patterns). This practice is often inspired by models such as those of Szalay and Toth. Dr. Bradbury emphasized that essential prerequisite skills can be taught within the context of the course itself.

2. **Open inquiry for short courses**: A concern was raised about the feasibility of implementing open inquiry in very short, couple-of-hours practicals (which are often confirmation-type labs). Robert Klein-Douwe (Groningen, physics labs) shared a successful, yet challenging, experiment: a very short open inquiry lab using a smartphone's magnetic sensor. He noted student division—some loved the creativity, others struggled with too little guidance. For a future attempt on the Earth's magnetic field, he plans to offer an intermediate option: allowing students to choose between a short open inquiry or a structured lab. Dr. Bradbury supported this intermediate approach: giving students the necessary tools and allowing them to decide the specific research question. Other participants confirmed that Guided or Structured inquiry can fit into a few or even a single afternoon in some cases, particularly in chemistry, where the turnaround is quick.

3. Educational research: During the discussions, several research outcomes and papers were shared. Freek Pols indicated some of the requirements/limits that they found for first year students: in this paper and provided information on engaging high school students in more open inquiry: in this paper. To address audience questions about the feasibility and effectiveness of open inquiry in chemistry labs, two interesting studies can be found in this paper and here.

4. Economics: Regarding costs, opinions varied: some argued it is cheaper over time as initial equipment investment is reduced and materials are reused, while others countered that it requires more guidance/TA hours. Forrest Bradbury's own Maker Lab course also shows that open inquiry can be offered for interdisciplinary groups of students by leveraging inexpensive Maker tools:

without the need for lab facilities, and with minimal contact time (similar to contact time in theory/conceptual courses).

Key take-home messages

Based on the S^3OIL team's extensive findings, three essential requirements were identified for successfully transitioning to authentic open inquiry labs:

1. **Prior "First-Order Scaffolding":** Students need foundational skills before starting. This involves pre-training on fundamental techniques and concepts that they will use in their independent projects.
2. **Simultaneous "Second-Order Scaffolding":** During the inquiry, students require continuous support focused on **process and reflection**—guidance on formulating strong research questions, managing data, and analyzing their findings. TAs must be trained to ask guiding questions rather than providing direct answers.
3. **Time and Agency:** Students must be given sufficient time to deal with failed experiments and unexpected results (the reality of science) and the agency (freedom) to make genuine experimental choices.

Wrap-up – enroll for the next webinars and/or a LabBuddy session!

The webinar concluded with a **wrap-up by the organizers** and an invite to enroll for upcoming webinars in the Present-day Practicals series and a special LabBuddy session.

- Fostering sustainability in lab education — Tue 13/01/'26
- Artificial intelligence in lab education — Thu 29/01/'26
- LabBuddy* session: Enhancing lab education — Thu 19/03/'26

Register here for the Present-day Practicals series => Webinar series 25/26 and/or

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See you soon!

On behalf of the organizers

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