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W KRAKOWIE



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More than just a laboratory course in advanced organic chemistry – preparation for writing a BSc thesis in style

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Dr Bartosz Trzewik

I'm a senior lecturer in the Department of Organic Chemistry,
Faculty of Chemistry, Jagiellonian University in Kraków.

I have been teaching organic chemistry for nearly 20 years. Among
many others I have lead:

Basic laboratory courses in organic chemistry

Advanced laboratory courses in organic chemistry

for students of study programmes: Chemistry and Medicinal Chemistry

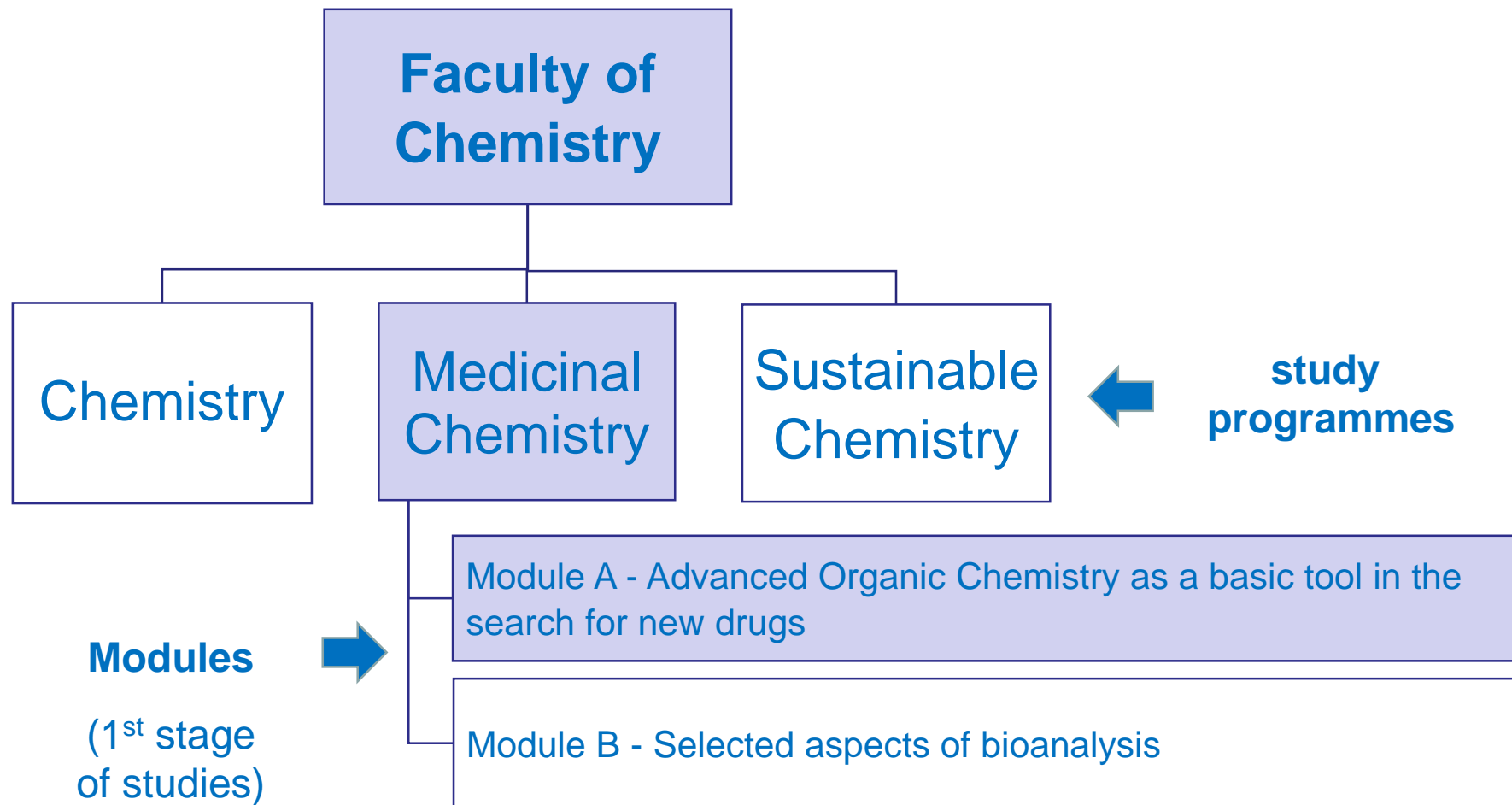


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Background

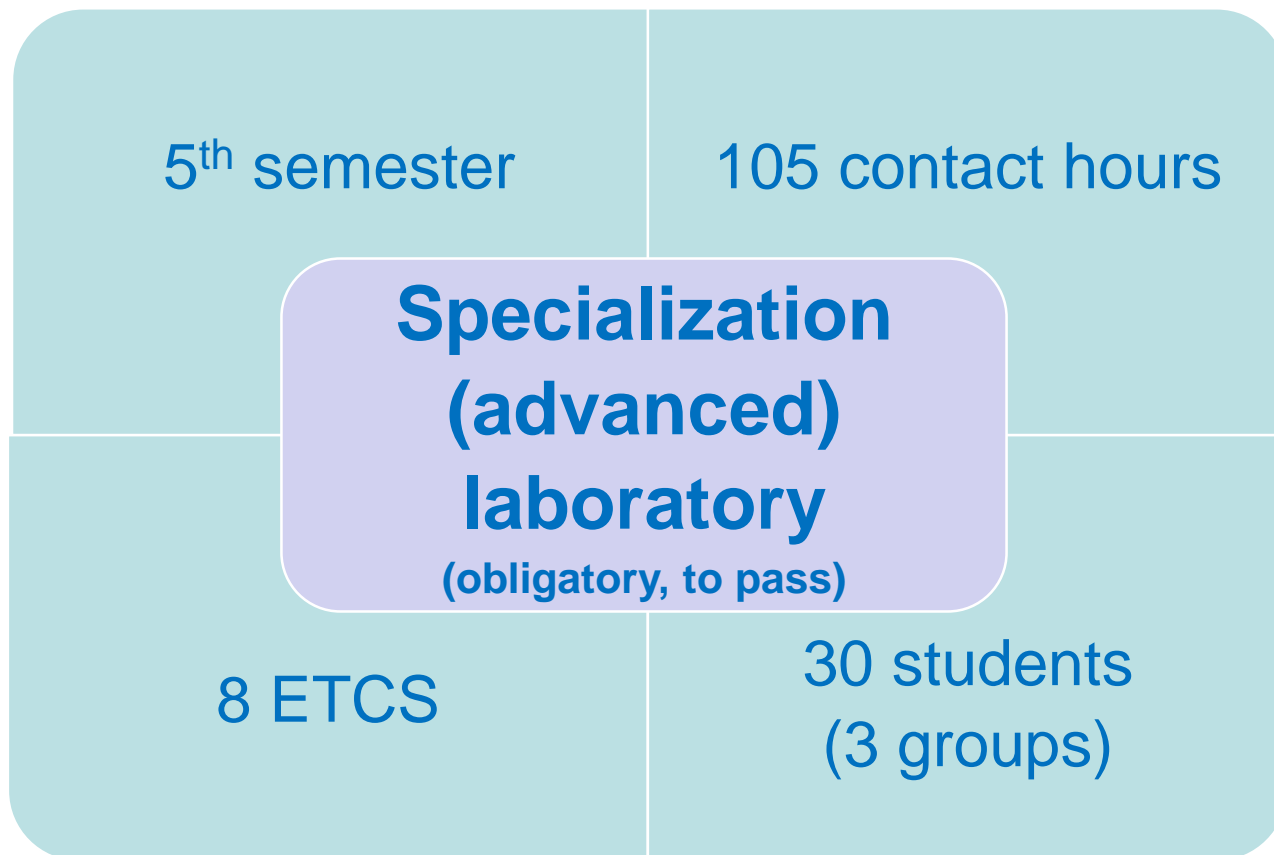


Chemistry studies at the Faculty of Chemistry





Specialization laboratory (in organic chemistry)





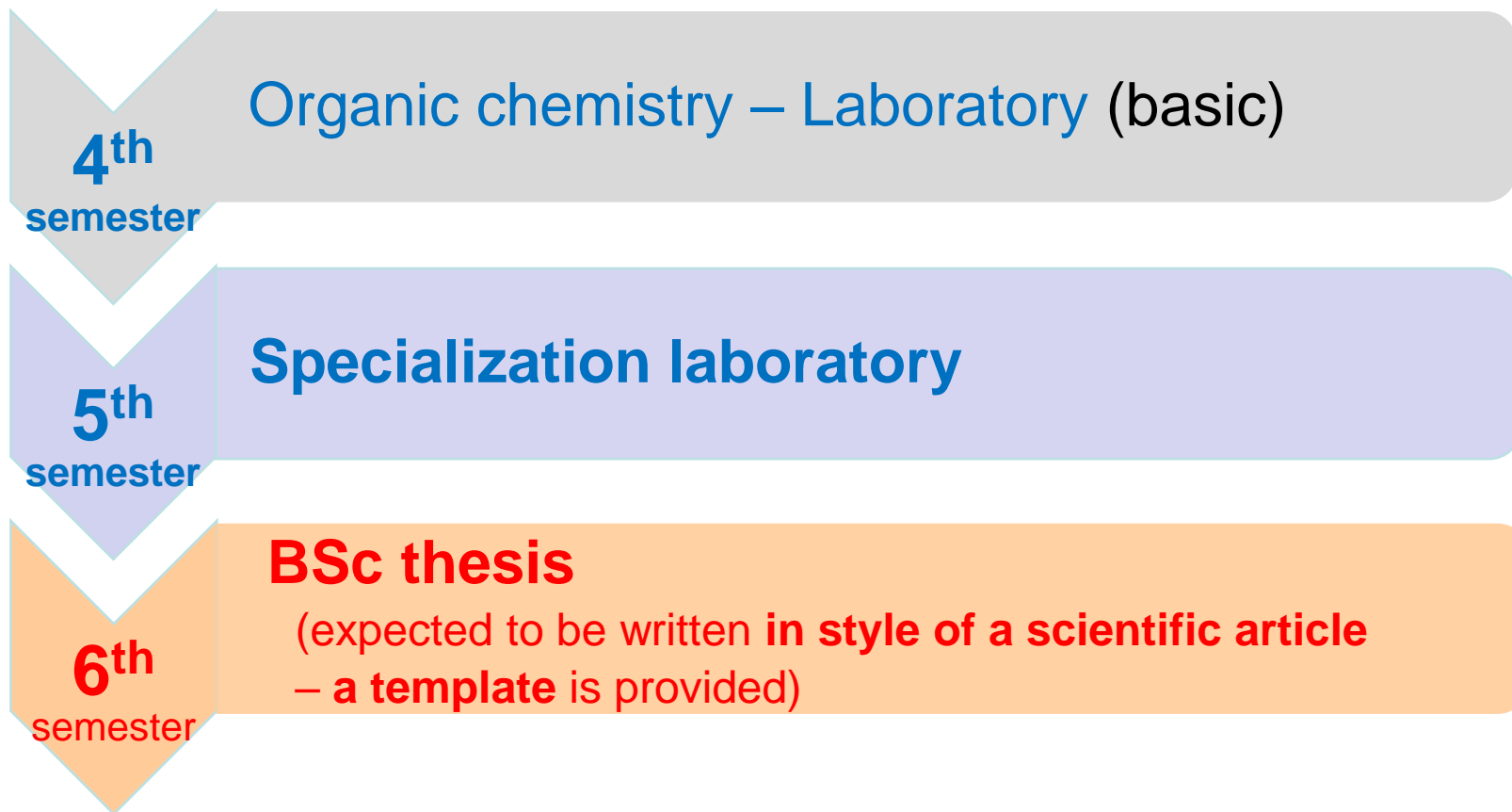
How to pass the course?

Preparation for the experiments (40 hours of own work)

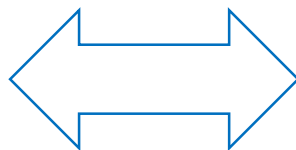
Performing all the experiments (8 from 19 in each set)
(105 contact hours)

Preparing reports for the experiments (50 hours of own work)

Preparing (and presenting in front of the group) **a presentation** depicting one of the experiment and its results

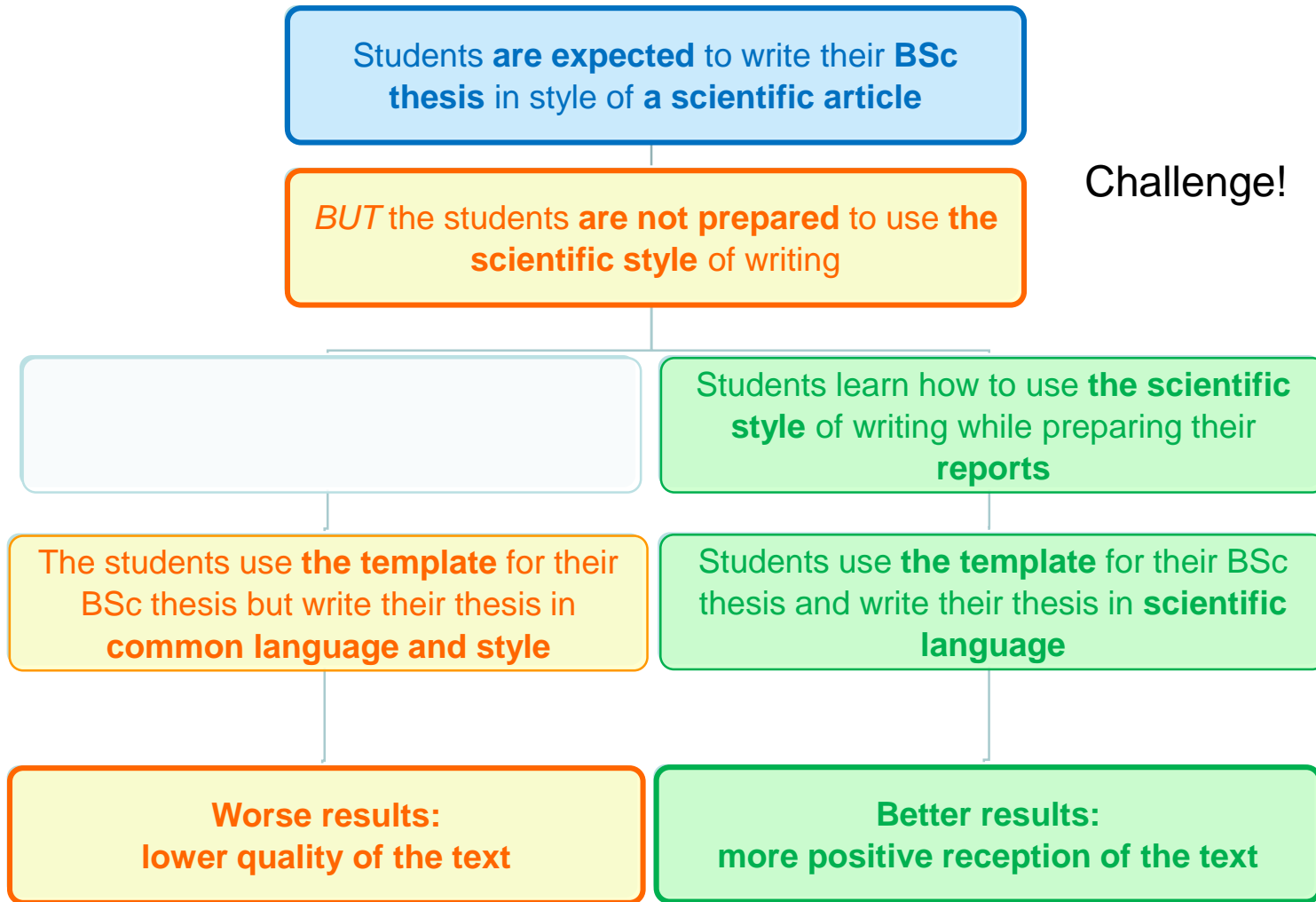


Good results
Good style



Student's goal
Teacher's goal

Learning Objectives



Routine



Flipped classroom approach

**On site
(student
laboratory)
or studying
room**

Synthesis

**Presentation
for the group
+ discussion**

- **Instruction (in English)**
- to be translated to Polish
- **Literature (in English)**
- to be translated to Polish
- to be studied

- **Literature (in English)**
- to be studied again
- **Reports**
- results to be compared with other student

**On-line
(student
educational
platform or
MS Teams)**



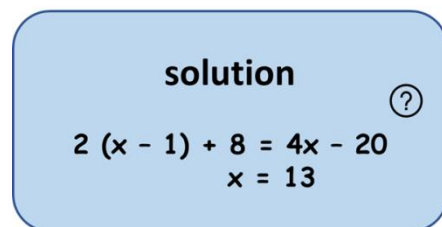
Communication – the key issue



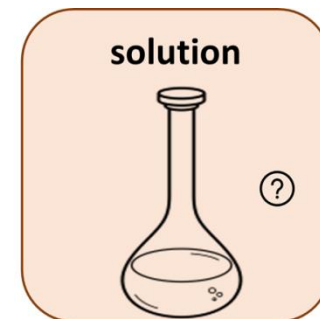
Both should be clear

Possible sources of problems:

- Words with **double / multiple meanings**, different in everyday language and in scientific language.
- Limitation** of a meaning:
 - salt \neq NaCl,
 - sugar \neq saccharose,
 - alcohol \neq ethanol
- Synonyms** used interchangeably without explanation
- Different notations** used on different items for the same concept, e.g. density quoted as ρ or d .



or





Possible sources of problems (*continued*):

- **Similar words or expressions or words** with a similar notation but **different meaning**, e.g.: chromatograph and chromatogram, limit and limitation, filter and filter off
- **Improper use of italics**, e.g.: *m* (meaning meter) instead of *m* (mass) or *g* (gram) instead of *g* (standard gravity) and *vice versa*.
- **Improper use of capital letters**, e.g.: *m* (mass) instead of *M* (molar mass)
- **Wrong symbols**, e.g.: *m* instead of *mol*



Wrong assumption that students know:

- Specialized **VOCABULARY** e.g. Grignard reaction, aliquot, defoliant
- **ACRONYMS**, e.g. DMSO, FID, PCR, GC-MS
- **EXPRESSIONS** from other languages, especially Latin, e.g. *vice versa*, *notabene*, *verte*, *implicite*, *explicite*, *vide infra*, *et al.*, *op. cit.*, *sine qua non*, *et caetera*

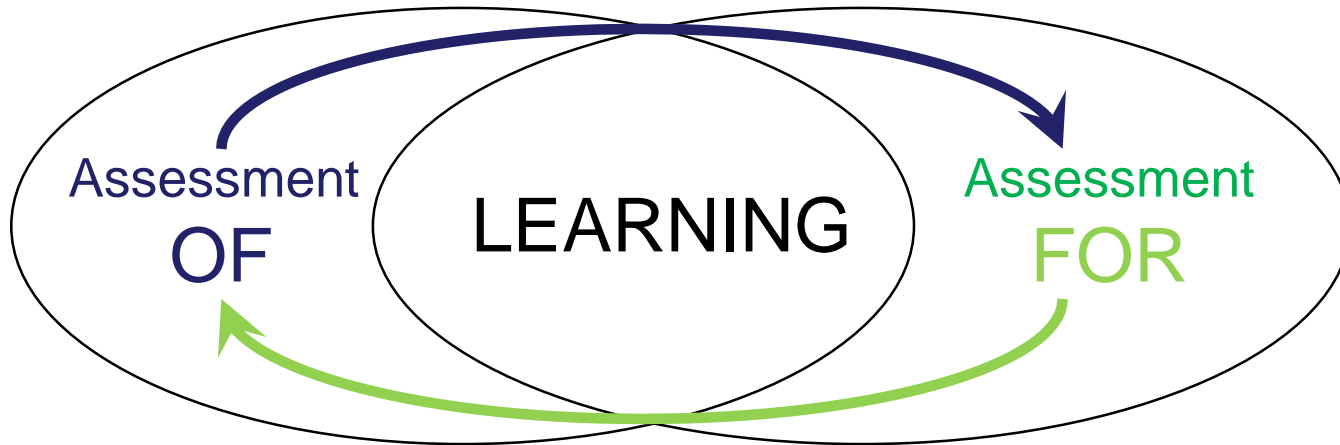




- **Lack of accuracy** may cause problems: *some, something, somewhere, this, that* means nothing
- **More words** does **not** mean **better** explanation
- **Incorrect** communication channel:
 - spoken / written word is not effective when describing the apparatus, a drawing is needed
 - drawing is not very effective when a process is shown, animation will be better,
 - spatial isomers of chemical molecules may be shown in 3D



Formative assessment as a driving force for learning



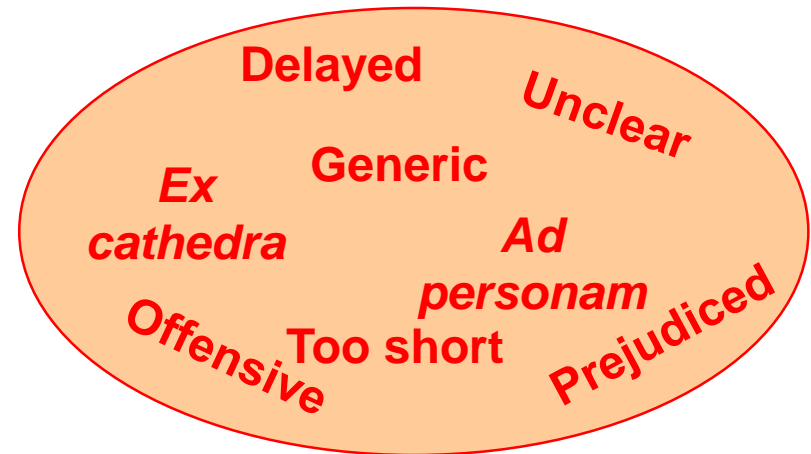
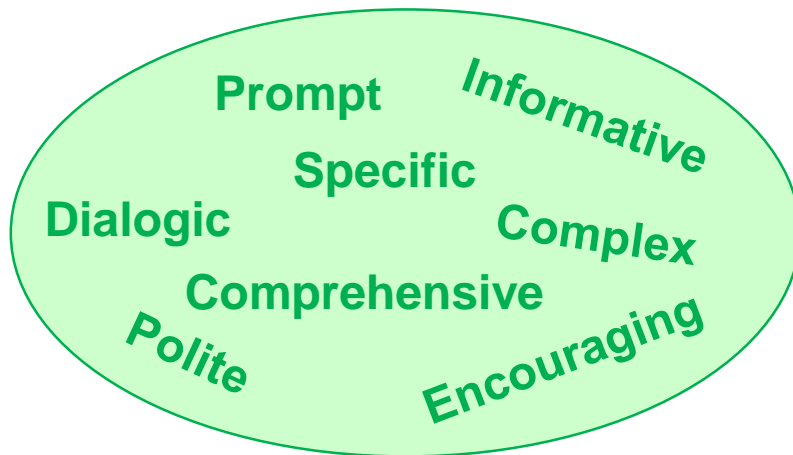
Formative assessment can precede **summative assessment** and should also follow it.

- at lower level, *each* element of a student's work could be *both* given a mark *and* given a feedback (*more than or instead of* a mark / a grade) - for future learning



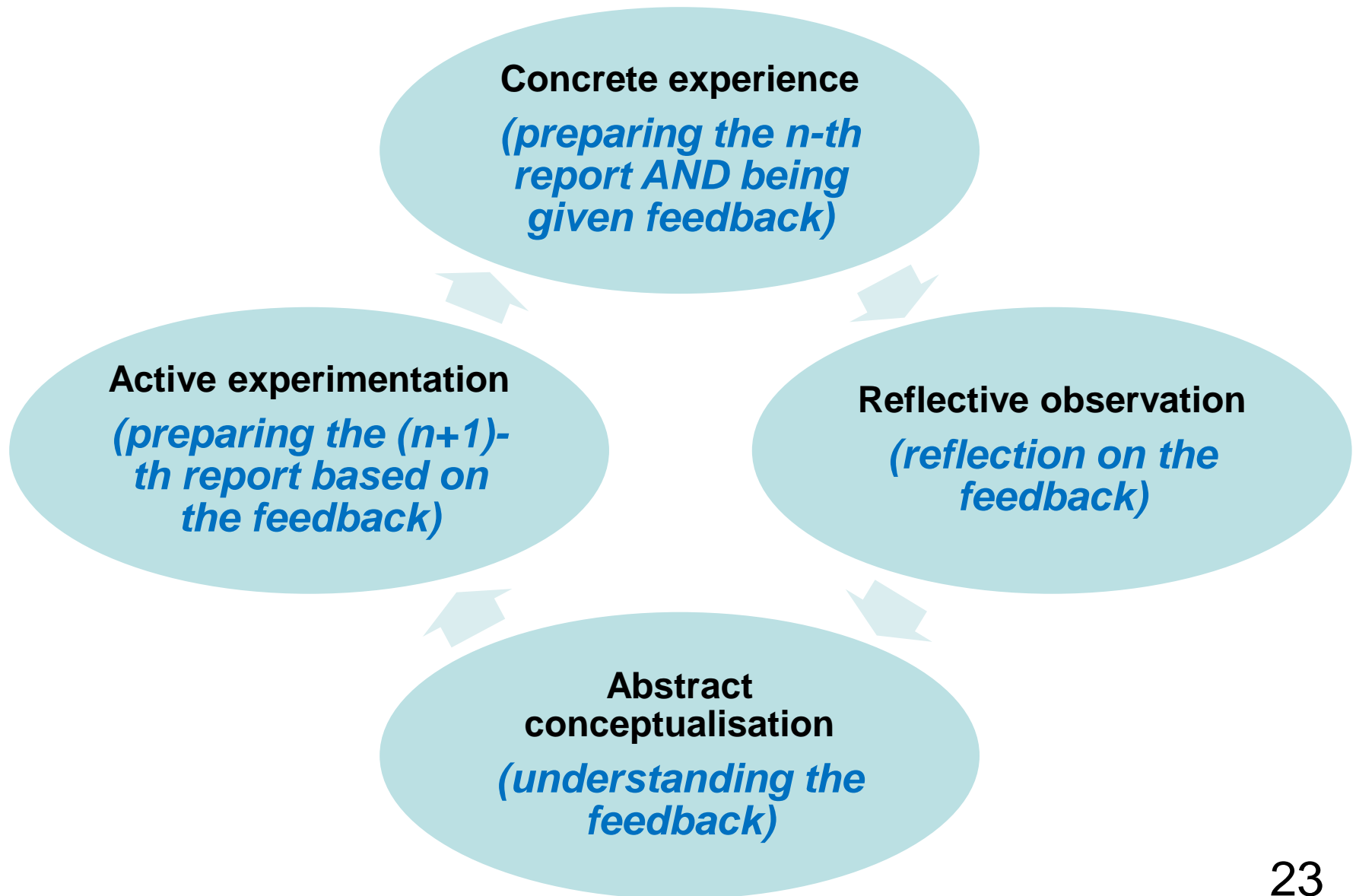
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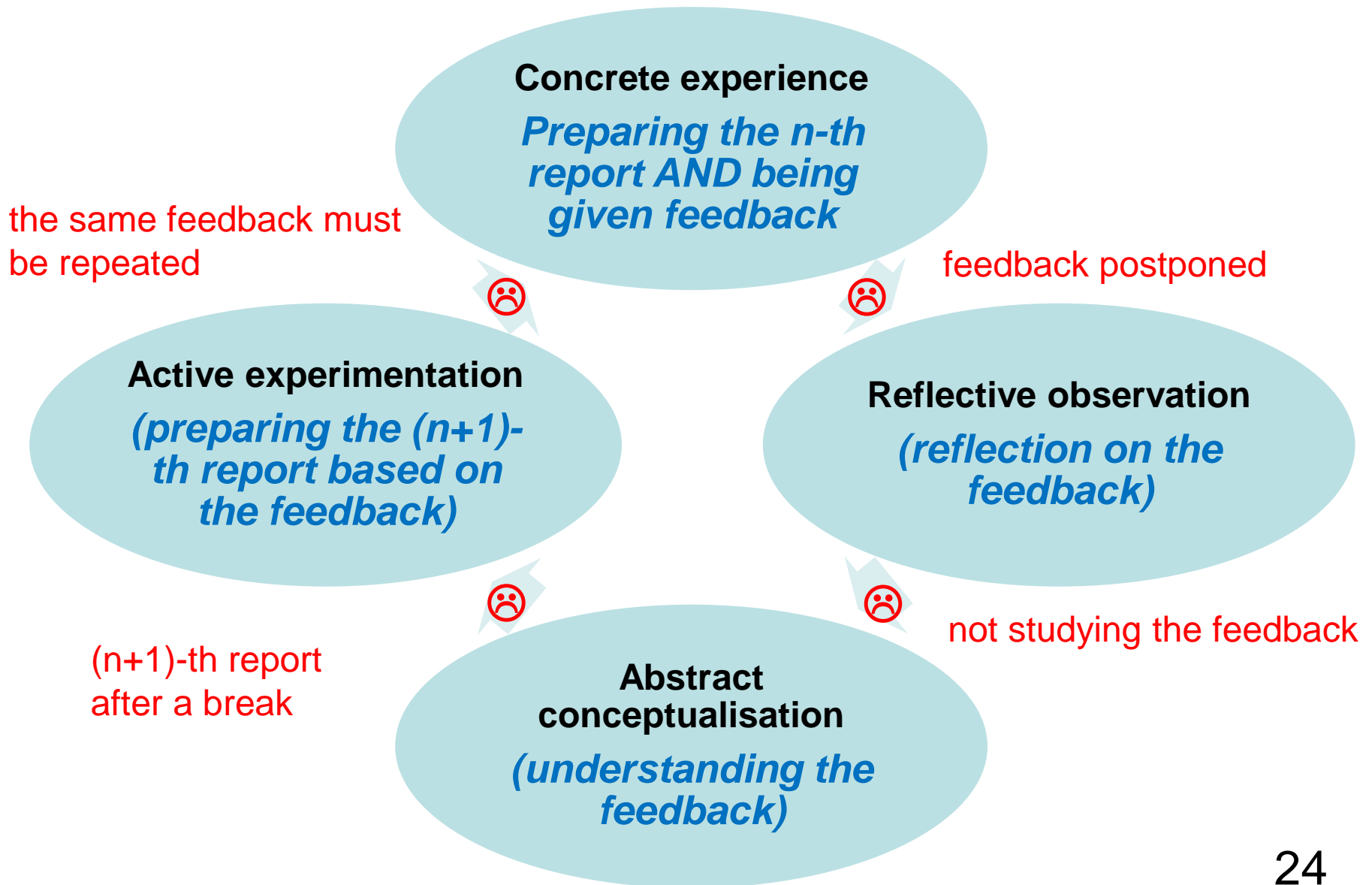
Feedback





How does it work?



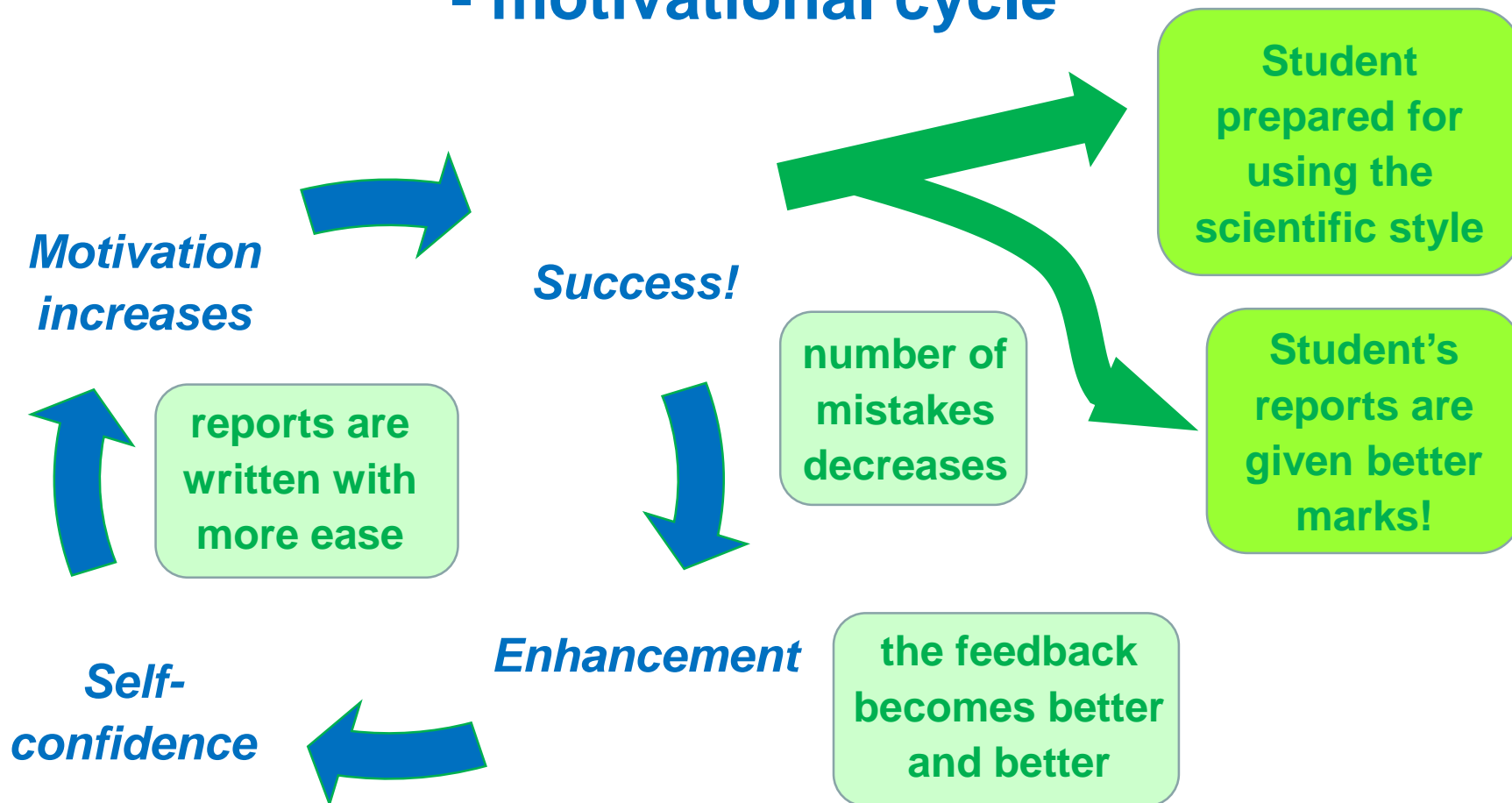




Motivational cycle



Possible effects of your feedback - motivational cycle





Practice (some real examples)

Content

- **Informative:** specific answers – **hints, proposals, and suggestions**
- **Complex:** complete, touching all aspects – **both positive and negative**

be good to

tert-

Purpose of the exercise:
To synthesize 4-tert-butyl-1,2-dimethylbenzene by working with a separator, reflux condenser, perform extraction and heating in an oil bath. *from tert-butyl chloride and o-xylene and to purify the product by distillation.*

Primary data:

Do not just underline the mistakes!

Conclusions:
It is very important to and the volatility of this exercise.
Be careful with boiling point of the such a situation the accordance with all exercise, the theoretical alcohol thermometer distillation stabilized with o-xylene (its boiling point certainly did not go 185 °C, not foreruns

Good description and good comments

completion of the reaction, the mixture was diluted with about 20 cm³ of petroleum ether, washed with a saturated solution of sodium bicarbonate in a separating funnel, and then with a solution of sodium chloride. The organic layer was dried with anhydr. calcium chloride or magnesium sulfate. Then the drying agent was separated, the petroleum ether was distilled off on the evaporator and the remaining liquid was distilled (theoretically the distillation temperature was supposed to be 209 °C, but the measurement was done using an alcohol thermometer, which can significantly reduce the results, so the temperature during the distillation stabilized at 185 °C) under atmospheric pressure.

(...g, ...mol)

"5.0 cm³" should

This is a fragment of the instruction. What drying agent did you use?

It is better to give the quantities of reagents immediately in cm³, grams (you can weight them) and in moles (to show molar ratios → you know which reagents are in excess, for example

(translated from Polish)



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You've chosen the glassware correctly, though the elements of the system are assigned together wrongly. Have a look at the diagram, please, and try again.

It would be good if you included a reaction diagram made in a chemical formula editor. You will be asked to do it while writing your BSc thesis

You've made a great progress! Remember about citing your references properly.

The report of execution of the task should describe the activities performed, not fragments of the instructions. Please include the observations.



Final feedback (example 2):

[Original report was written in Polish] You wrote your report almost very well, Mrs. *[name]*. You wrote the description of the experiment nicely. It is clearly visible that it is based on the instruction, which was translated from English with an automatic translator – please remember to check such translations. Both diagrams require links in the appropriate place in the description, as well as literature data (you must insert references in the text (eg. [1], [2], [3] ...) to articles (NOT to databases or teaching materials) and include links to these articles at the end: [1] ..., [2] ..., [3] ... The rest of the minor comments, corrections, and tips are included in the text.



Final feedback (example 1):

Mrs. [name], you have written this report quite satisfactorily, even though it is flawed:

- it would be also good to record the *observations* during the reaction and during the working-up of the reaction mixture – then it would be clear when and what gas was evolved, right?
- in the part concerning the calculation of the yield of the product, data on densities and molar masses (or masses and molar masses) of the reactants are missing. Such incomplete calculations are hard to come by;
- there is no reaction scheme.

On the other hand, you described the distillation process very well.

Summing up, I can give you no more than „B” for this report. I hope that my remarks will allow you to write the next reports better 😊



What to take into account (examples)?

(during giving the feedback on the report)

- ✓ ***GOALS*** should be described specifically and completely
- ✓ ***REACTION SCHEME*** and ***MECHANISM*** drawings should apply to the ***UIPAC*** rules
- ✓ ***INTRODUCTION*** should be brief and concise, references should be included
- ✓ ***DEPICTION*** of the experiment should be complete and allow to repeat the experiment
- ✓ ***CALCULATIONS*** should be meritorically and formally correct
- ✓ ***CONCLUSIONS*** should not repeat goals and introduction



Reception

(from talks with the students and evaluation questionnaires)



Very valuable feedback!

Nobody has given me
so complex feedback
before.

Dr Trzewik gave us
many useful hints
during the course.

Now I know how to
show stereochemistry
in chemical structures.

We haven't been
taught how to cite
references. Now it is
clearer for me.



Summary



Advantages

- ✓ *students' reports style become much better*
- ✓ ***your feedback could be used by the students during preparing their BSc thesis***
- ✓ *could be used during various courses (not only organic chemistry!)*
- ✓ *your feedback could be used by the students during other laboratory courses*
- ✓ *very positive reception by the students*

Disadvantages

- ✓ *not suitable for larger groups*
- ✓ *the assistant cannot be changed during the course*
- ✓ ***time consuming (at first)***
- ✓ *some elements of the feedback must be repeated (even several times)*



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Thank you for your attention!
(and I encourage discussion)

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