Suggestions on how to assess inquiry-based learning sequences



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Program

1. What we know from science education research about exams
2. Some conceptual clarifications
3. Trends in examination culture
4. The dilemma of performance grading
5. Check what is important!
6. How to include partner, peer, and self-assessment
7. A suggestion for teacher assessment

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0. Why do we assess students?

Suggestions…



0. Why do we assess students?

- we're required to by law
- to grant approvals
- …

- provide feedback
  - ✓ teacher
  - ✓ students
  - ✓ parents

1. What we know from science education research about assessment

Assessment affects the learning behavior!

- variety of methods not only in the design of lessons, but also in the assessment/evaluation of performance
- formative performance evaluation with the possibility of improvement (“feedback”)
- encouraging students to pursue individual subject-related interests and to show their skills in different ways (e.g. group presentations with assigned roles)
- support students in their reflection on learning objectives and self-assessment

(Stern, 2008)

2. Some conceptual clarifications

- Scientific literacy is *"…the knowledge and understanding of scientific concepts and processes required to participate in a democracy"* (NRC 1996, p. 22).
- Performance is the *"… result and completion of an activity that is associated with effort and, if necessary, self-overcoming, and for which quality standards are recognized"* (Klafki 1996, p. 124).
  - outcome
  - process
  - volition (willingness to learn)
- Educational standards defined by authorities.
  ⟶ **competencies** (dependent on subject and country)
  - observing, recording and describing (knowledge)
  - investigating and processing (*How is knowledge gained?*)
  - interpreting and evaluating
  - deciding and acting
  - communicating

- “extended understanding of performance”
  - social-communicative skills
  - personality (self-esteem, ability to reflect)

If you want to promote the development of competencies in all areas, it is beneficial to identify and recognize them.

- difference between evaluation and assessment of performance
  - evaluation: information about the level of performance ⟶ feedback
  - assessment: grades the outcome with respect to certain criteria

  ⟶ **different consequences!**

- different kind of norms to grade performance
  - social norm: is measured in relation to the class average (group oriented)
  - factual norm: is compared with the curricular learning objectives (absolute standard)
  - individual norm: is compared with previous achievements of the same person and thus show personal learning progress (Stern, 2008)

3. Trends in examination culture

"... is not the ability to give a correct answer to a question that has been dealt with in class, but to respond to situations that go beyond the horizon of the school and have not been taught. We must train people who know how to act in situations for which they have not been prepared." (Wiliam 2006, p. 3)

- content: specific subject matter takes a back seat in favor of real-world problems in meaningful contexts
  → **concepts**
- learning: trend is moving away from memorization and exercise towards investigating relevant problems
- teaching: less instruction, more individual coaching, providing appropriate learning environments (Stern, 2008)

4. The dilemma of performance evaluation

incompatible functions

- feedback for students
- feedback for the teacher
- selection: students receive certificates with or without authorizations that open up or deny them opportunities for the next step in their careers

feedback ⟶ formative / mid-term assessment

- acompanying the learning process

summative assessment ⟶ certificates

- at the end of a learning process/period

clear separation of learning and assessment situations

5. Check what is important

… and not what is easy to test!

- new type of tasks
  ⟶ inquiry-based learning
- competencies
- concepts

6. How to include partner-, peer-, and self-assessment

6.1 tools of self-assessment

- learning journal

After each learning unit, a page for your personal thoughts!	
Date: _____ Topic: _____ How was it? ++ / + / - / --	Interesting for me was: _____ I have learned: _____ Superfluous was: _____ We should have taken more time for: _____ What I plan to do on the topic: _____

Rules:
The learning journal is yours.

- *The teacher is not allowed to look into it without your permission.*
- *If you want to and are asked, you can read from it at the end of the lesson.*
- *At the end of the semester, you will need it to summarize which lessons were the best for you and what new things you have learned.*

redrawn after (Stern, 2008)

- reflection of learning goals
  Students can weight a given list of topics:
  What do I want to learn in physics this year? What interests me the most? My personal ranking for the topics.

- reflection of learning progress

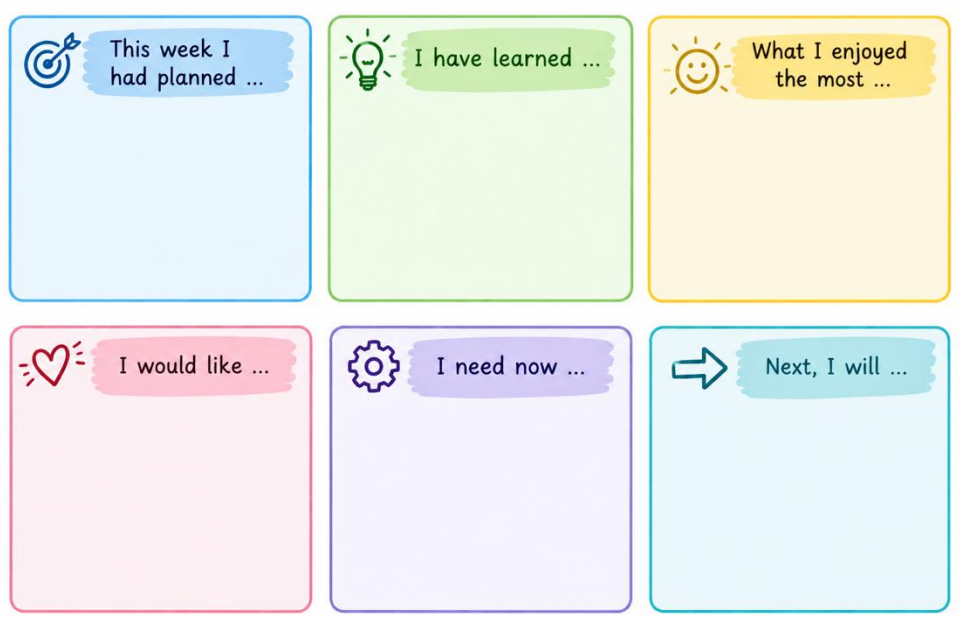
BEFORE: Mark with a blue cross x how much you already know!

Terms related to SONIC	**I know my way around**		
	good	partly	bad
Air waves: Echo & speed of sound	☐	o	x
Supersonic Bang	☐	☐	☐
Sounds & Noises, Music & Noise	☐	☐	☐
Musical Instruments: Strings & Diaphragms	☐	☐	☐
Pitch (Hertz) & Volume (Decibels)	☐	☐	☐
Noise protection	☐	☐	☐
Ultrasound (in Animal Kingdom & Medicine)	☐	☐	☐

AFTER: Mark with a red circle o how well you know your way around now. How many improvement jumps have you made? Where have you not learned?

(Stern, 2008)

- (weekly) review



- diagnostic differential

	Applies	Partially	Somewhat not too	Rather accurate not too
Overall, I have received a lot of suggestions in the subject ..... and benefited from them.	☐	☐	☐	☐
I learned a lot of new things in terms of content, e.g. about ....., ..., ...	☐	☐	☐	☐

(Stern, 2008)

6.2 tools for peer-assessment/review

- combination of self-, partner- and teacher-assessment
  - learning achievements, such as experimental protocols, are assessed by students themselves
  - then peers correct and make suggestions for improvement
  - afterwards teacher checks the understanding with questions and confirms or adds things to the self-and partner- assessments
- evaluation of presentations by peers

  teacher...
  - provides criteria for presentations
  - rules for feedback, and
  - communicates modalities of assessment (e.g. awarding of points)

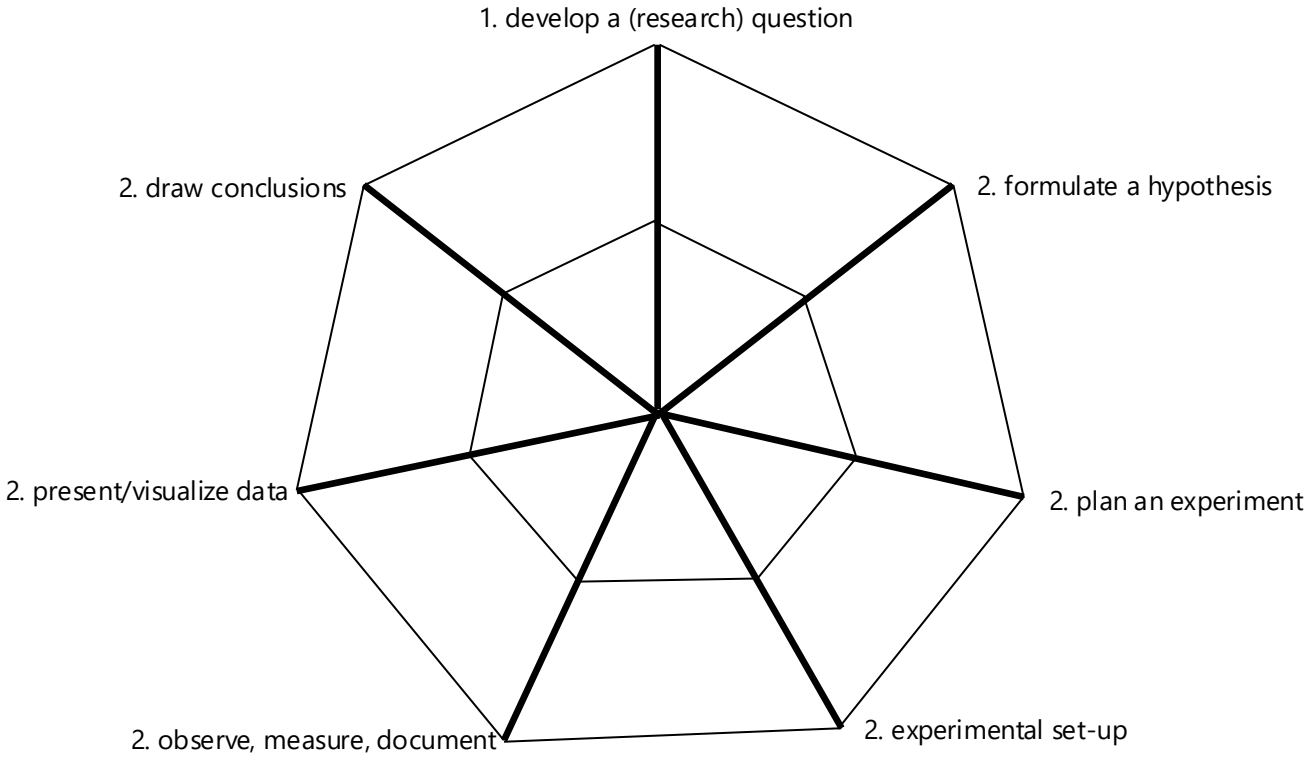
(Stern, 2008)

7. A suggestion for teacher-assessment

- *our case:*
  Inquiry Learning comprises many different subdomains.
- experimental competencies (Nawrath, Maiseyenka, Schecker, 2011)
  1. develop a (research) question
  2. formulate a hypothesis
  3. plan an experiment
  4. make the experiment work (experimental set-up)
  5. observe, measure, document
  6. present/visualize data
  7. draw conclusions from data and discuss them

(Stern, 2008)

Spider Net


1. develop a (research) question
2. formulate a hypothesis
2. plan an experiment
2. experimental set-up
2. observe, measure, document
2. present/visualize data
2. draw conclusions

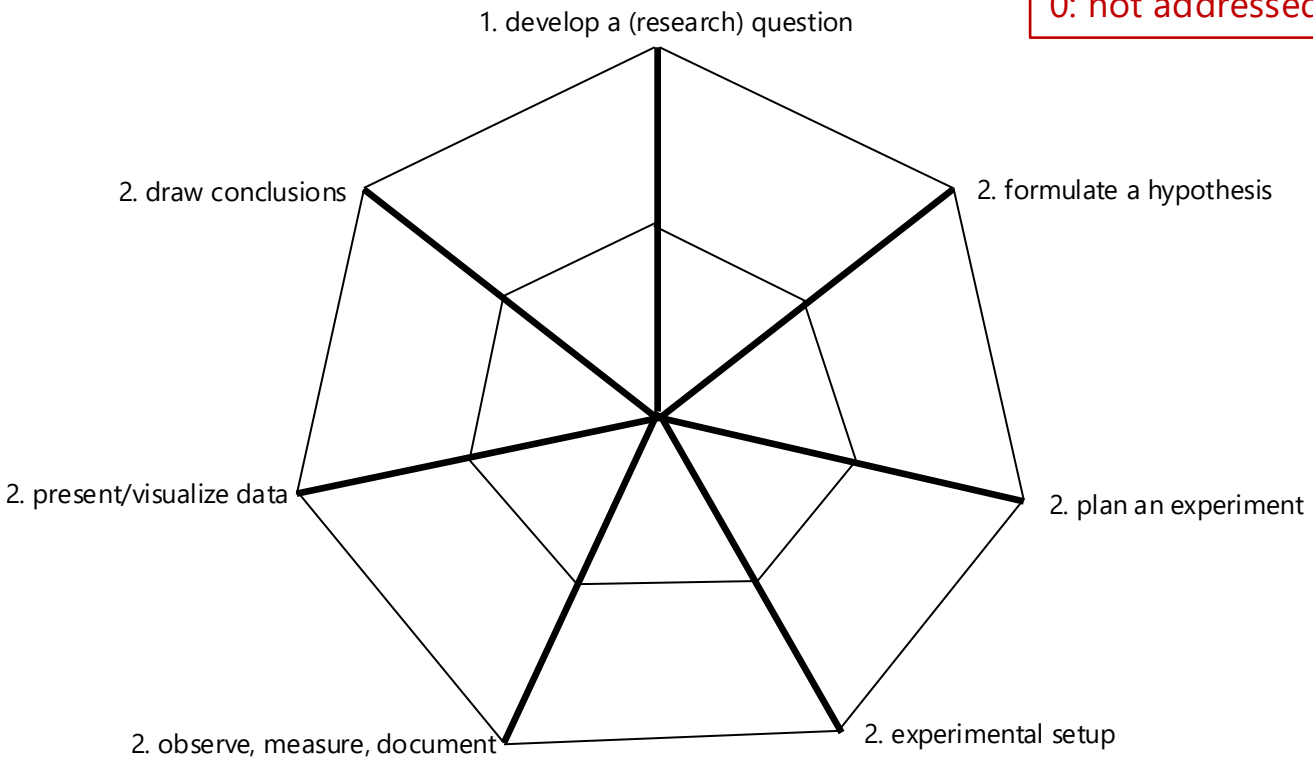
Objectives

- feedback
  one of the most powerful tools a teacher has (Hattie, 2009)
- revealing the discrepancy between the actual state and the target state
- describing of the path from the actual state to the target state for learners
- enough, but not too much information
- cyclic use: it is not intended to cover all aspects within one experiment

- Teachers can use the model in two different ways:
  - assess the students' competencies
  - planning and reflection guide for teachers
    Which of the subdomains have I already addressed in my teaching?
    What is still left open?

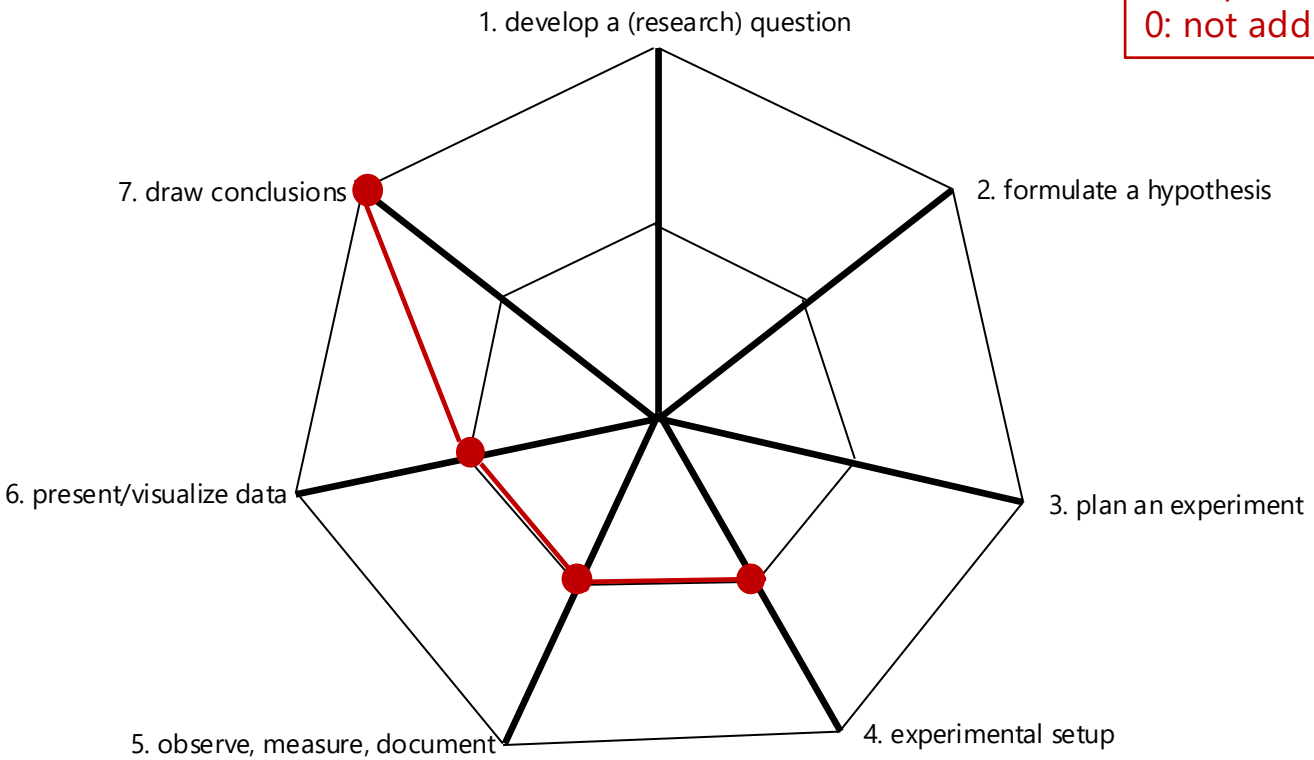
How can the Spider Net be used?

significance within the learning environment
2: main focus
1: important
0: not addressed



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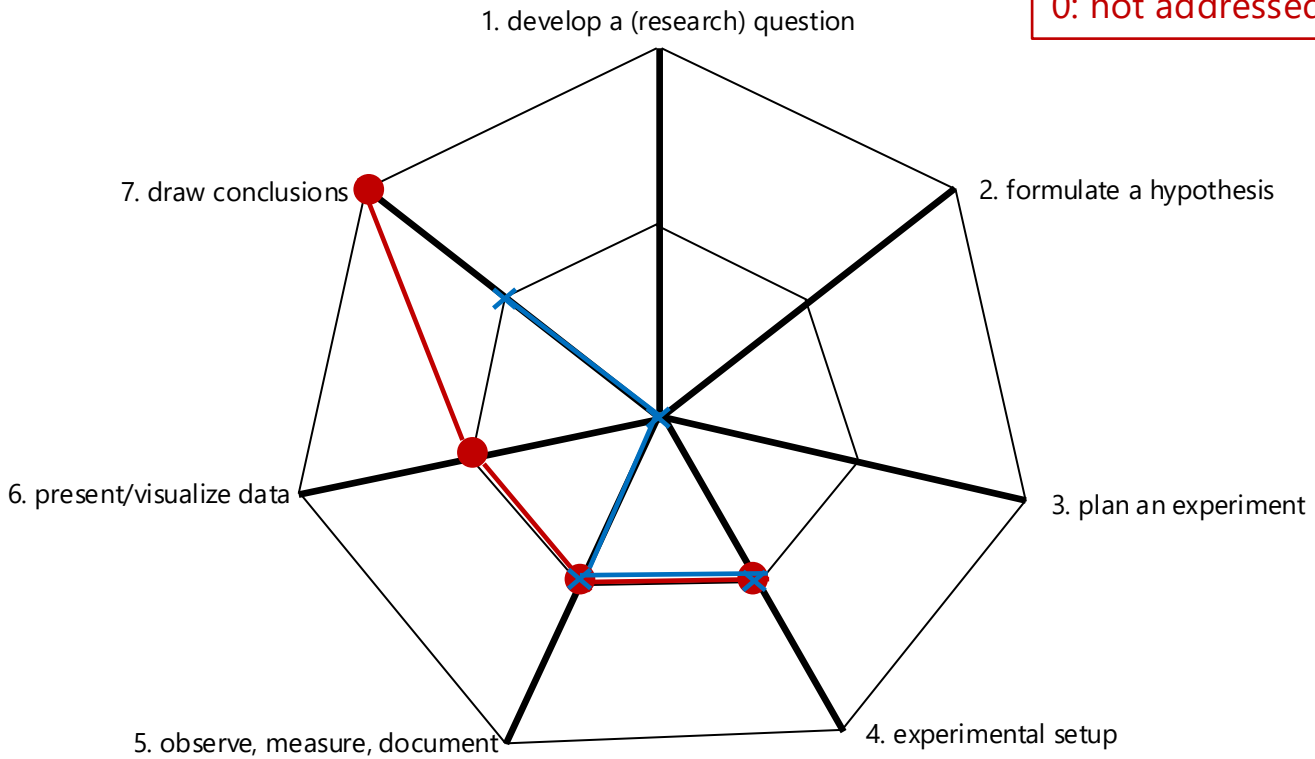
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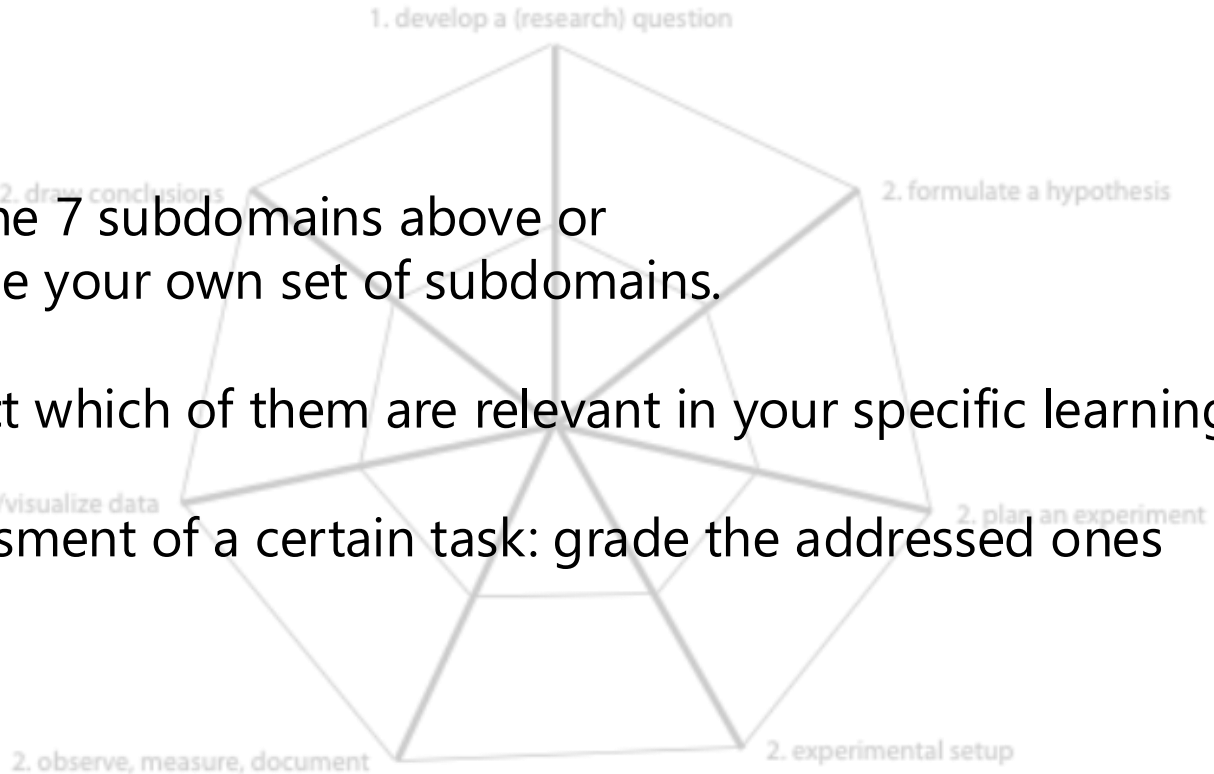
learner's performance
2: high
1: medium
0: low

significance within the learning environment
2: main focus
1: important
0: not addressed



example: Kulgemeyer (2026)

Spider Net summarized for inquiry-based learning environments



1. Use the 7 subdomains above or choose your own set of subdomains.

2. Reflect which of them are relevant in your specific learning scenario.

3. Assessment of a certain task: grade the addressed ones



Thank you for your attendance!

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References

Hattie, J. A. C. (2009). *Visible Learning: A sythesis of over 800 meta-analyses relating to achievement*. London, New York: Routledge.

Kulgemeyer, C. (2026). Experimentelle Kompetenzten im Physikunterricht. Feedback ud Leistungsbeurteilung. *Plus Lucis*(3), 28-31.

Nawrath, D., Maiseyenka, V., & Schecker, H. (2011). Experimentelle Kompetenz – Ein Modell für die Unterrichtspraxis. *Praxis der Naturwissenschaften – Physik in der Schule*(September 2011), 42 - 48.

Stern, T. (2008). *Förderliche Leistungsbewertung*. Salzburg: Pädagogische Hochschule Salzburg.