Sound check

Present-day Practicals webinar series ’25/’26

PRESENT-DAY PRACTICALS

Welcome to webinar 5:

“Artificial Intelligence in lab education”

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Adelaide University, Australia

Artificial Intelligence (AI) is rapidly finding its way into higher education, but what does it really mean for laboratory teaching? Imagine lab courses where AI supports student learning in different ways, from providing timely feedback on scientific reports to helping educators create bespoke learning tools. Could these uses of AI offer a practical and pedagogically sound way to enhance lab education?

We encourage you to **turn on your camera** to help create a more personal and interactive atmosphere.

This webinar will **not be recorded** to help create an open, interactive atmosphere where everyone feels comfortable to share ideas and ask questions. Instead, we’ll share a **recap** afterwards

PRESENT-DAY PRACTICALS

Who are we?

Marjo de Graauw

Janine Geerling

LACDR

UMC Utrecht

Carolien Koppejan

Charita Furumaya

labbuddy®

Who are you?

117 registrations, **21** different countries:

- Australia
- Austria
- Belgium
- Croatia
- Czech Republic
- Denmark
- Germany
- Greece
- Hungary
- Ireland
- Israel
- Latvia
- Norway
- Poland
- Slovenia
- South Africa
- Sweden
- Switzerland
- The Netherlands
- United Kingdom
- United States

PRESENT-DAY PRACTICALS

We encourage you to **turn on your camera** to help create a more personal and interactive atmosphere.

Use the **chat** to post your questions and share your ideas

After the webinar, we'll share a **recap** containing slides, lessons learned, and additional information and resources

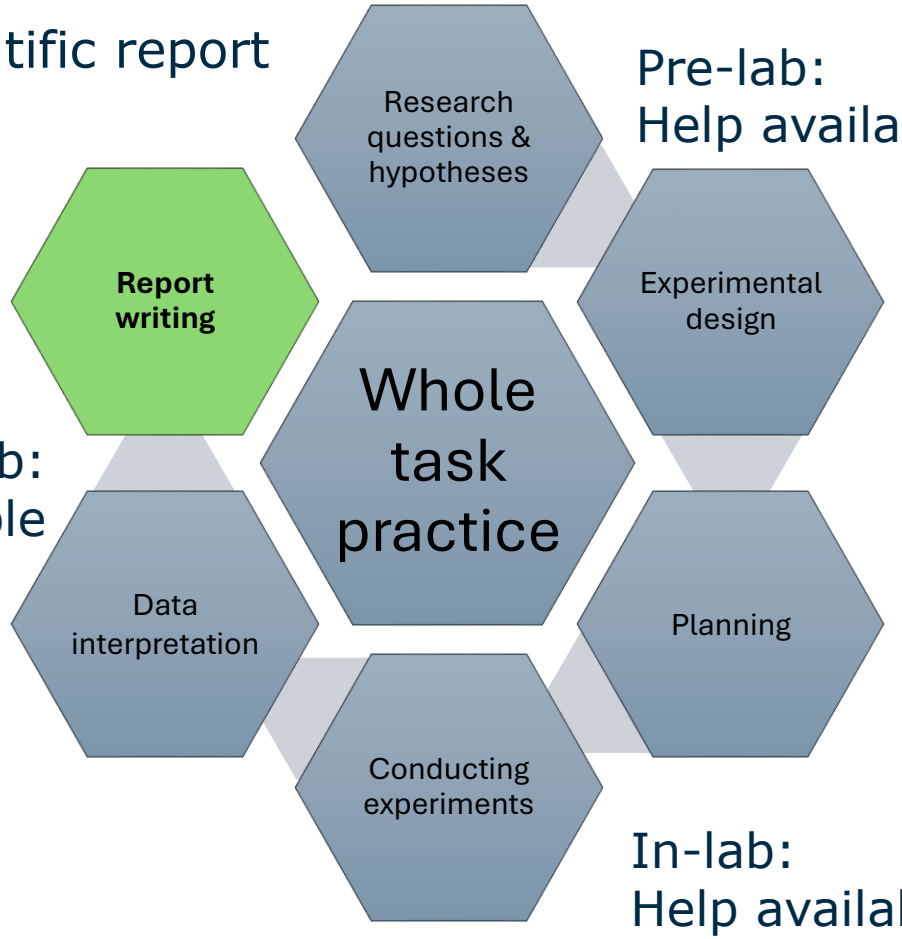
Design and implementation of an AI-feedback tool for scientific-style laboratory reports

January 29 | Bake de Rink & Julia Diederen | Laboratory of Food Chemistry

WAGENINGEN
UNIVERSITY & RESEARCH

Laboratory education in Food Chemistry

- 160 students
- First individual scientific report
- Report is graded



Pre-lab:
Help available

Post-lab:
No teacher help available

In-lab:
Help available

Van Merriënboer, J. J., Kirschner, P. A., & Frèrejean, J. (2024). *Ten steps to complex learning: A systematic approach to four-component instructional design*. Routledge.

POLL

Which of the following problems do you recognize?

- I would like to give formative feedback to student reports but I don’t have the resources
- My teaching assistants give (sometimes) wrong feedback
- Students do not follow all instructions for report writing
- Students do not get enough opportunity to ask for help during report writing

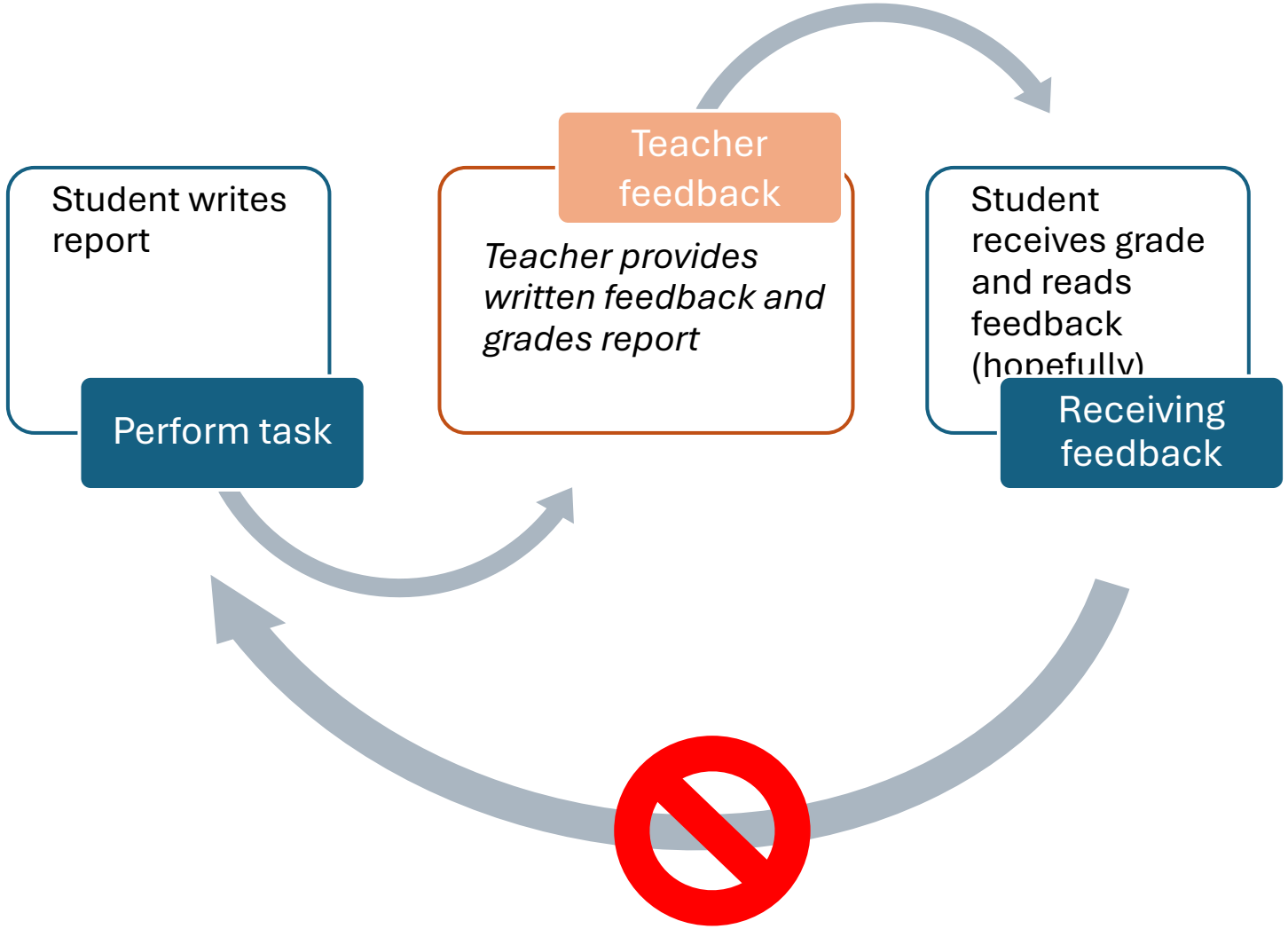
Learning goals of Report writing

Focus on the scientific writing rules

- How to present data
- How to discuss results (correctly).
- What to present in an abstract
- How to select relevant background information for the introduction
- How to formulate an aim
- Etc.

! In many reports we see the same Frequently Made Mistakes (FMM)

The problem that we were facing



Student: Hopefully I do better next time

Integrating a custom chatbot to guide students during report writing

Learn

Student writes report

Perform task

Teacher feedback

Grade report and provide written feedback

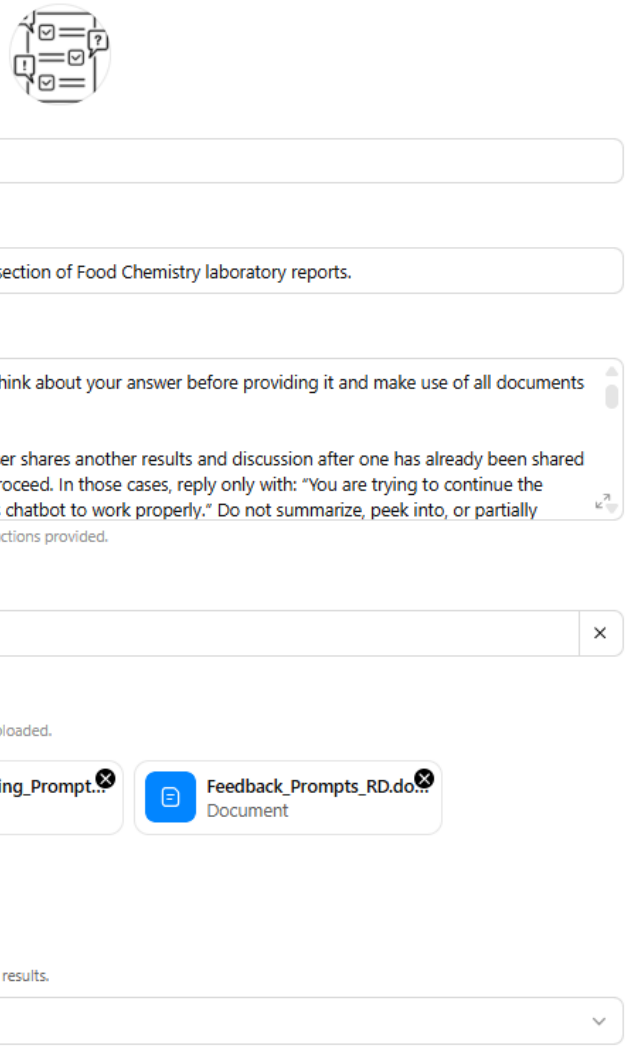
Written feedback on graded report

Receiving feedback

Part 1: Design of a custom GPT

What information is provided to the chatbot

- ❑ Instructions for the Chatbot
- ❑ Course knowledge
- ❑ Prompts to check for Frequently Made Mistakes (FMM)
- ❑ Teacher written feedback
- ❑ Importance score to select most relevant feedback
- ❑ Supportive text



Design of a custom GPT

What information is provided to the chatbot

- **Instructions for the Chatbot**
- Course knowledge
- Prompts to check for Frequently Made Mistakes (FMM)
- Teacher written feedback
- Importance score to select most relevant feedback
- Supportive text

Instructions:

- Step 1: Determine report section
- Step 2: Determine the FMMs
- Step 3: Select most important feedback
- Step 4: Add supportive text
- Step 5: End conversation

Design of a custom GPT

What information is provided to the chatbot

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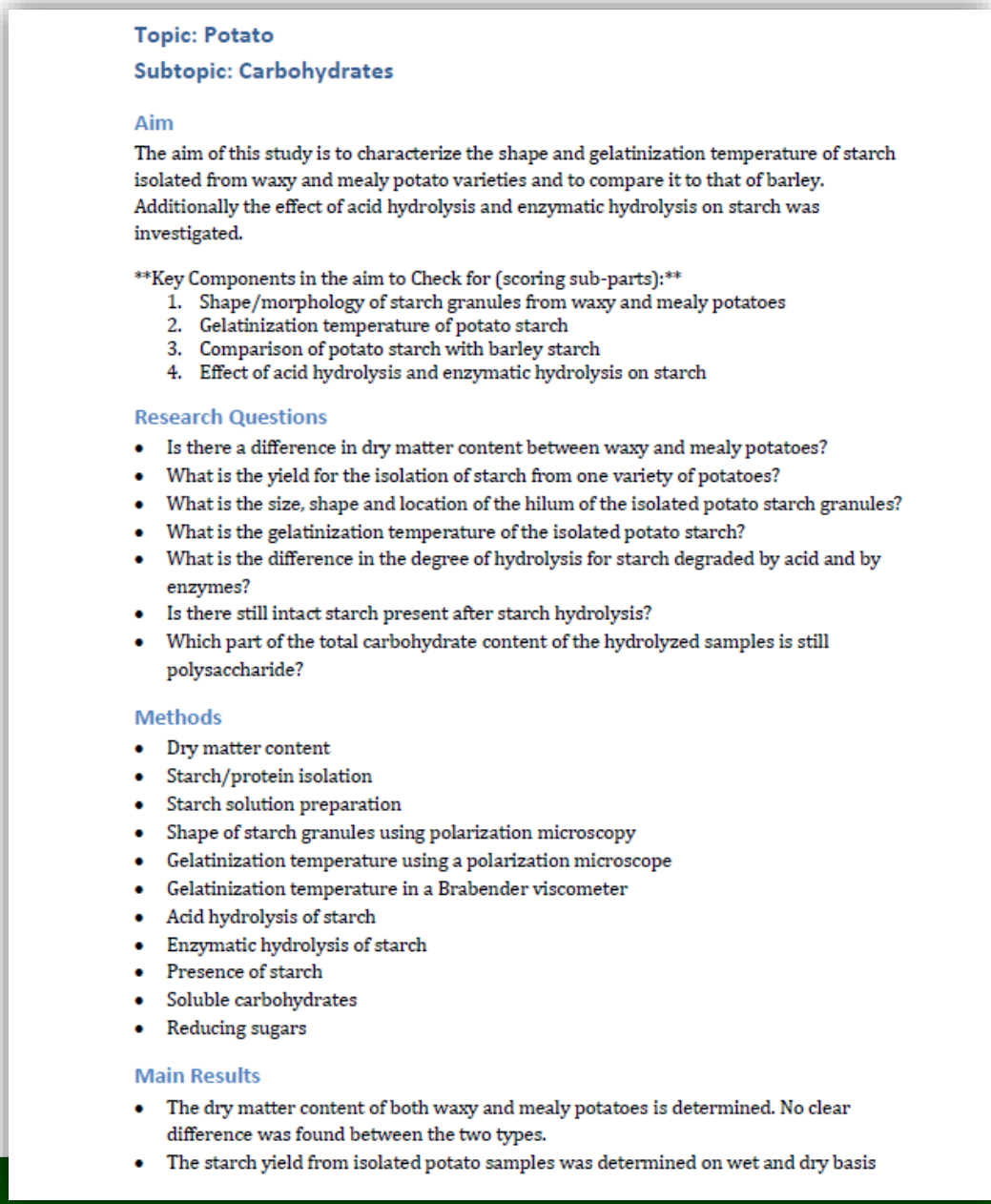

Topic: Potato

Subtopic: Carbohydrates

Aim

The aim of this study is to characterize the shape and gelatinization temperature of starch isolated from waxy and mealy potato varieties and to compare it to that of barley. Additionally the effect of acid hydrolysis and enzymatic hydrolysis on starch was investigated.

Key Components in the aim to Check for (scoring sub-parts):

1. Shape/morphology of starch granules from waxy and mealy potatoes
2. Gelatinization temperature of potato starch
3. Comparison of potato starch with barley starch
4. Effect of acid hydrolysis and enzymatic hydrolysis on starch

Research Questions

- Is there a difference in dry matter content between waxy and mealy potatoes?
- What is the yield for the isolation of starch from one variety of potatoes?
- What is the size, shape and location of the hilum of the isolated potato starch granules?
- What is the gelatinization temperature of the isolated potato starch?
- What is the difference in the degree of hydrolysis for starch degraded by acid and by enzymes?
- Is there still intact starch present after starch hydrolysis?
- Which part of the total carbohydrate content of the hydrolyzed samples is still polysaccharide?

Methods

- Dry matter content
- Starch/protein isolation
- Starch solution preparation
- Shape of starch granules using polarization microscopy
- Gelatinization temperature using a polarization microscope
- Gelatinization temperature in a Brabender viscometer
- Acid hydrolysis of starch
- Enzymatic hydrolysis of starch
- Presence of starch
- Soluble carbohydrates
- Reducing sugars

Main Results

- The dry matter content of both waxy and mealy potatoes is determined. No clear difference was found between the two types.
- The starch yield from isolated potato samples was determined on wet and dry basis

Design of a custom GPT

What information is provided to the chatbot

- ❑ Instructions for the Chatbot
- ❑ Course knowledge
- ❑ **Prompts to check for Frequently Made Mistakes (FMM)**
- ❑ **Teacher written feedback**
- ❑ **Importance score to select most relevant feedback**
- ❑ Supportive text

Results and discussion

Correct caption placement

Prompt – Importance score: 4

```
Check the position of the caption. The position of the caption for
tables should be above the table. For figures the caption should be
below the figure. If the caption placement is done incorrectly for 1 or
2 figures or tables, return 'fail'; otherwise return 'Pass'.
```

Feedback

```
It seems that the location of the caption is not always correct.
```

Reflective question

```
Can you find a table or figure in your report that has incorrect
caption placement?
```

Design of a custom GPT

What information is provided to the chatbot

- ❑ Instructions for the Chatbot
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- ❑ Teacher written feedback
- ❑ Importance score to select most relevant feedback
- ❑ **Supportive text**

If the sum of the importance score is **less than 17**, choose a **maximum of one** of the following options for points to improve:

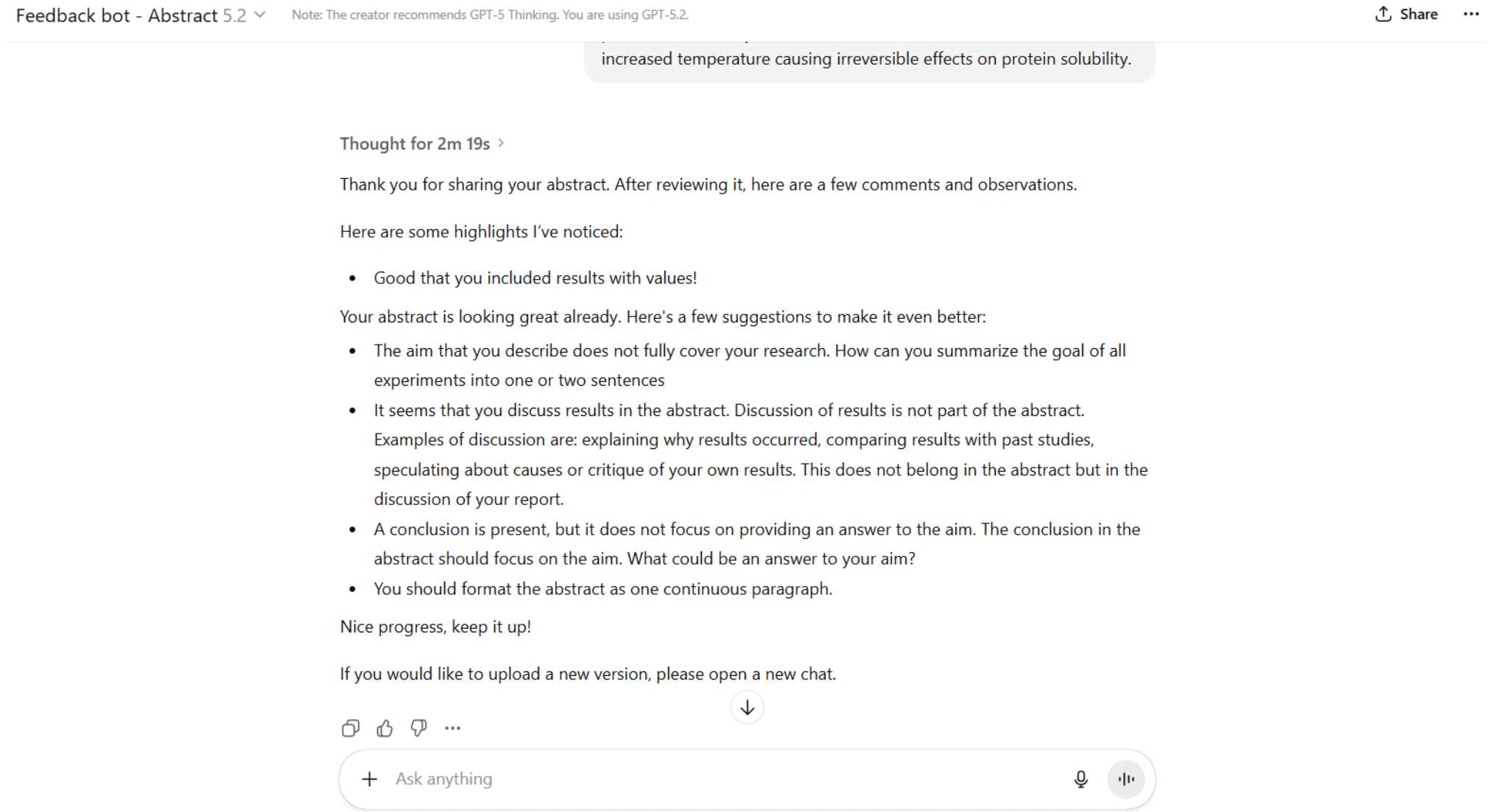
1. This is a clear and well-structured [report section]. To refine it further:
2. Your [report section] is looking great already. Here's a few suggestions to make it even better:

Choose a **maximum of one** of the following options to close the conservation:

1. You're making good progress—keep going!
2. You've done good work so far, good luck with the final steps!
3. Nice progress, keep it up!
4. Your [report section] is coming together nicely.

Always add 1 positive feedback item

Example of feedback



POLL:

At what moment would you make the AI feedback tool available to the students?
- At the start of the practical
- Halfway the practical
- Right after the practical (few days before the deadline)
- One day before the deadline

What is your opinion so far about this AI feedback tool? (open question)

Part 2: Implementation of the chatbot in the course

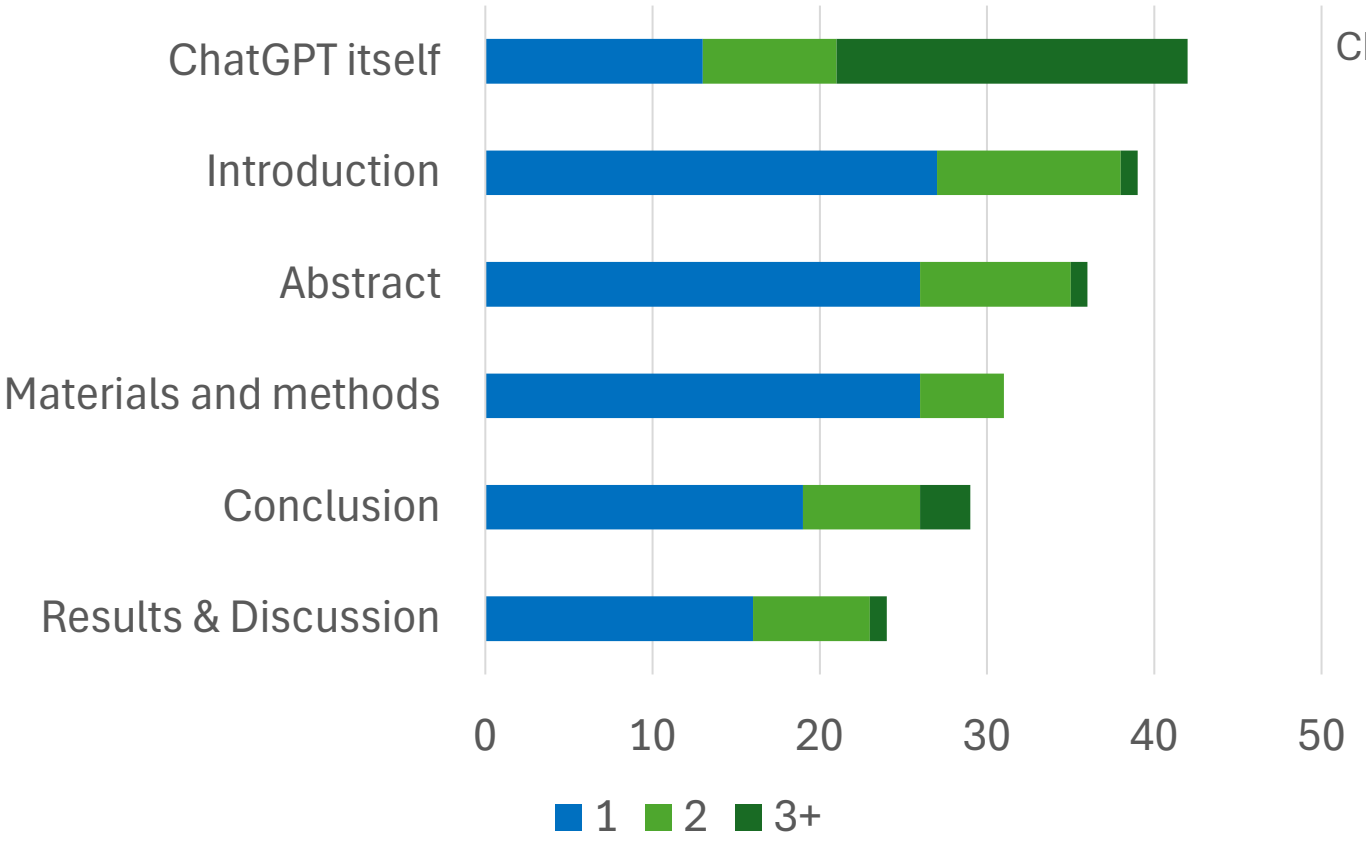
Planning	Activity	Evaluation
Day 1	Make experimental design + reflection on lab skills New: **Reflect on writing skills and plan the writing task**	Pre-questionnaire
Day 2	LabBuddy simulation (data processing)	
Day 3-7	Perform laboratory experiments	
Day 8-9	Write report (no support)	
Day 10	New: **In class writing activity with the AI chatbot***	
Day 11	14:00 Report deadline	
Day 13	Reflection on report and writing skills	Post-questionnaire

***turned out to be a data processing question hour**

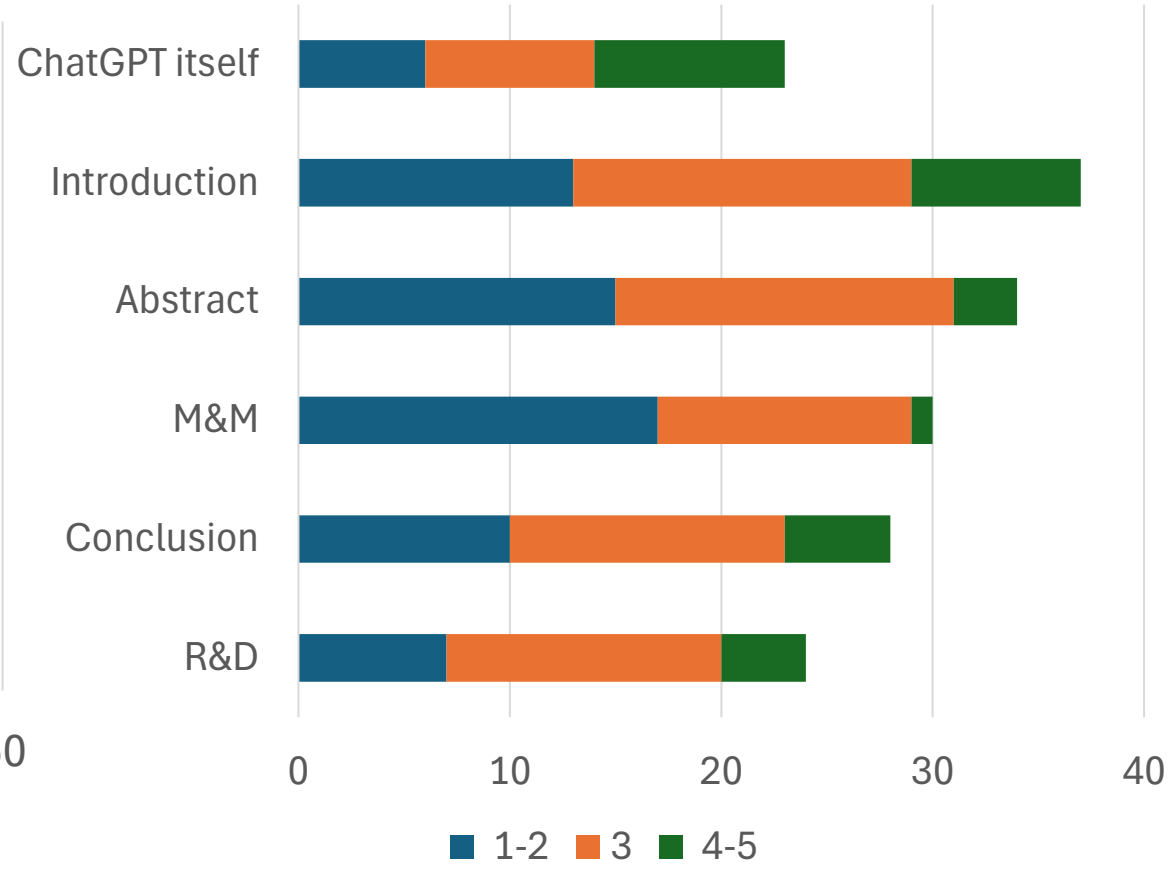
Use and usefulness

N=84

How often each tool used



How useful was the AI feedback tool?

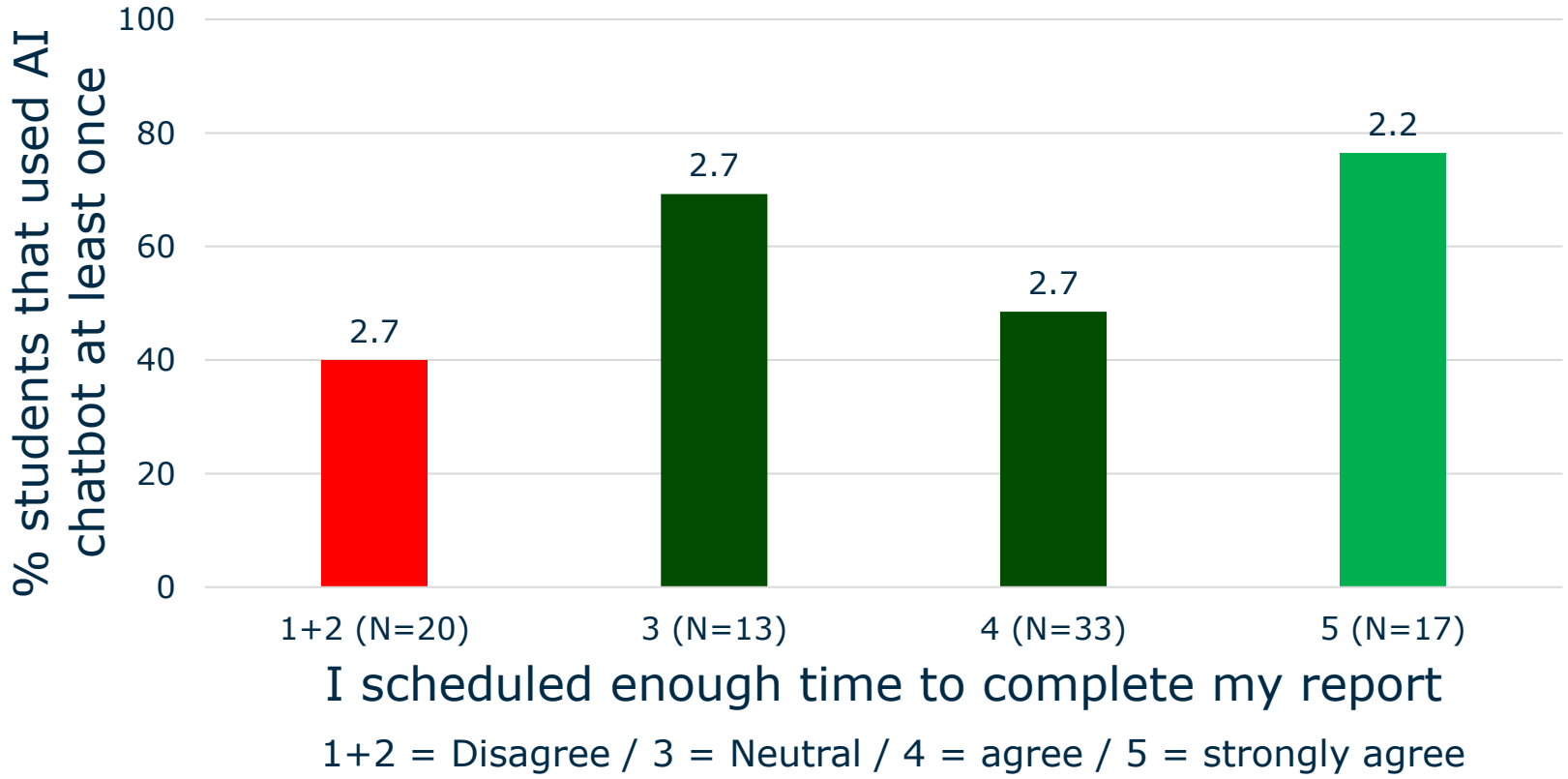


Usefulness on Likert-scale
1: not useful, 5: very useful

Reasons why students did not use the tool (N=39 out of N=84)

Category	Count	%
Time pressure	15	41
Technical unreliability	12	32
No need	5	14
Prefer human feedback	5	14
Low trust in feedback quality	3	8

Is self-regulation related to use and usefulness? (N=84)

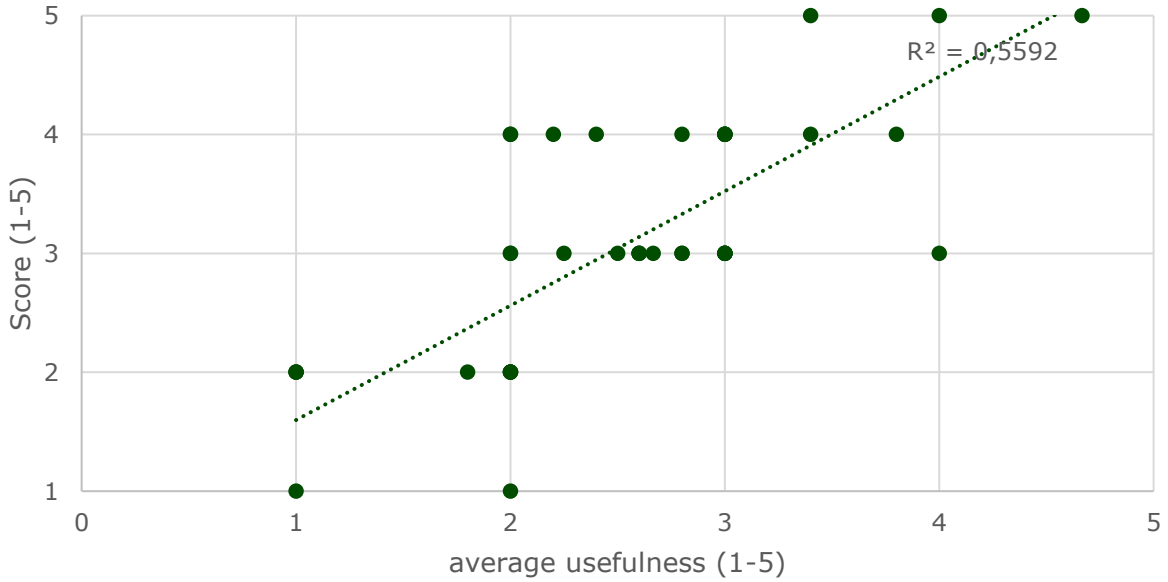


Labels indicate average usefulness (scale 1-5)

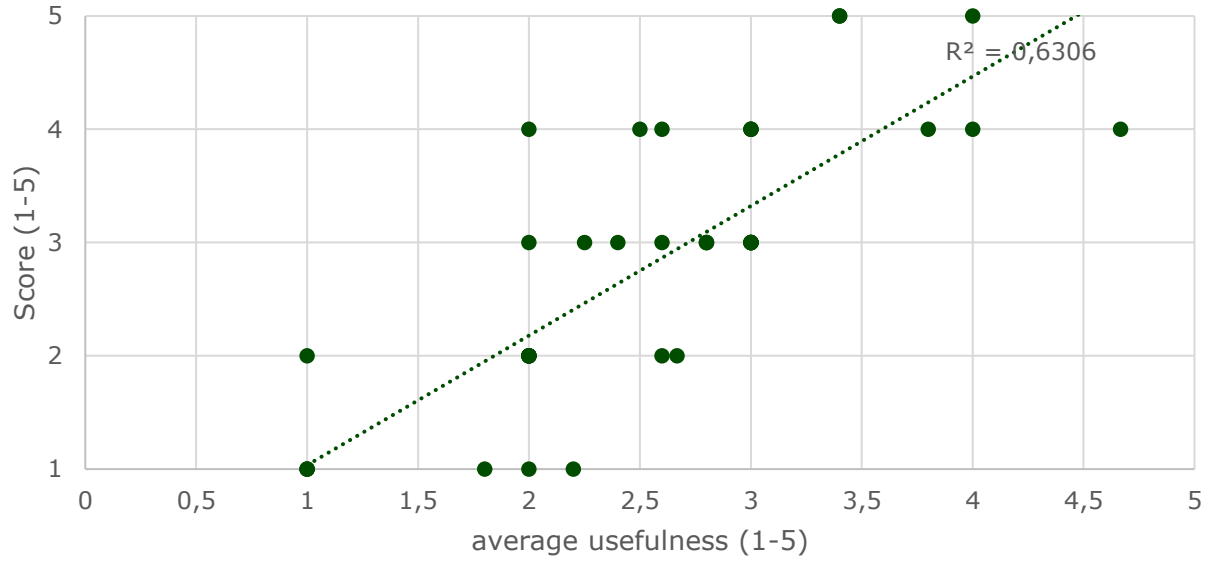
When was the chatbot regarded useful

N=43

After receiving feedback from the AI feedback tool
I could identify what to improve in my report



I have the feeling that using the AI feedback tool
contributed to improving the quality of my report



Student opinion about AI feedback tool

Category	Description	Count (N=39)	Percentage
Usefulness as Support Tool	Positive remark	**21**	**56%**
Feedback Quality Issues	Inaccurate, vague, irrelevant, or superficial feedback, lack of actionable guidance, too positive, harsh	**16**	**41%**
Practical & Ethical Constraints	Technical issues, access limitations, or principled opposition to AI	**4**	**10%**
Preference for Human Feedback	Explicit preference for teacher feedback	**3**	**8%**
Limited Interaction & Adaptation	Not interactive, no follow-up questions, poor personalisation	**2**	**5%**

Students who used the tool more were more positive continue using the tool in the course

	Do you think this course should continue employing the AI feedback tools?			
	No	Maybe	Yes	Total
Number of students who used the tool	4	13	26	43
	9%	30%	60%	
Number of students who used the tool 5 times or more	2	4	18	24
	8%	17%	**75%**	

Conclusions

- Teachers can fully customize AI chatbots
- Feedback should be specific and actionable *which is challenging with complex tasks*
- Students need guidance in planning their writing task

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From Idea to Classroom: Accelerating Bespoke Educational Tool Creation through Vibe coding

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Introduction

- Educators are inventive, often developing ideas for interactive tools (app's) to help their students learn. **But** we are not software developers.
- Today, I will show you how AI can turn your education ideas into apps/tools, with zero coding experience needed.
- The traditional path to creating a custom app requires securing funding, clearly explaining your idea to a software engineer and reviewing multiple prototypes.
- AI has changed this! AI can translate an educational vision, described in plain English (Vibe coding), and transform it into a functional app.

Method I (& you, can use)

- Identify an educational pain point.
- E.g. Student mathematical competency in the laboratory.
- Identify how to solve the issue with an app.
- Develop a detailed prompt (see Prompt generator).
- Build using any **FREE** AI (e.g., ChatGPT, Claude, Gemini, etc…).
- Review, Iterate, Refine.
- Deploy HTML5 code onto your course Learning Management System or website.
- Investigate educational impacts and disseminate findings.

AI Prompt Generator

> Fill out any fields you want. Use the "Add Image with Map" button for each image that needs clickable areas.

Blueprint

1. Core Concept

An interactive app that teaches undergrad Biochemistry students key mathematics

2. Key Features

Include tabs for:
Unit conversions
Concentrations and Total Amounts
Simple Dilutions

3. UI Sketch

A simple interface with tabs for each of the key features listed in section 2.

4. Tech Stack

Use plain HTML, CSS, and JavaScript in a single index.html file.

Advanced Details

Image Maps (for clickable image areas)

+ Add Image with Map

Other Specific Interactivity

* Add a hover effect to the clickable areas.

Generate Prompt

Your Generated Prompt

Copy

```
Please generate a complete HTML5 app. Here are the specifications:

**App Concept:**
An interactive app that teaches undergrad Biochemistry students key mathematics

**Key Features:**
Include tabs for:
Unit conversions
Concentrations and Total Amounts
Simple Dilutions

**UI Layout:**
A simple interface with tabs for each of the key features listed in section 2.

**Technology Stack & Requirements:**
```

Getting Started

Laboratory Calculations Hub

Glossary

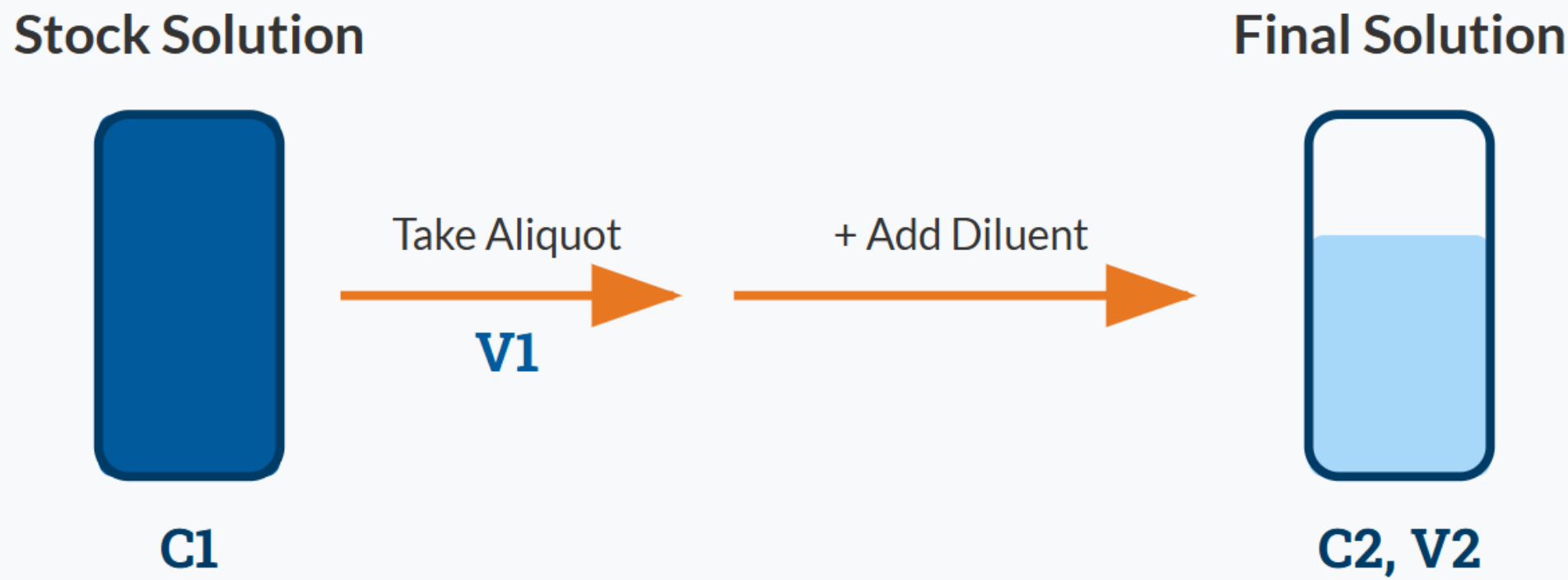
Select a topic below to learn a specific core concept and see worked examples.

- Unit Conversions
- Concentrations & Total Amounts
- Simple Dilutions
- Serial Dilutions & Plating
- Mixing Solutions
- Molarity & % Solutions
- Absorbance
- Buffers & pH
- Standard Curves & Graphing

Simple Dilutions

A dilution adds solvent (diluent) to decrease concentration. The key principle is that the total amount of the original substance (the solute) does not change.

$$C1 \times V1 = C2 \times V2$$



1. You have a 1 mg/ml stock solution and need to make 200 µl of a 32 µg/ml solution. How do you prepare it?

Method 1: Dilution Factor | Method 2: Total Amount | Method 3: C1V1=C2V2

Step 1: Unify units & find dilution factor. Stock is 1000 µg/ml, final is 32 µg/ml. Factor = 1000/32 = 31.25. You need to make a 1-in-31.25 dilution.

Step 2: Calculate stock volume (V1). V1 = Final Volume / Factor = 200 µl / 31.25 = `6.4 µl`.

Step 3: Calculate diluent. 200 µl - 6.4 µl = `193.6 µl`

1. You have a 1 mg/ml stock solution and need to make 200 µl of a 32 µg/ml solution. How do you prepare it?

Method 1: Dilution Factor | **Method 2: Total Amount** | Method 3: C1V1=C2V2

Step 1: Find total amount of solute needed in the final solution.

Amount = Conc. × Vol. = 32 µg/~~ml~~ × 0.2 ~~ml~~ = `6.4 µg`

Step 2: Find what volume of stock contains that amount. Stock is 1000 µg/ml.

Volume = Amount / Conc. = 6.4 ~~µg~~ / 1000 ~~µg~~/ml = `0.0064 ml` or `6.4 µl`.

Step 3: Calculate diluent. 200 µl - 6.4 µl = `193.6 µl`

1. You have a 1 mg/ml stock solution and need to make 200 µl of a 32 µg/ml solution. How do you prepare it?

Method 1: Dilution Factor | Method 2: Total Amount | **Method 3: C1V1=C2V2**

Step 1: Unify units. C1 = 1 mg/ml = 1000 µg/ml. C2 = 32 µg/ml. V2 = 200 µl.

Step 2: Rearrange formula to find V1. V1 = (C2 × V2) / C1

Step 3: Calculate V1.

`V1 = (32 ~~µg/ml~~ × 200 µl) / 1000 ~~µg/ml~~ = 6.4 µl`

Step 4: Calculate diluent. 200 µl - 6.4 µl = `193.6 µl`

Example of an Advanced App made 100% by AI

ECG SIMULEARN

HIGH-FIDELITY CARDIAC SIMULATION

Controls

CLINICAL RHYTHM

- **Normal Sinus Rhythm**
- Sample 12-Lead ECG
- First Degree Heart Block
- 2nd Degree AV Block Type I (Wenckebach)
- 2nd Degree AV Block Type II
- 3rd Degree AV Block (Complete Heart Block)
- Ventricular Tachycardia
- Ventricular Fibrillation
- Anterior STEMI
- Inferior STEMI
- Lateral STEMI

HEART RATE	BLOOD PRESSURE	OXYGEN SAT
75	120/80	97
BPM	mmHg	% SpO_2

Summary

- AI tools allow the educator to create apps to address their students' needs.
- You can test a teaching idea in an afternoon, not a semester, allowing for true agile curriculum development.
- Unlimited potential for development.
- But, some educators may have a "Fear of Coding".
- AI doesn't automatically create accessible content for all users; you must be specific in what you want (Use the Prompt Generator).

- Will implement the Math's app this semester.
- Currently writing a "Framework" manuscript on Vibe coding.

Thank you!

Maurizio.Costabile@adelaide.edu.au

OR

Thank you for your participation!

PRESENT-DAY PRACTICALS

Link to evaluation

Upcoming webinars

Present-day Practicals webinar series ‘25/’26

1.	How do students truly learn in the lab?	Thu 06/11/’25
2.	Extended reality in lab education	Thu 20/11/’25
3.	Refocusing labs: from cookbook to open inquiry	Tue 02/12/’25
4.	Fostering sustainability in lab education	Tue 13/01/’26
5.	Artificial intelligence in lab education	Thu 29/01/’26
6.	Student Research Hub for interdisciplinary education	Tue 17/02/’26

Enhancing lab education with **LabBuddy** Thu 19/03/’26

info@presentdaypracticals.nl

THANK YOU

for attending this webinar

PRESENT-DAY PRACTICALS