

Aligning efforts in education

Thursday, 22 January 2026
WiNSt Education Day

Today's sessions

Session 1: Towards a shared perspective

(10.15 - 11.00hrs)

- **What problems need solving?** (Alex)
- **Physics of learning** (Sven)



Session 2: Aligning efforts

(15.15 - 16.15hrs)

- **Setting goals & levels** (together & subgroups)

What problems need solving?

Workload students too high

Students cannot check
their progress & level

Poor attendance of
lectures/tutorials

Insufficient tuning between courses

Different takes on expected
performance level of students

Unclear linkage between
learning activities and
learning objectives

Assessment: Difficulties in determining
what constitutes a 4, a 6, an 8...

SESSION 1: TOWARDS A SHARED PERSPECTIVE

High study pressure

- **Every 7 weeks, students are assessed in 4 courses**

What is the level?

- **Memorization enough?**
- **What's the passing level? Is it the same for every required class?**
- **What is a cum laude, what is sufficient?**

How do students know?

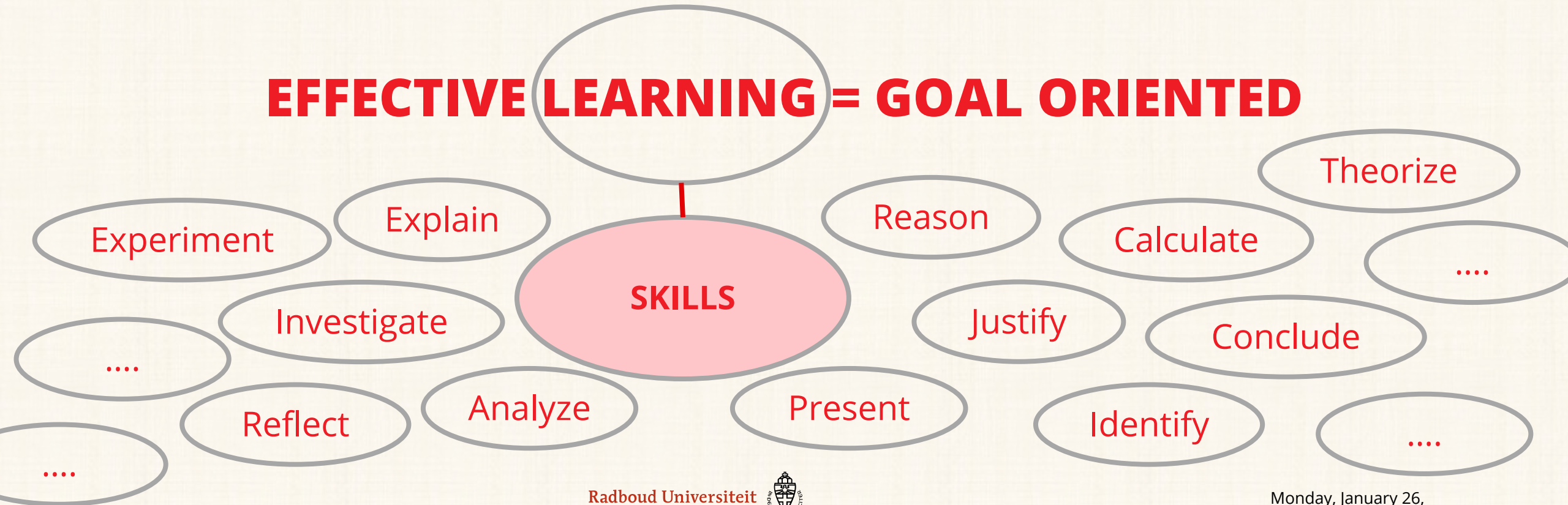
- **Can they gauge their level, during the course?**
- **Do they know where to find “practice” for the things they don’t know? Without penalty?**
- **Can they identify where the educational information is and linked to what the goals are?**

Optimize our educational means?

- **Tutorials are poorly attended (< 50% of the class)**
- **Tutors but not all courses**

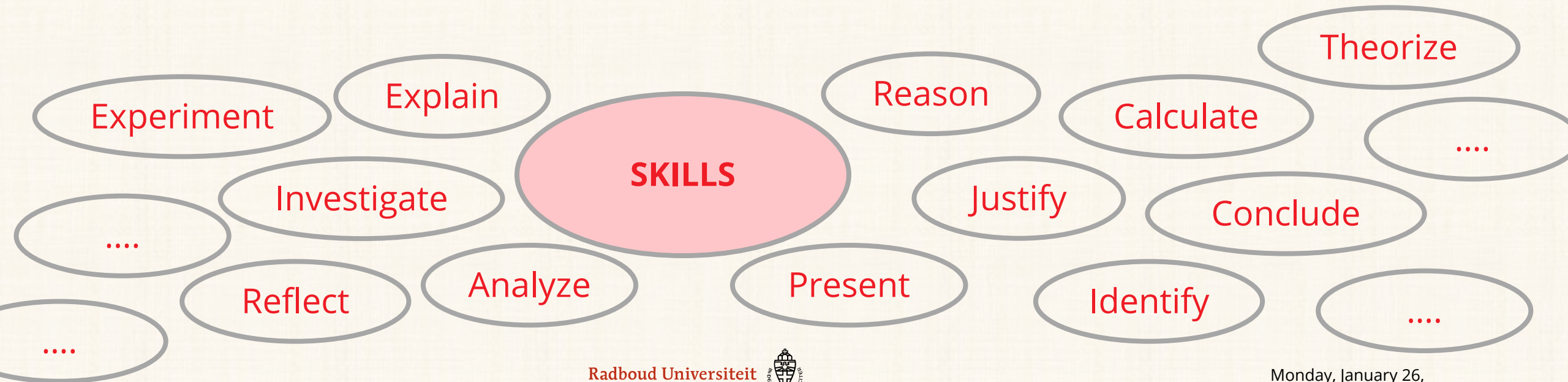
Physics of learning

EFFECTIVE LEARNING = GOAL ORIENTED



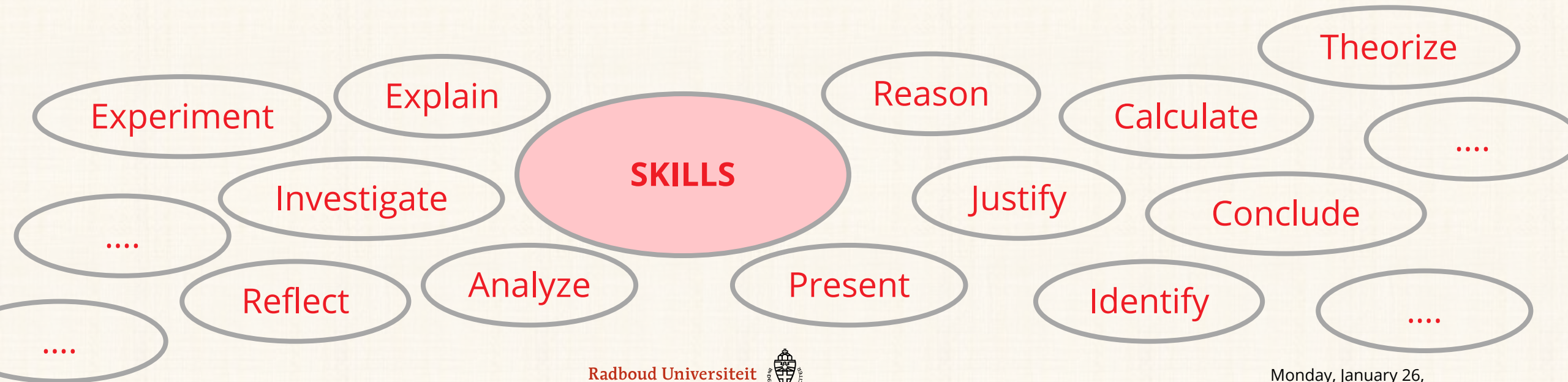
Physics of learning

LEARNING → TOPICS (ONLY)



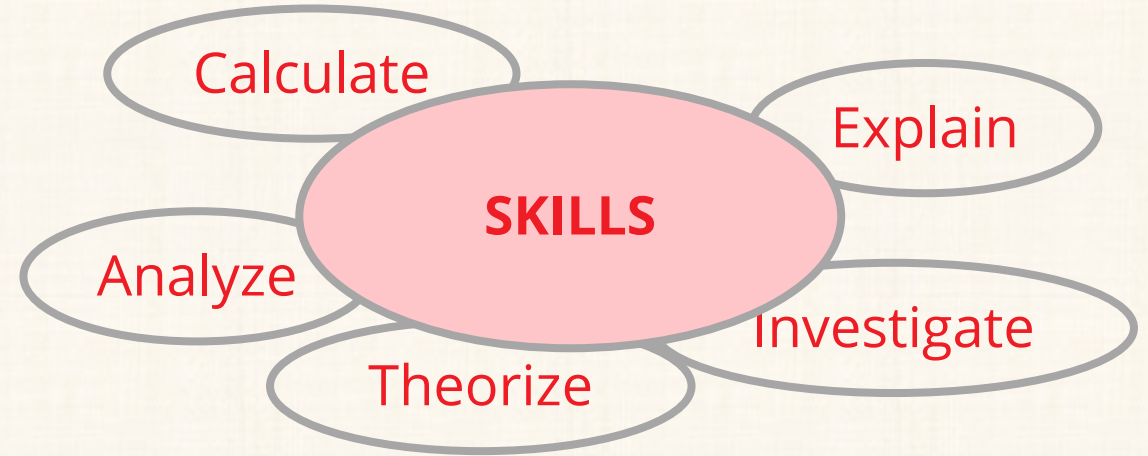
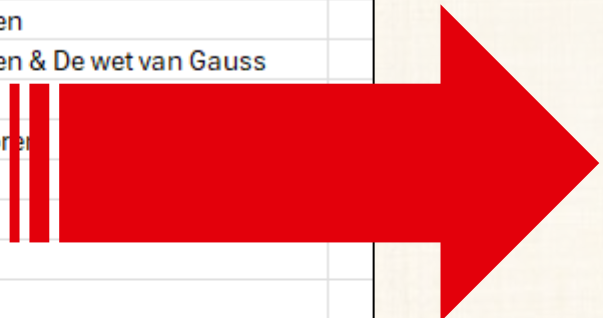
Physics of learning

LEARNING GOAL → TOPIC (ONLY)



Physics of learning

	A	B
1		Electricity and magnetism
2	1	Elektrische lading en elektrisch velden
3	2	Elektrische lading en elektrisch velden & De wet van Gauss
4	3	Elektrische potentiaal
5	4	Elektrische potentiaal & Condensatoren
6	5	Elektrische stromen en weerstand
7	6	Gelijkstroomkringen
8	7	Magnetisme en magnetische velden
9		
10		
11	1	Magnetisme & Bronnen van magnetische velden
12	2	Bronnen van magnetische velden
13	3	Elektromagnetische inductie & wet van Faraday
14	4	Inductie vrellingen en wissenstroomschakelingen
15	5	Em trillingen en wissenstroomschakelingen
16	6	Wissenstroomschakelingen & Maxwell
17	7	De vergelijkingen van Maxwell en elektromagnetische golven
18		



- At the end of this course...
- students...
- are able...
- to justify...**
- the values of elementary electro-magnetic parameters (e.g., field, potential, capacity, resistance)...
- across different electro-magnetic circuits.

Physics of learning

Learning objectives

Students are able **to justify** the values of elementary electro-magnetic parameters across different electro-magn...



Constructive Alignment

Assessment

Students **justify**...

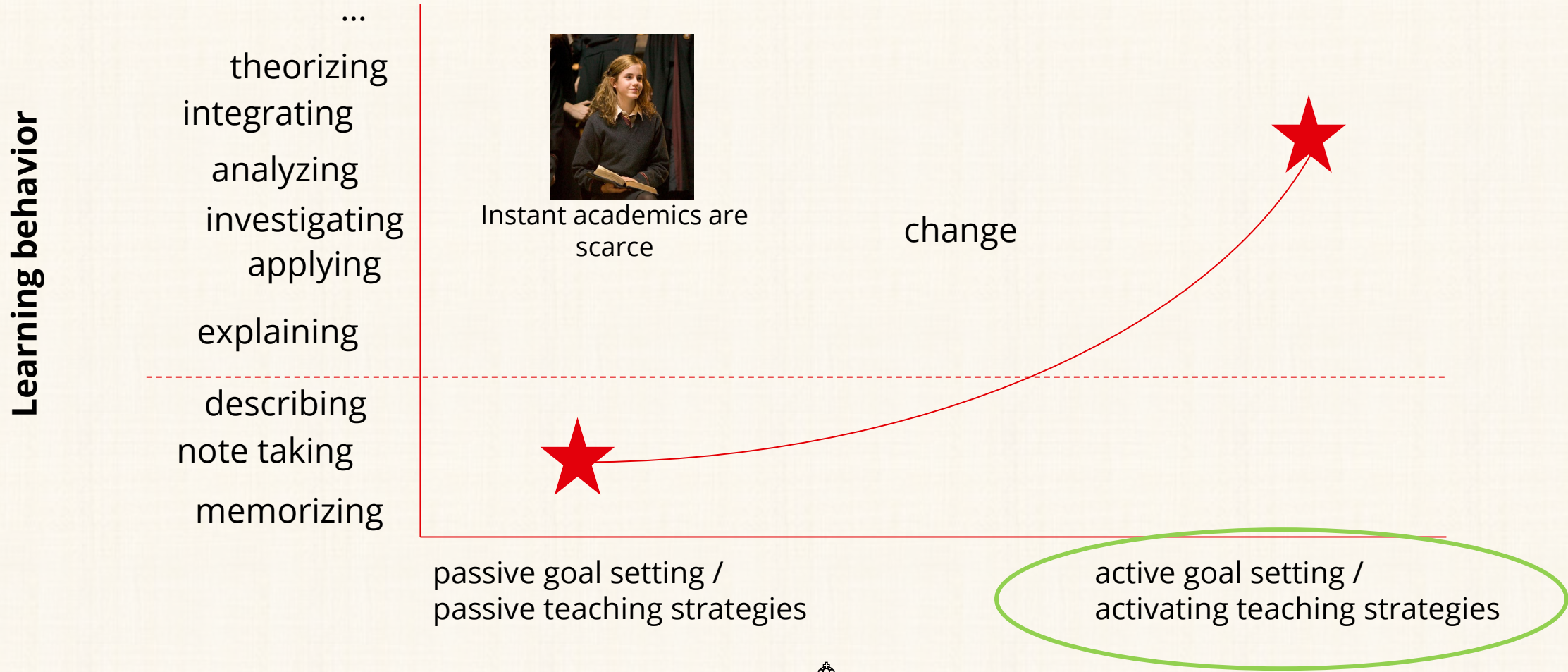


Learning activities

Students **justify... (etc)**

How does this solve any problems?

Physics of learning



Physics of learning

Learning objectives

Students are able **to justify** the values of elementary electro-magnetic parameters across different electro-magnetic circuits



Physics of learning

Constructive Alignment

- **Students shift focus towards learning the required skills** (with regard to topic X, Y, Z)
 - It is the only way to pass the course!
- **Centralizing observable skills increases perceived relevance of learning activities**
 - All learning activities serve the learning objectives
 - Redundant learning activities can be removed
- **Yields efficient, goal-oriented course-designs**
 - Beneficial for study load
 - Easier to select relevant learning activities
 - Easier to compare courses and tune them to the 'greater key'
- **Observable skills are assessable at various levels**
 - Criteria are needed to determine which level constitutes a pass (Session 2)

SESSION 1: TOWARDS A SHARED PERSPECTIVE

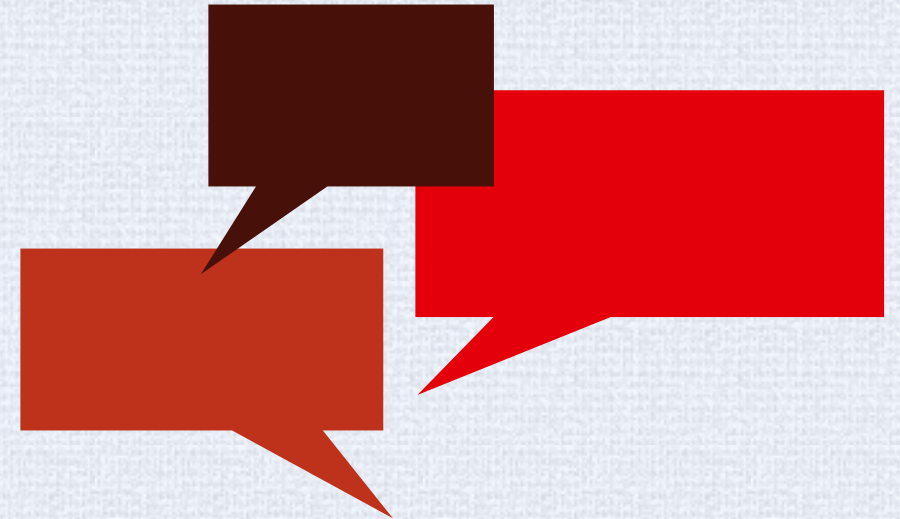
END OF SESSION 1

Today's sessions

Session 1: Towards a shared perspective

(10.15 – 11.00hrs)

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Session 2: Aligning efforts

(15.15 – 16.15hrs)

- **Setting goals & levels** (together & subgroups)

Setting goals & levels

Or Warmteleer, if you prefer that

Deliverables for this session:

1. (Skill-oriented) **learning objectives** for Space & Time

2. **Key determinants** for different levels

- What typifies excellence mastery of these skills?
- What typifies insufficient mastery?
- Sufficient?

Setting goals & levels

20
minutes

Instructions:

1. Form groups of ~ 3
2. Study the **Space & Time** course topics
3. Define the underlying (assessable) **skills**
4. Define at least 2 learning objectives that combine skills & content
5. Write them on a flap-over (to be presented/discussed)

At the end of this course, students are able to...

perform [**skill**] with [**topic**] in [**context**]

Blooms Action Verbs

Knowledge (Remember)	Comprehension (Understand)	Application (Apply)	Analysis (Analyze)	Synthesis (Evaluate)	Evaluation (Create)
Arrange	Associate	Add	Analyze	Appraie	Arrange
Choose	Classify	Apply	Appraise	Argue	Assemble
Count	Computer	Calculate	Arrange	Assess	Categorize
Define	Convert	Change	Breakdown	Attach	Choose
Describe	Defend	Choose	Calculate	Choose	Collect
Draw	Demonstrate	Classify	Categorize	Compare	Combine
Duplicate	Describe	Complete	Classify	Conclude	Compile
Identify	Distinguish	Compute	Combine	Contrast	Comply
Label	Estimate	Demonstrate	Compare	Criticize	Compose
List	Explain	Discover	Contrast	Critique	Construct
Locate	Express	Divide	Criticize	Defend	Create
Match	Extend	Dramatize	Design	Describe	Design
Memorize	Extrapolate	Employ	Detect	Discrimminate	Develop
Name	Generalize	Examine	Develop	Determine	Devise
Omit	Give Examples	Explain	Diagram	Estimate	Do
Order	Identify	Generalize	Differentiate	Evaluate	Drive
Outline	Illistrate	Graph	Discriminate	Explain	Explain
Point	Indicate	Illustrate	Distinguish	Grade	Formulate
Quote		Interpret	Examine	Judge	Generate

Setting goals & levels



SPACE & TIME

Coordinate systems, Galilean relativity, Principles of Special Relativity

Lorentz transformations and their consequences

Relativistic Doppler effect

Energy, momentum, and 4-vector kinematics

Relativistic particle physics in cosmic rays and beyond

Causality – spacetime – and event horizons

Final application: making GPS work

Setting goals & levels

20 minutes

Instructions: define different levels

Learning objective At the end of this course, students are able to...	Insufficient	Sufficient	Excellent
to justify the values of elementary electro-magnetic parameters across different electro-magnetic circuits	- [sloppy calculations] [wrong formulas] [incorrect calculations] [cannot handle simple circuits]	+ [correct calculations] [can handle simple circuits]	+++ [correct calculations] [can handle complex circuits] [logical and elaborate]

What observable properties typify these different levels?

Setting goals & levels

10
minutes

Plenary Discussion

Overall happiness?

What went well?

Helpful tips?

Eye-openers?

Challenges?

Fruitful ideas?

SESSION 2: ALIGNING EFFORTS

END OF SESSION 2

Back-up course

Warmteleer

Druk, wet van Pascal, Hydrostatica, drijfkrachten, Inleiding stromingsleer, vergelijking van Bernoulli

Nulde Hoofdwet: temperatuur, Thermometers en temperatuurschalen, Thermische uitzetting, Ideale gaswet

Eerste Hoofdwet: energie, Specifieke warmte, Latente warmte en fase overgangen, Thermodynamische processen (adiabatisch, isotherm. Isobaar, isovolumentrisch) PV diagrammen

Energie overdracht door straling van een ideaal gas, Kinetische theorie van een ideaal gas

Specifieke warmte van een ideaal gas, Equipartitie principe, Adiabatische processen van een ideaal gas, Boltzmann factor en Maxwell-Boltzmann verdeling

Tweede hoofwet: entropie, Reversible and irreversible procesen, Warmtemaswchines (pompen en koelkasten, Efficiencie en Carnot cyclus

Verbrandingsmotoren, Entropie, Speciaal topic: landauer limiet