Spidercharts as an instrument for the participatory development of elements of inquiry-based learning in university teaching

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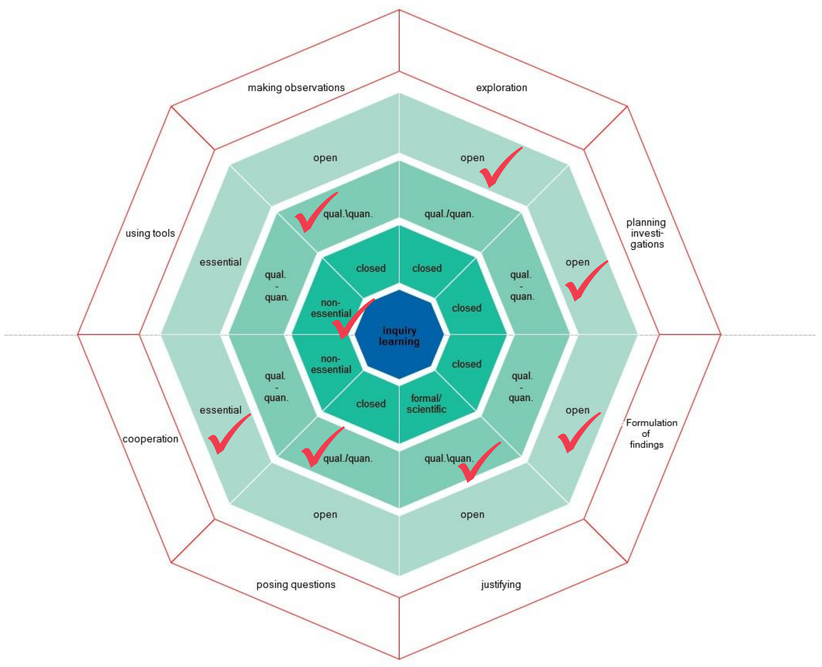
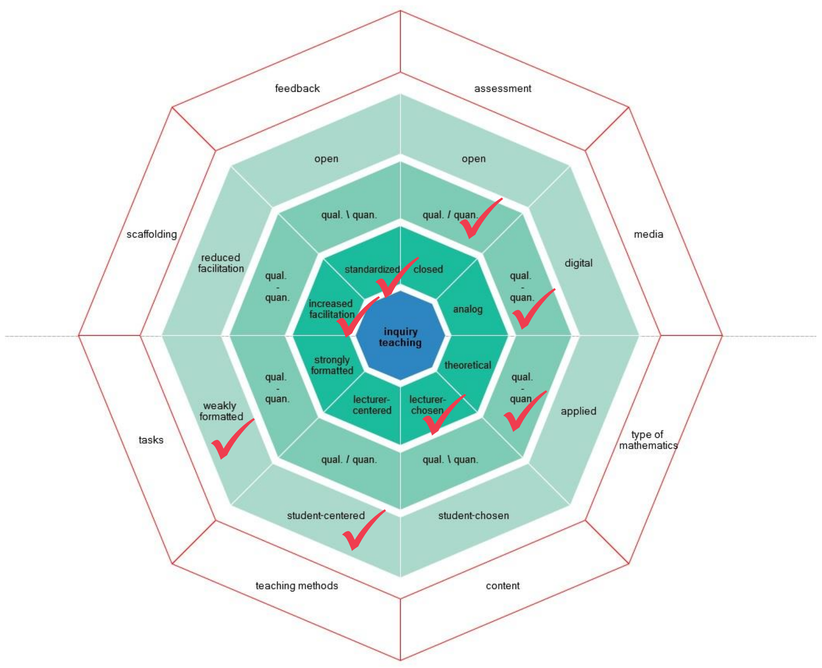
The teaching innovation project *Partnership for Learning and Teaching in University Mathematics* [PLATINUM] shares the common vision of the expansion of inquiry-based mathematics education [IBME] in university teaching. Mathematicians and didacticians from 8 European universities have come together to further develop concrete approaches to IBME in university teaching and to implement and reflect on these in their local communities.

The project is based on the teaching-learning and development concept of the Community of Inquiry (see Jaworski, 2006).
The spidercharts are inspired by the wheel-model (Brew, 2013) & the double-wheel-model (Lübcke, Reinmann & Heudorfer, 2017). Characteristics and quality nuances are based on research literature on IBME (Artigue & Blomhøj, 2013; Dorier & Maass, 2014) & reflections within the PLATINUM community.

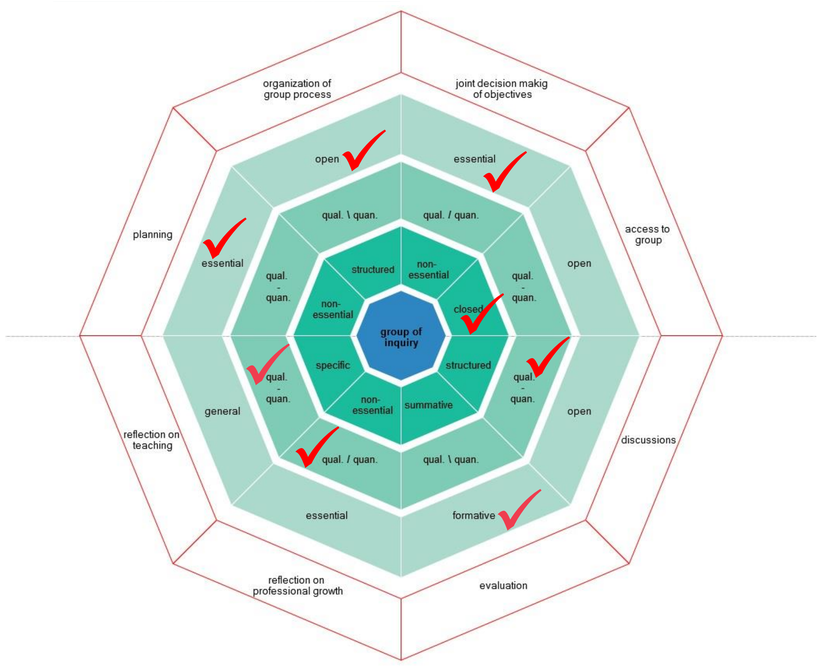
Inquiry Learning



Inquiry Teaching



Group of Inquiry



Example from Leibniz University Hannover:

making observations
- The hint guides students to include materials that structure what shall be observed (limiting the openness). We chose the middle **qualitative** box.

exploration
- What shall be explored and how is **open**

planning investigations
- The path of possible investigations is **open**

formulations of findings
- The way findings shall be formulated is **open**

justifying
- 2 parts: math (formal), didactic (open). We chose the middle **quantitative** box.

posing questions
- Initial task is closed. In the process of solving, questions posed are open. We chose the middle **qualitative** box.

feedback
- We use **standardized** evaluation- sheets.

assessment
- 2 assessment types: Presentation (open) and multiple choice exam (closed). We chose the middle **quantitative** box.

media
- Digital and analog parts. We chose the middle **quantitative** box.

type of mathematics
- 2 parts: Math (theoretical), Didactic (applied). We chose the middle **quantitative** box.

content
- It is fixed: We chose **lecturer-chosen**

teaching methods
- Active involvement is required. We chose: **student-centered**

organization of group process
- It is need-oriented. We chose: **open**

joint decision making of objectives
- We discuss and update our our objectives on a regular basis. We chose: **essential**

access to group
- Our group works continuously on topics revolving around teacher education. If other colleagues were interested in joining, we would organise extra extended group meetings. We chose: **closed**

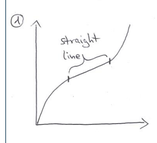
discussion
- Discussing what is on our agenda and addressing spontaneous discussion points is equally important to us. We chose the middle **qualitative** box.

cooperation
- Negotiations within the group are **essential**

using tools
- Tools are **non-essential** for solving the task

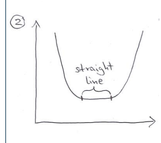
Example Teaching Unit

Introduction:
An upper high school class is revisiting inflection points in mathematics. One of the pupils draws onto the sheet of his neighbor graph 1 below and comments:



"Listen, I always wondered if a function that looks like this has inflection points everywhere on the straight line. What do you think?"

The neighbor, visibly amused, adds graph 2 below and replies:



"Look, can't you do the same with a parabola? If you flatten it on the lower side like this, wouldn't it then have lots of extremums as well? Infinitely many, even!“

Task:
- Design and implement a "learning activity" [in our mathematics education course] that will enable your fellow students to find a mathematical answer to the above implied questions.
- Additionally, discuss a teacher's possibilities of an in-class reaction to the above interaction.
- Hint: The material provided should suffice to arrive at a solution to the mathematical problem. However, consulting external sources is not prohibited.

tasks
- Students have to formulate concrete sub-questions. We chose: **weakly formatted**

scaffolding
- Intentionally no additional scaffolds (besides material). We chose: **reduced facilitation**

evaluation
- We have open discussions about the progress of our group work. We chose: **formative**

reflection on professional growth
- We explicitly reflect on how the group meetings foster our professional growth. We do this infrequently, but it is important. We chose the middle **qualitative** box.

reflection on teaching
- We reflect topics in more general terms (e.g. discussing theories) as well as with regard to specific situations. We chose the middle **qualitative** box.

planning
- We regularly plan teaching units together. We chose: **essential**

All three spidercharts are **reflection tools** that shall
- present the common vision of PLATINUM
- help to reflect on and characterize the creative leeway in designing teaching units
- serve the futher growth of the local communities
- structure reflection processes alongside different characteristics of *inquiry learning*, *inquiry teaching* and the work in *groups of inquiry*.

References

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