

# Understanding and supporting teaching repertoire development **an ecological approach**

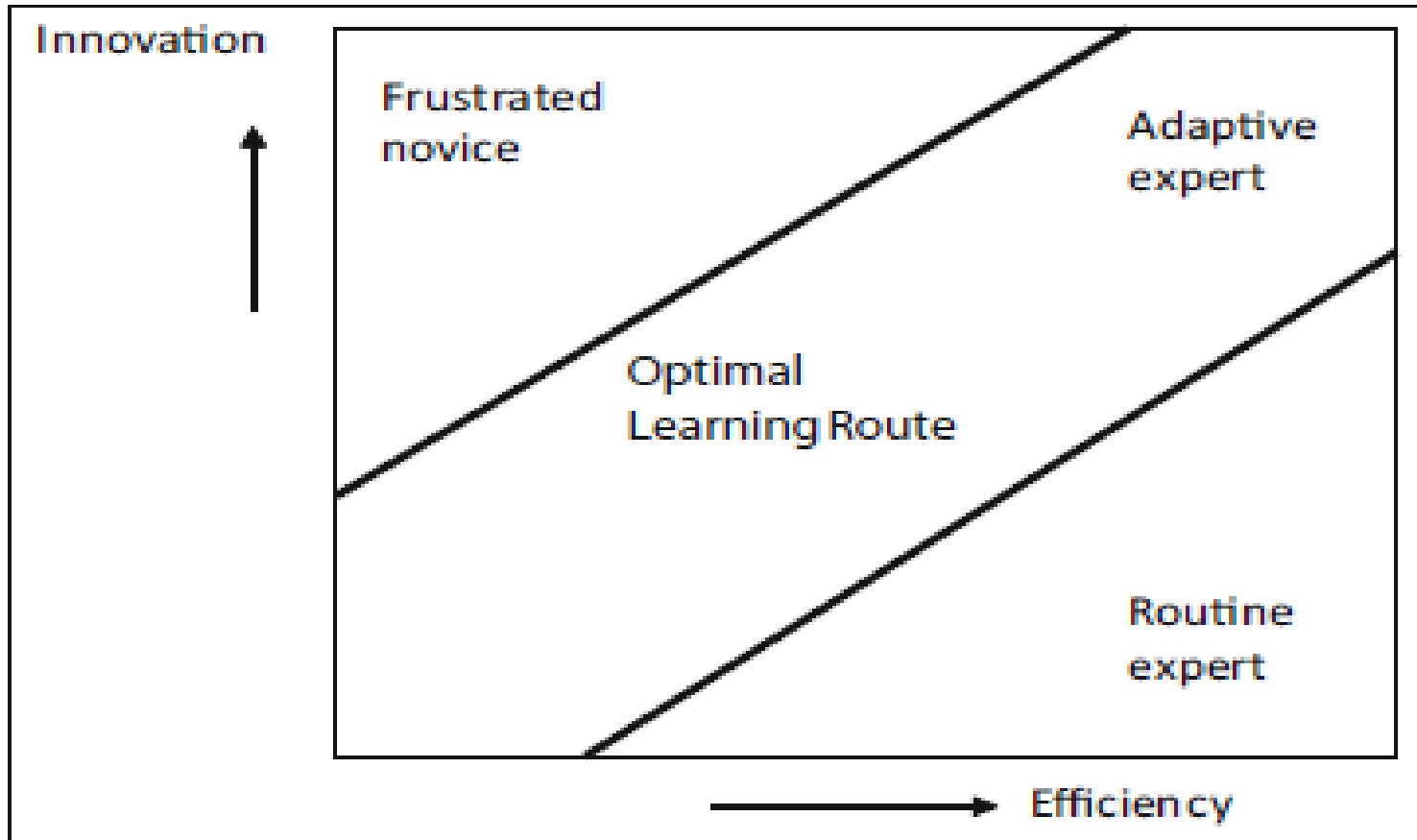


Fred Janssen



Universiteit  
Leiden  
ICLON

# Teaching repertoire development



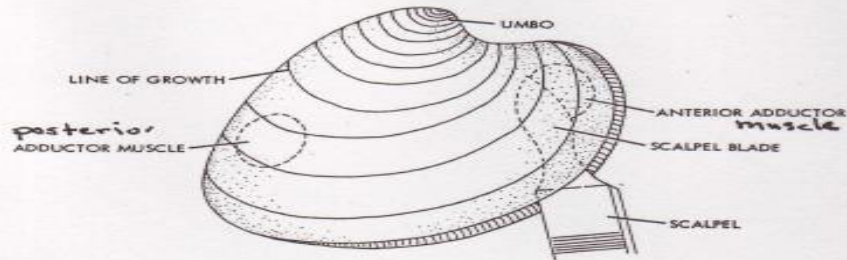
**Supporting teaching repertoire development is not easy**

# Reforming Again, Again, and Again

LARRY CUBAN

# Regular teaching practice Joyce

**CAUTION: The scalpel is a sharp instrument. Always be very careful when handling it and cut away from your hand and body.**



Repeat this procedure to cut the posterior adductor muscle. Open the shell. If necessary, carefully run your fingers or scalpel between the shell and the mantle to separate the mantle from the shell. The space between the two halves of the mantle is the mantle cavity.

Open the left valve as far as possible. When done, your specimen should look like the diagram below.

Completed (the two shell halves are open as shown to the right).

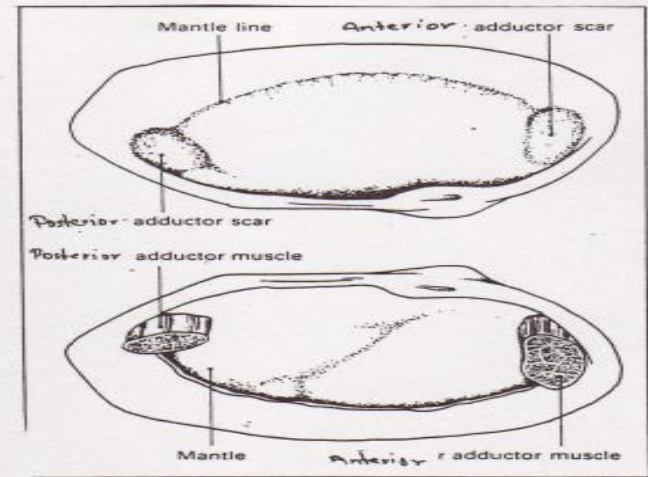
Verified \_\_\_\_\_

Observe the hinge. Notice the interlocking teeth that hold the two valves of the shell together. Locate the "scars" from the anterior and posterior adductor muscles on the inner surface of the left valve. These scars indicate where the posterior and anterior adductor muscles were attached.

What is the gape? \_\_\_\_\_

What forms the "scars" on the valves? \_\_\_\_\_

Describe the inner layer of the shell. \_\_\_\_\_



Explain new theory

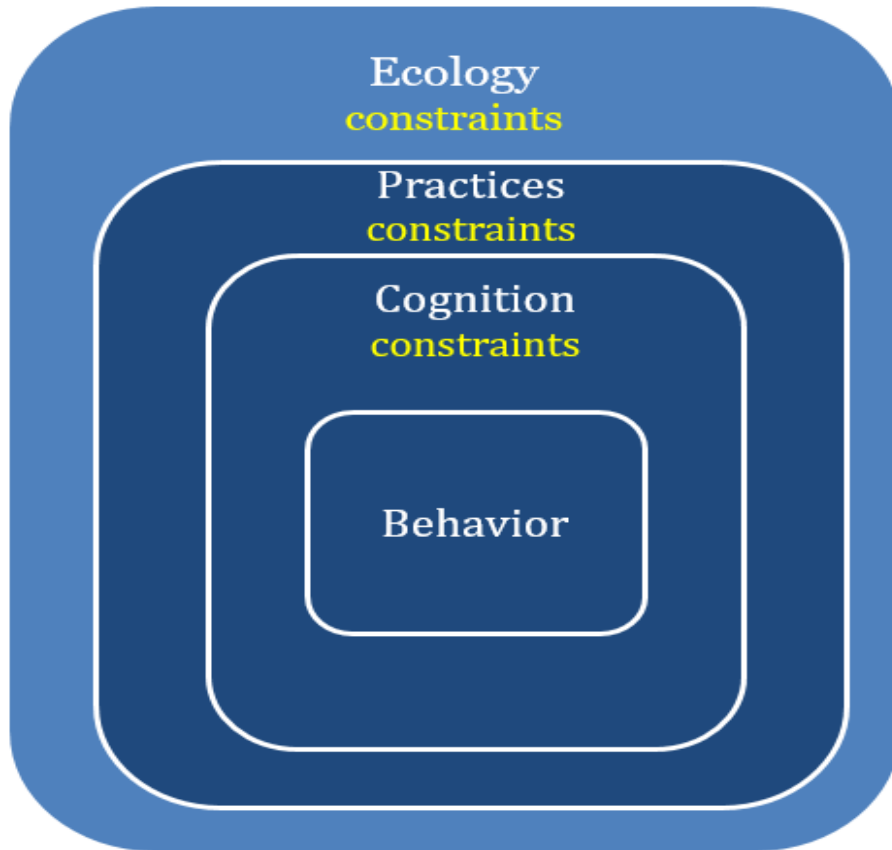
Present the research question

Present the method

Students collect data

Student interpret the results using theory

# Multiple perspectives on understanding and supporting teaching repertoire development



## *Ecological perspective*

Focus on ecology

## *Sociocultural perspective*

Focus on practices

## *Cognitive perspective*

Focus on cognitions

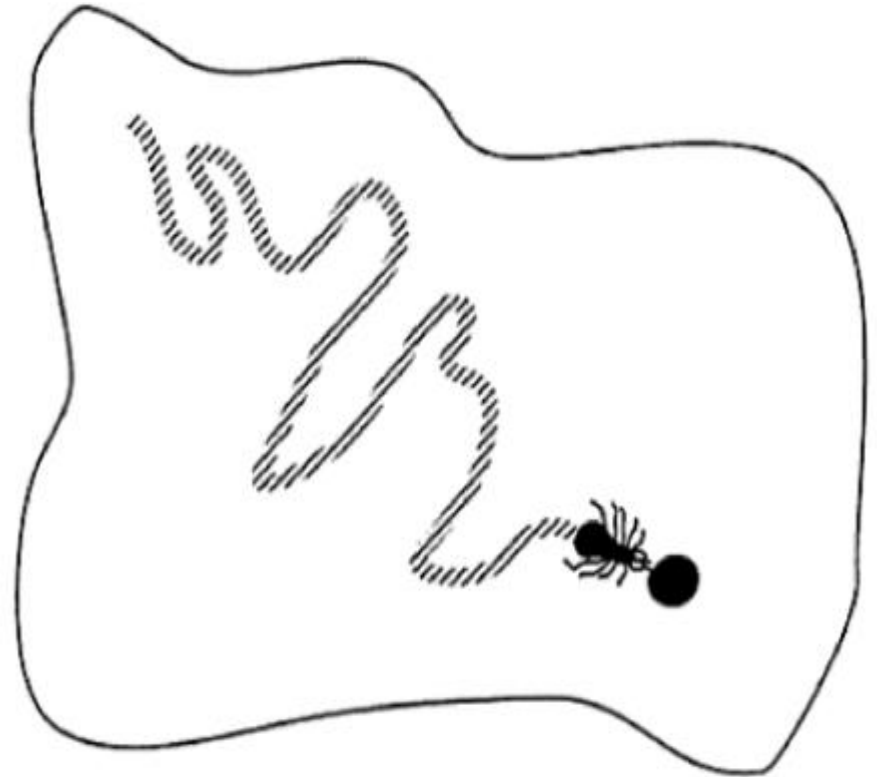
## *Behavioral perspective*

Focus on isolated behaviors

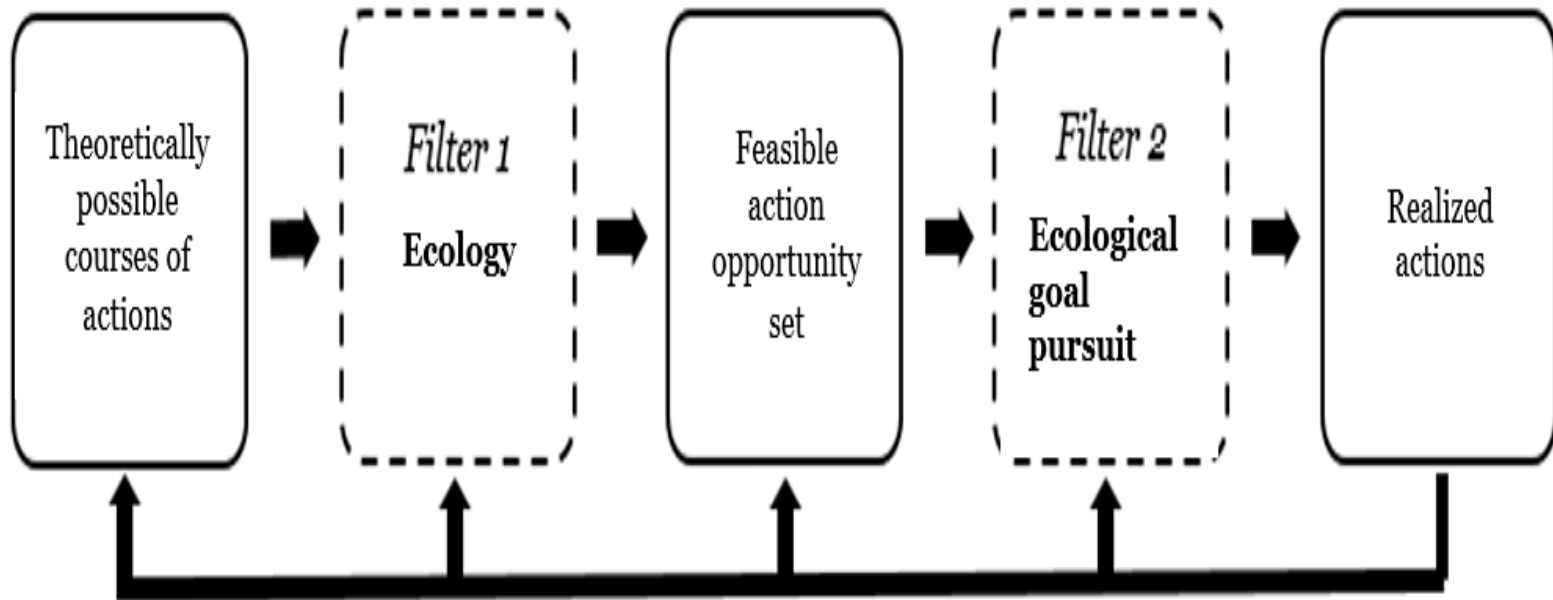
# Towards an ecological approach

## Shared framing assumptions

1. If you want to understand what people do, perceive or decide you should study their goal-relevant internal and environmental constraints/affordances .
2. Identify constraints/affordances that shape what can be done (formative) instead of describing what people do (descriptive) or should do (normative)



# Ecological two filter model



# Why do reforms often fail? Many educational innovations simply do not pass the two filters

**Educational innovations:  
Impossible teapots?**

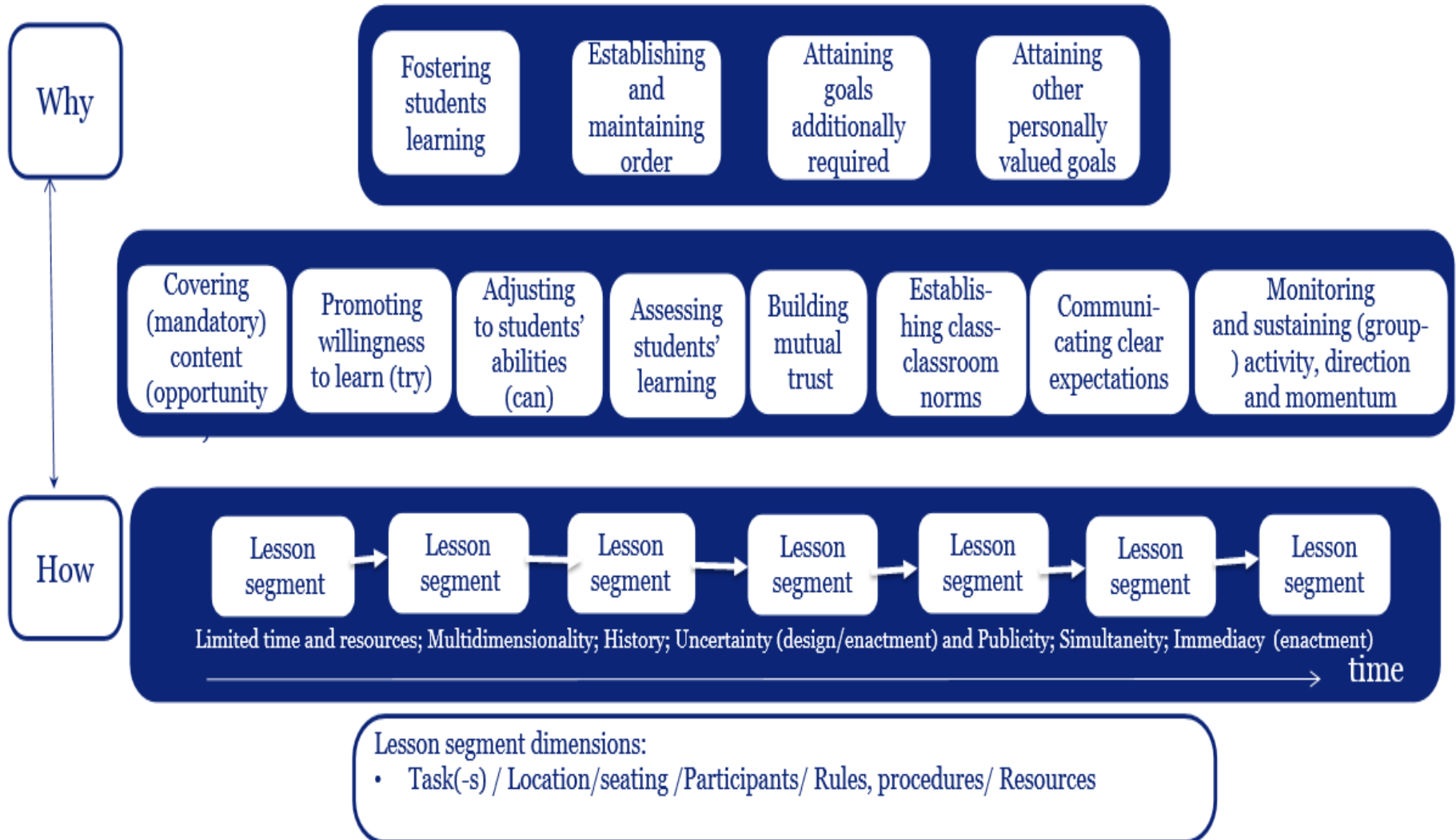


**What do teachers need?**

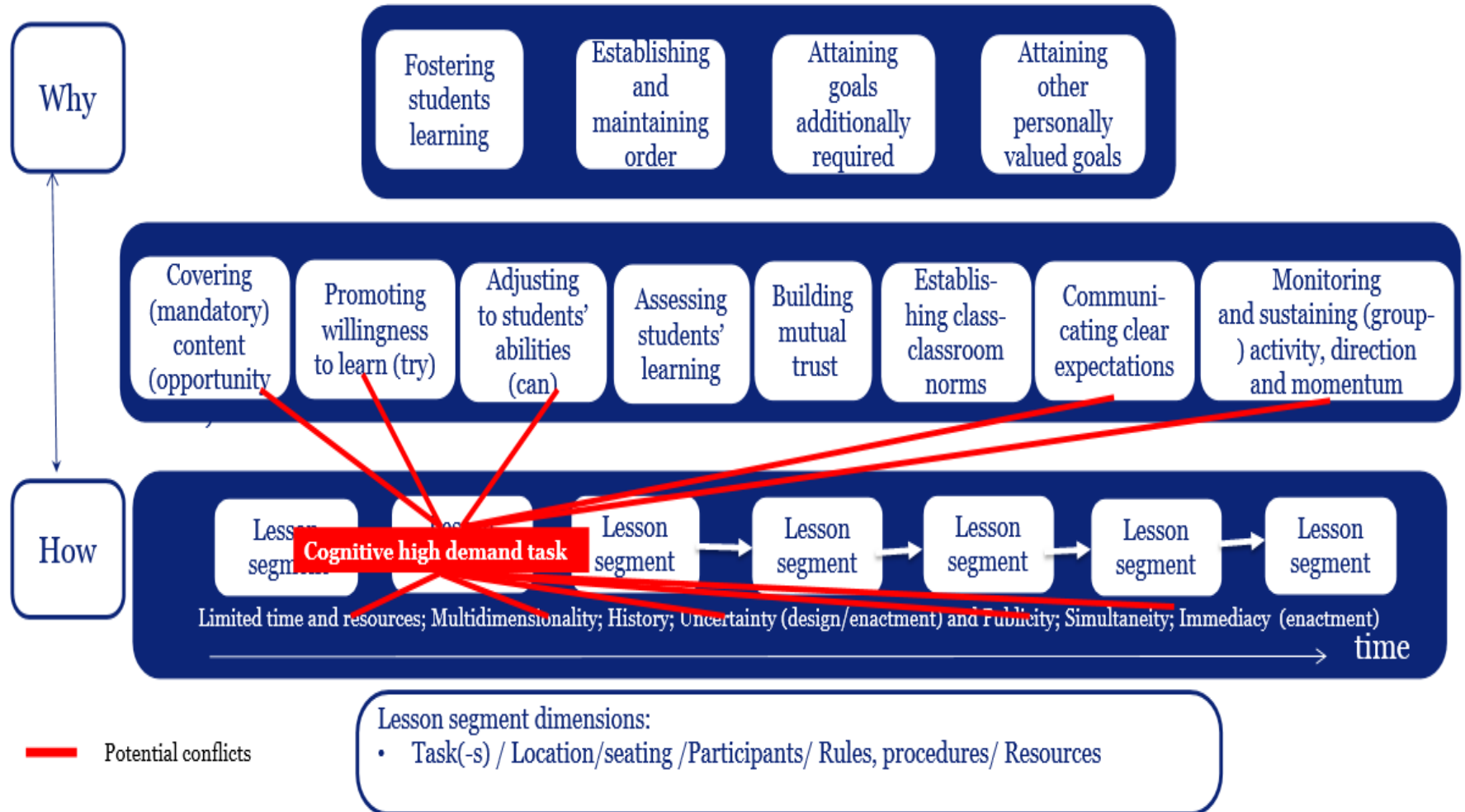




# Filter 1: Classroom Ecology



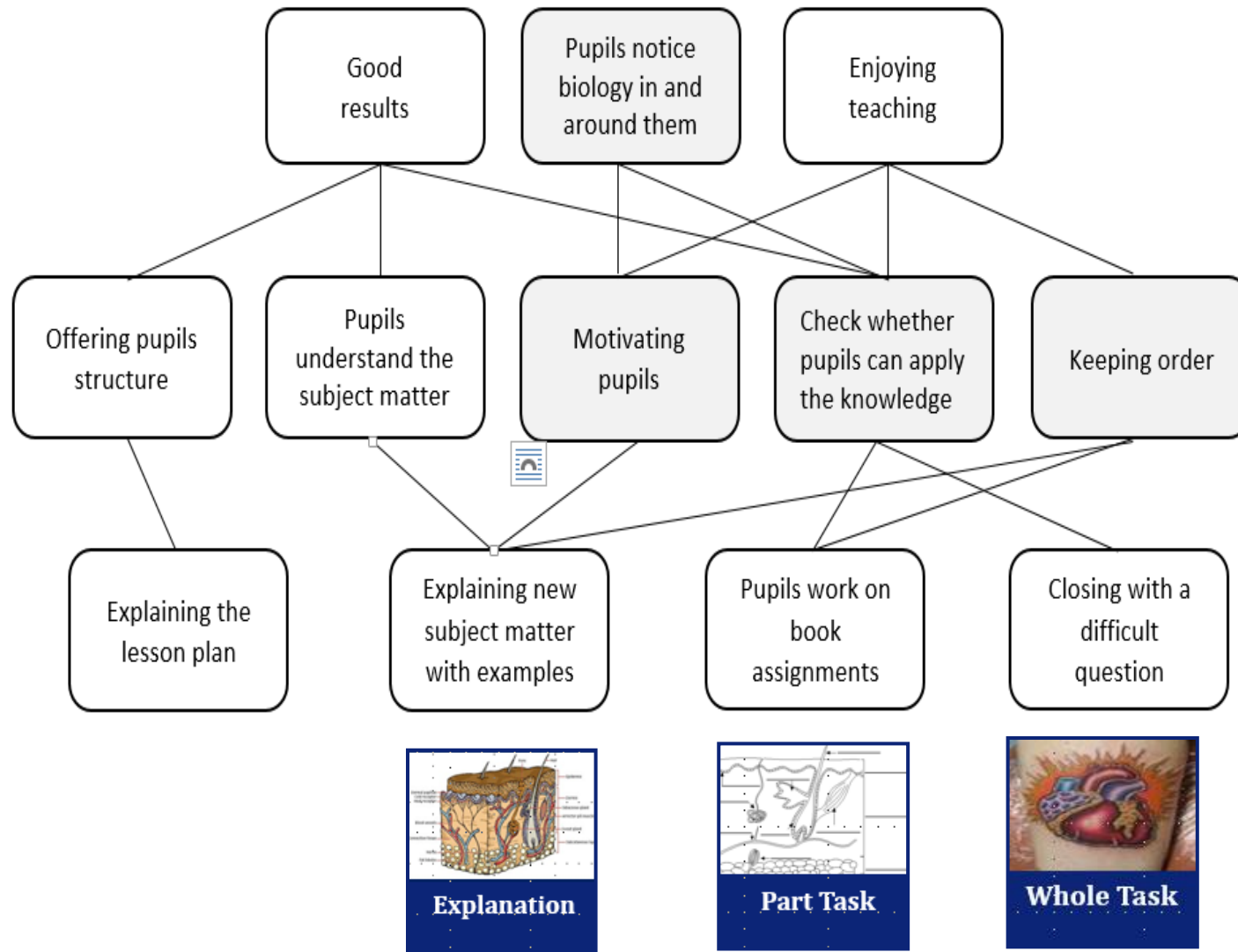
# Why reforms fail again and again: An ecological explanation



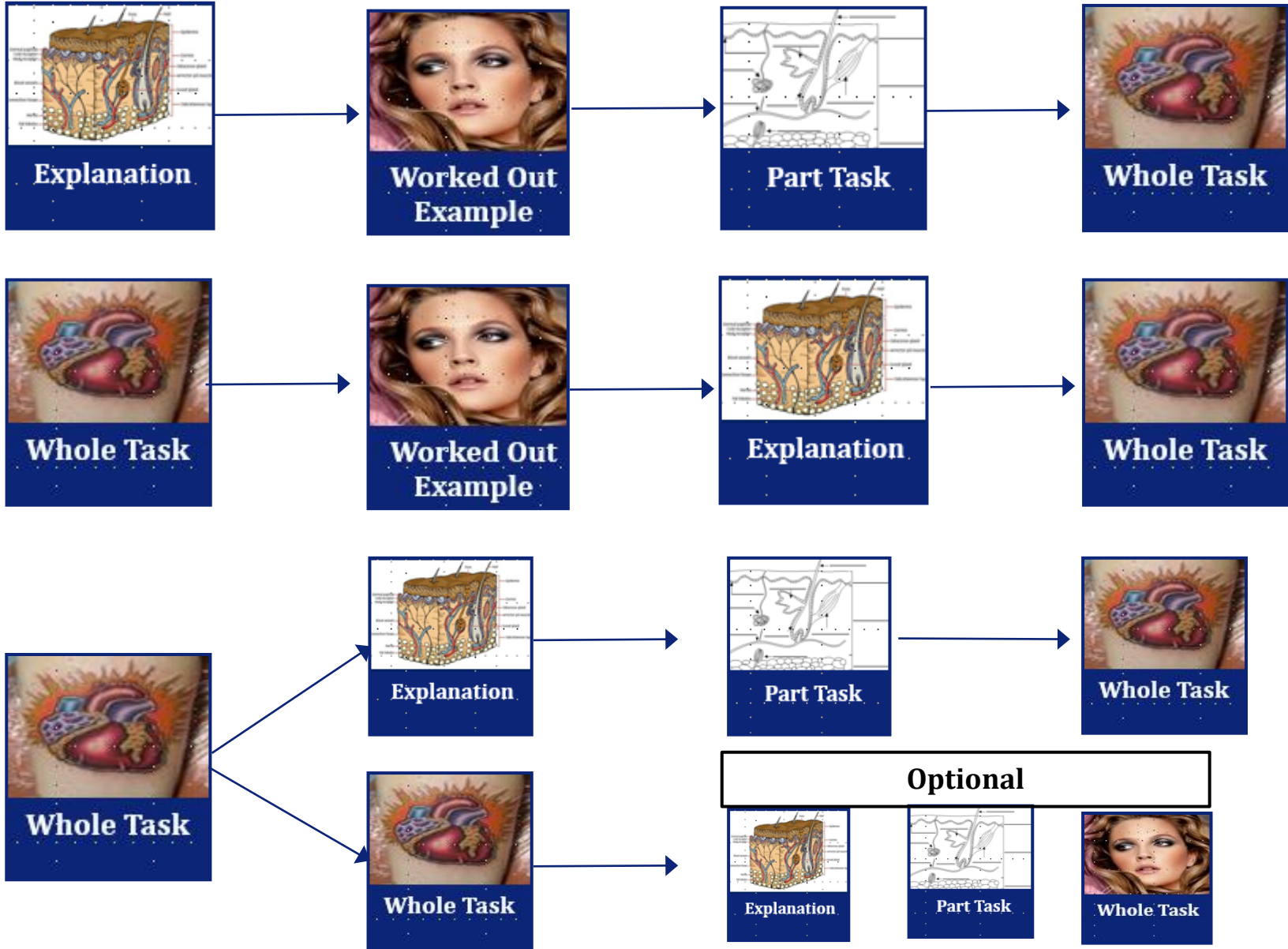
# Filter 2: Ecological rationality

Olympian Agency	Ecological Agency
Context doesn't matter	Ecology 'has plans for people'
People pursue one overarching goal	People pursue multiple goals simultaneously <ul style="list-style-type: none"><li>• Multifinality</li></ul>
View from nowhere <ul style="list-style-type: none"><li>• Complete knowledge</li></ul>	Knowledge is perspectival <ul style="list-style-type: none"><li>• Multiple perspectival montage</li></ul>
Action alternatives and consequences are known or developed from scratch <ul style="list-style-type: none"><li>• General complex methods</li><li>• Design from scratch</li></ul>	Action alternatives need to be developed with limited time and resources <ul style="list-style-type: none"><li>• Innovation by recombination (modularity)</li><li>• Recognition based heuristic search</li></ul>
People chose the best <ul style="list-style-type: none"><li>• Optimizing</li></ul>	People try to improve their current situation <ul style="list-style-type: none"><li>• Satisficing</li></ul>

# Goal system Ilse



# Innovation by recombination of existing building blocks



# Bridging methodology

1. Take teachers' goal systems as a starting point
2. Represent both the innovative and current lesson frames in building blocks
3. Design a stepwise progression from current to new practice by recombination and adaptation of existing building blocks
4. In a way that enables teachers to see each step as a better way to to achieve their personally valued goals

# Co-construction of goal system representations

**Laddering method** (Janssen, Westbroek, Doyle & Driel, 2013; Janssen, Westbroek & Borko, submitted)

1. **Select** a representative lesson
2. **What** do you regularly do (lesson segments)?
3. **Why** do you do it that way, why is that important?
4. **Evaluate** what goes well (white boxes)/where you like to improve (grey boxes)

# Explicating a teacher's GS representation

## The laddering method

1. Ask the teacher to select a representative lesson.

*Joyce choose to focus on how she taught practicals in her biology classes for students age 13 and 17*



# Explicating a teacher's GS representation. The laddering method

2. Next the teacher is asked what he/she typically does subsequently teaching such a lesson; **What** do you regularly start with? What do you do next?

Explain new theory

Present the  
research question

Present the  
method

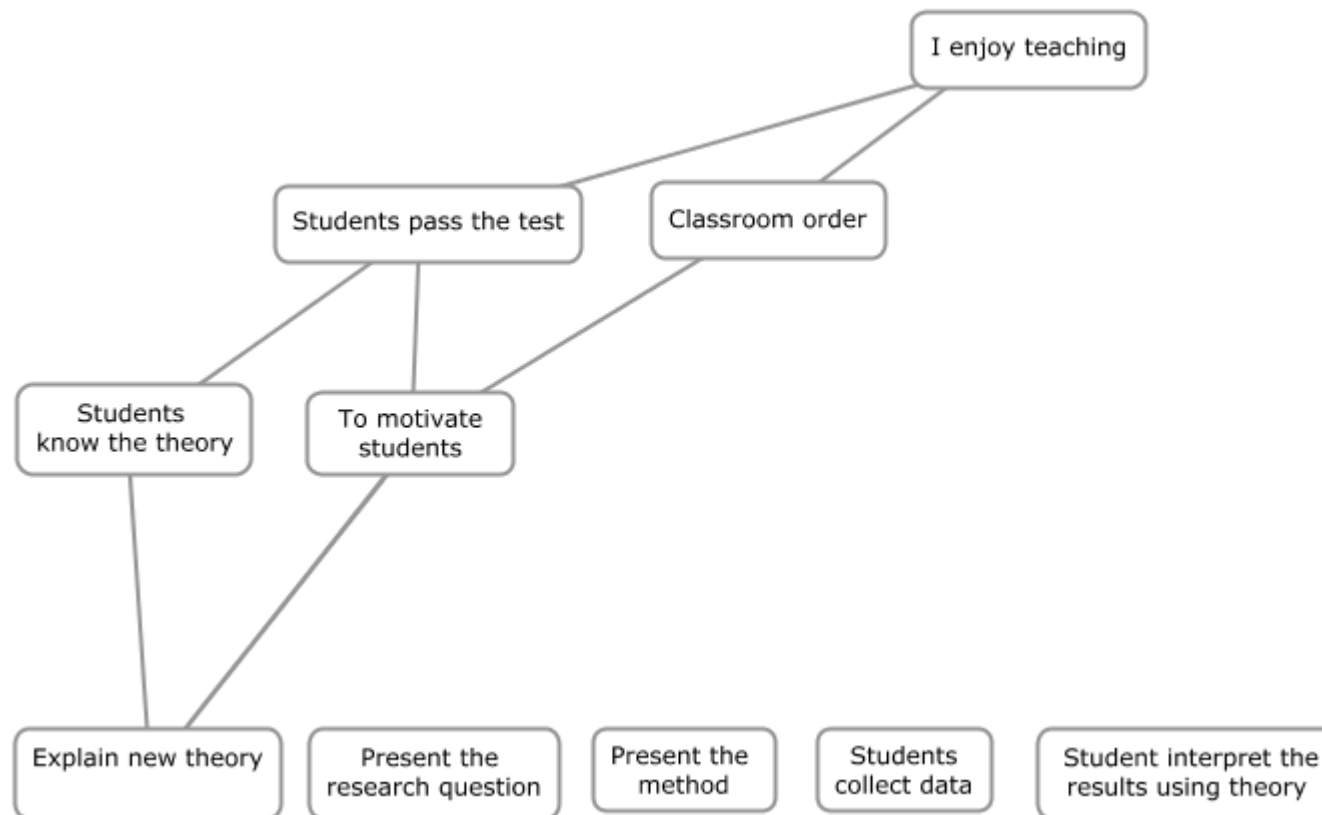
Students  
collect data

Student interpret the  
results using theory

*Joyce typically teaches cookbook practices: she explains new theory, presents the research question and method, students collect data and interpret results.*

# Explicating a teacher's GS representation. The laddering method

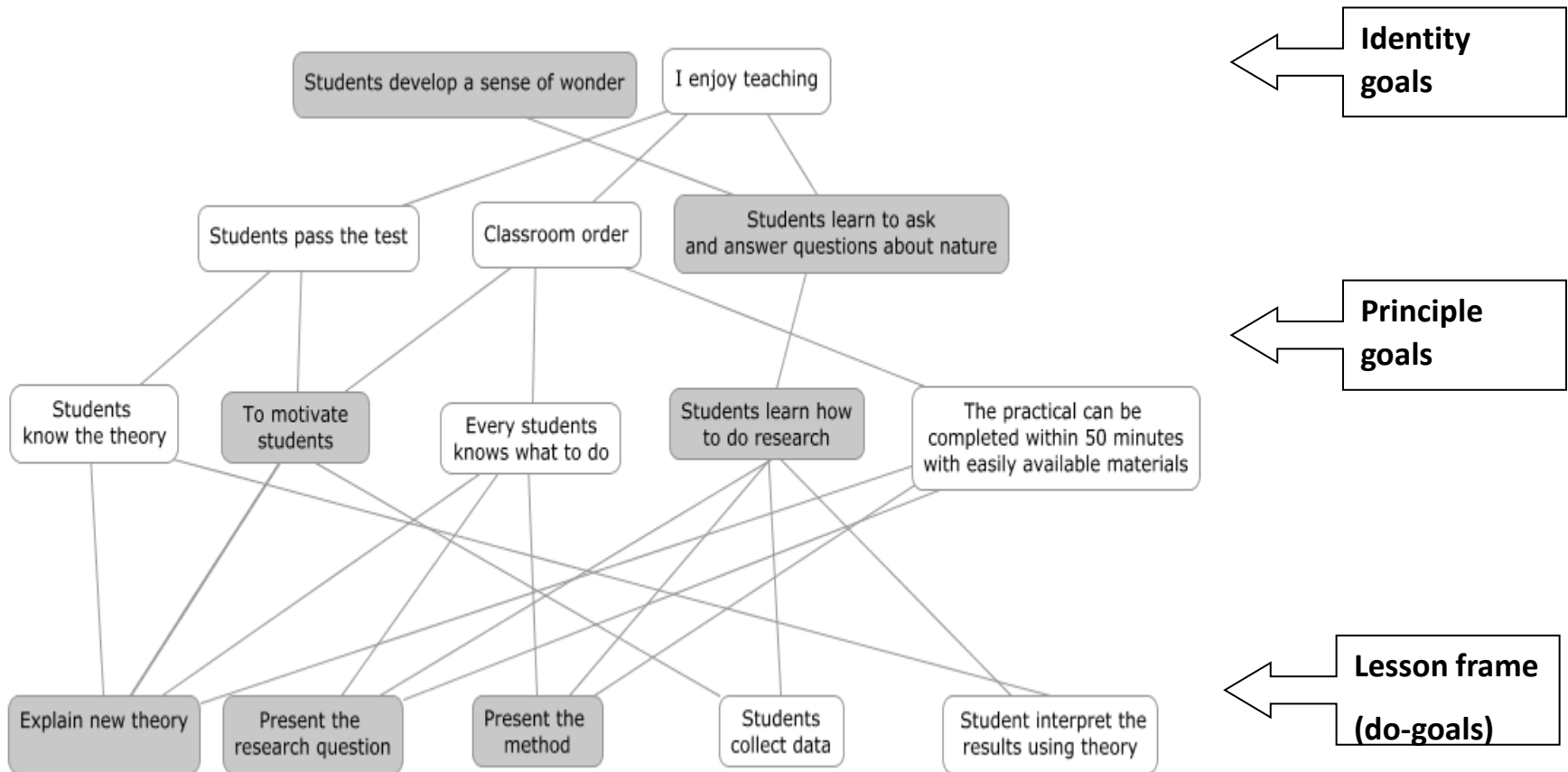
3. Next the goals that the teacher connects to his/her lesson segments are explicated by asking the teacher the following question for each lesson segment: Why you do it this way?



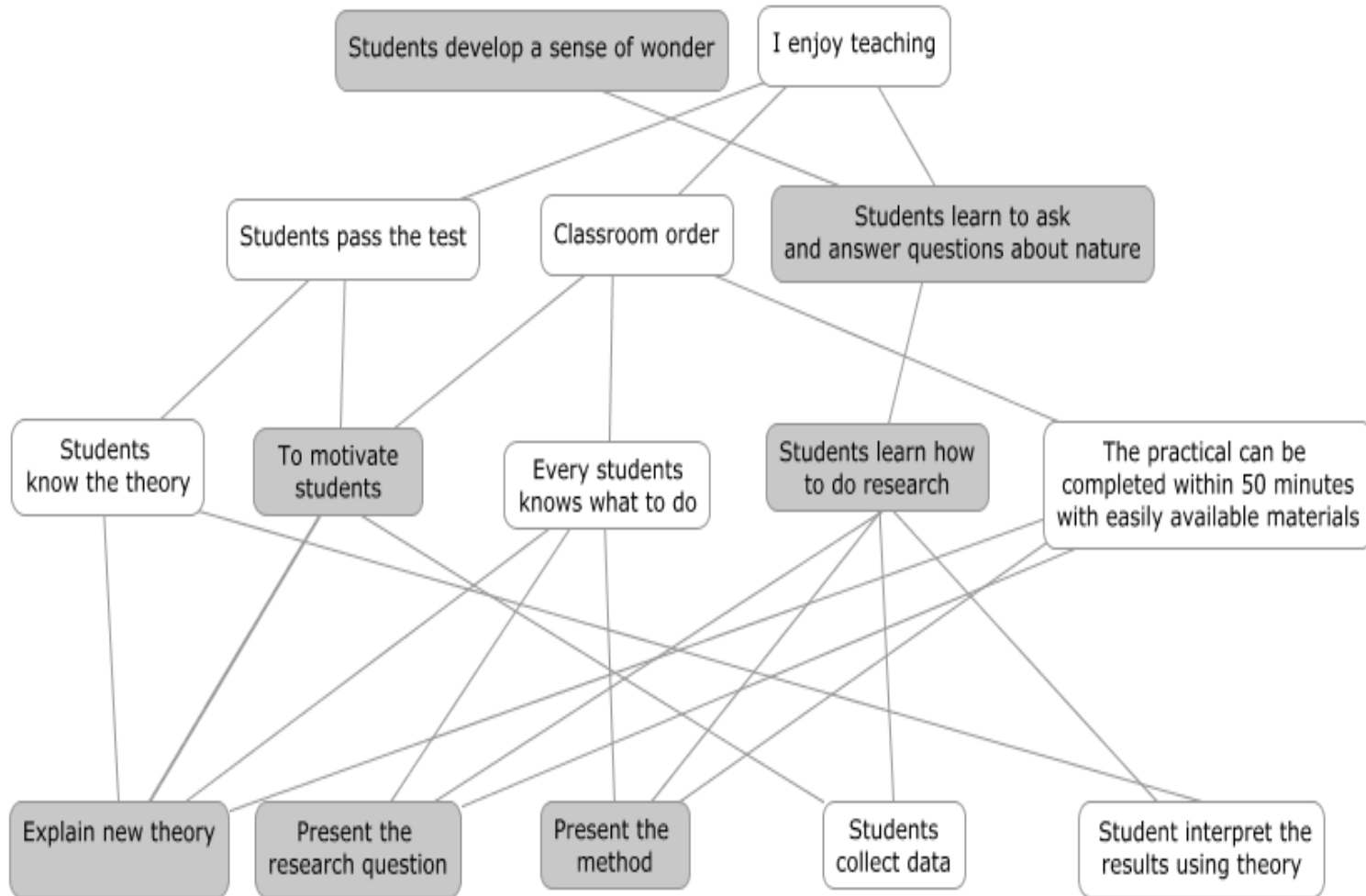
# Explicating a teacher's GS representation

## The laddering method

4. Finally the teacher is asked to evaluate his/her goal system representation: What are you satisfied about (white boxes) and what are you not satisfied with (grey boxes)?



# Goal system Joyce

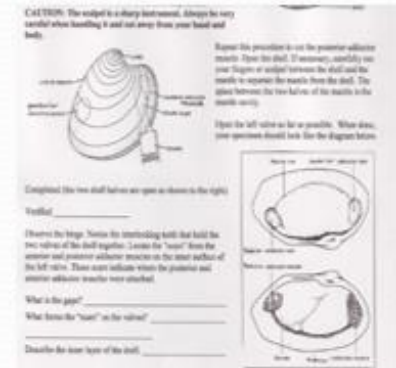


# Bridging trajectory exemplified for open inquiry

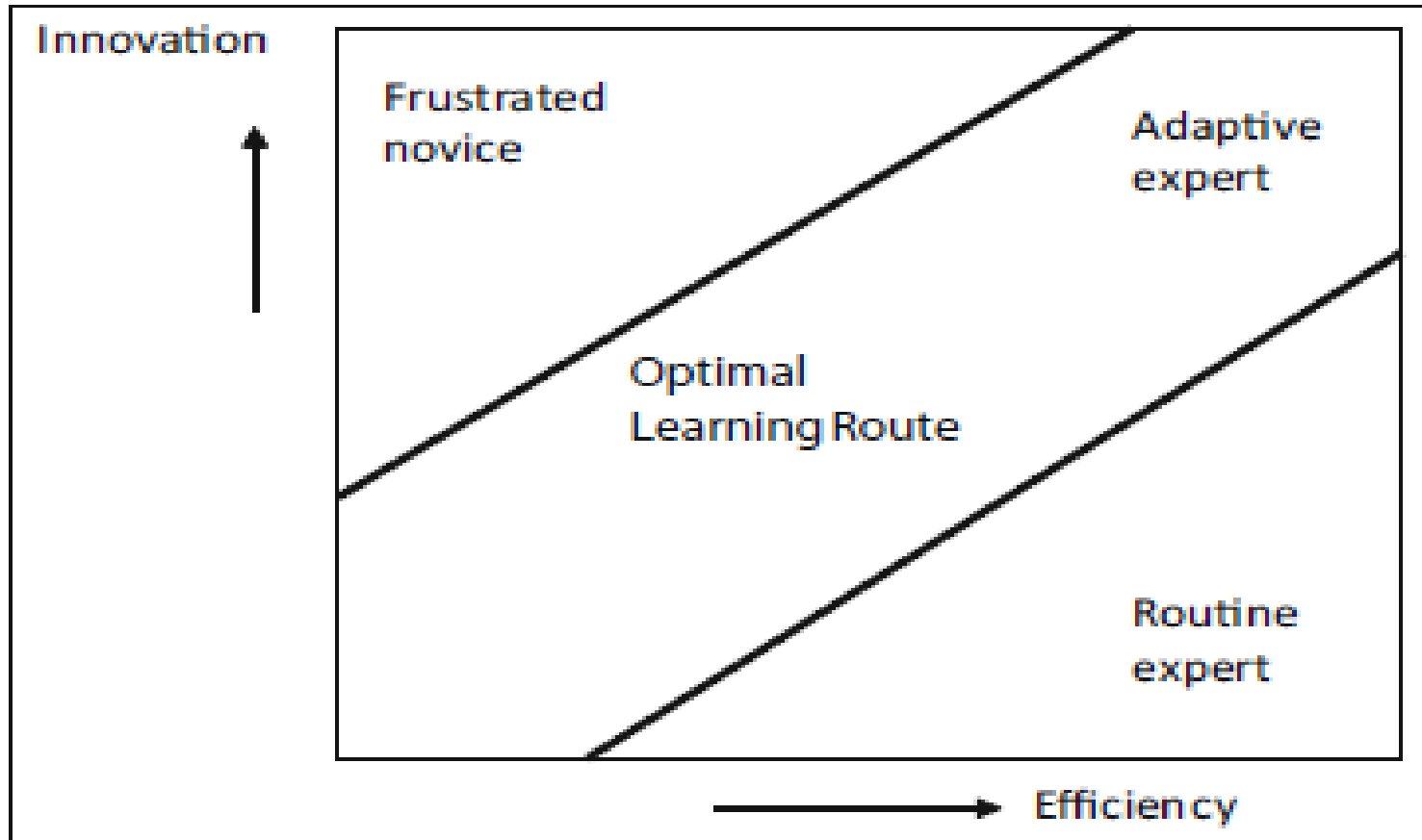
<b><i>Cookbook frame</i></b>	Theory T	Question T	Material/ Method T	Data col&ana St	Explaining results St	
<b><i>Open inquiry frame</i></b>	Question St (adap) Material T	Tentative Explanati on St (adap))	Method St (adap))	Data col/ana St (adap)	Explaining results St(adap)	Theory T (adap)

# Bridging trajectory

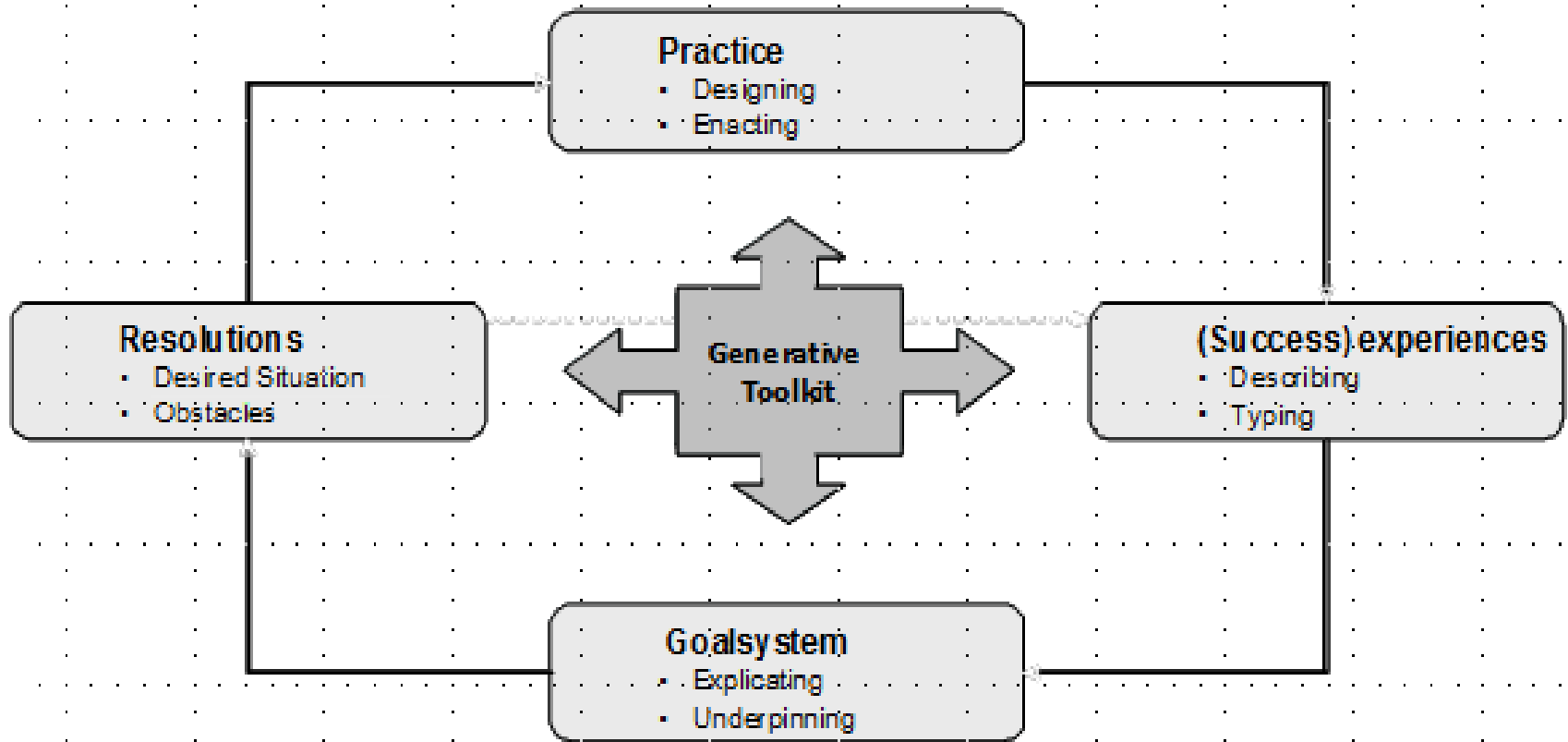
Regular lab Joyce	Theory (T)	Question (T)	Material/ Method (T)	Data collection & analysis (St)	Explaining results (St)
<b>First step</b>	Question (T) & Tentative answer by the students (St)	Theory (T)	Material/ Method (T)	Data collection & analysis (St)	Explaining results (St)
<b>Second step</b>	Question (T) & Tentative answer by the students (St)	Theory (T)	Material (T) Method (St adap)	Data collection & analysis (St)	Explaining results (St)
<b>Third step</b>	Question (T)	Tentative explanation (St) Theory (T)	Material (T) Method (St adap)	Date collection & analysis (St)	Explaining results (St)
<b>Fourth step</b>	Question (St) Material (T) &	Tentative explanation (St)	Material (T) Method (St adap)	Data collection & analysis (St)	Explaining results (St). Theory (T)



# Teaching repertoire development



# Teaching repertoire development





## **Fred Janssen**

- Master's degree in Biology
- PhD 'Learning biology by designing'
- ICLON, Leiden Graduate School for Teaching (since 1999)
  - Biology teacher educator (until 2016)
  - Full professor of science education (since 2016)
  - Department head secondary education (since 2018)
  - Senior Comenius Fellow / Leiden Teachers' Academy fellow
  - Scientific director ICLON (since 2022)
  - Focus of my own research program (13 PhD's / 2 Post-docs)

**An ecological approach to  
student and teacher learning**

# Interfacultair Centrum voor Lerarenopleiding, Onderwijsonderzoek en Nascholing (ICLON)

100+ onderwijsexperts

Opleiden van academische docenten	Professionaliseren en wetenschapsoriëntatie	Onderzoek naar onderwijs
<ul style="list-style-type: none"> <li>• 1<sup>e</sup> graads &amp; 2<sup>e</sup> graads (meerdere trajecten)</li> <li>• 330 studenten</li> <li>• Vakdidactici alfa, bèta, gamma &amp; onderwijskundigen</li> <li>• 18 schoolvakken</li> <li>• Samen opleiden met 9 opleidingsscholen waarbij 90% van alle VO scholen in de regio Zuid Holland zijn aangesloten</li> </ul>	<ul style="list-style-type: none"> <li>• Wetenschapsoriëntatie PO</li> <li>• Wetenschapsoriëntatie VO</li> <li>• VO-HO aansluiting</li> <li>• ONZ netwerk &gt; 60 scholen i.s.m. de faculteiten</li> <li>• Docentprofessionalisering (PO, VO, HO)</li> </ul>	<ul style="list-style-type: none"> <li>• 3 Hoogleraren</li> <li>• 2 UHD's / 5 UD's</li> <li>• 45 lopende PhD projecten / 55 gerealiseerde dissertaties</li> <li>• 240 wetenschappelijke publicaties / 102 professionele publicaties (in de laatste 5 jaar)</li> <li>• Structurele samenwerkingsverbanden en publiceren met met 7 universiteiten uit de top 50</li> <li>• Nieuwe taak: coördinatie en versterking HO onderzoek</li> </ul>
<ul style="list-style-type: none"> <li>• Goede universitaire, regionale, nationale en internationale verankering</li> <li>• Opleiden, professionaliseren en onderzoek m.b.t. de gehele keten (po,vo, ho)</li> <li>• Uitstekende beoordelingen van visitatiecommissies</li> <li>• Werken vanuit een gemeenschappelijke kennisbasis</li> </ul>		

# ICLON Knowledge base

## 12 Teaching - Learning principles

### For understanding and supporting student and teacher agency development

#### The 12 teaching-learning principles



##### Adaptive

Learning is promoted when teaching support is tailored to what a pupil or student needs...



##### Collaborative learning

Learning is promoted when pupils...



##### Language awareness

Learning is enhanced when attention is paid to both conceptual and linguistic aspects of the...



##### Formative

Learning is enhanced when evaluation is used to learn from it...



##### Goal system-based

Learning is promoted when it builds productively on existing multiple goals...



##### Inclusive

Learning is promoted when the needs of all learners are met and all learners are included...



##### Inquiry-based

Learning is enhanced when researchable questions are asked for which data are collected to infer...



##### Modular

Learning is promoted when teachers rearrange their existing building blocks for educational...



##### Multiple perspective-based

Learning is promoted when it is...



##### Safe and participatory

Learning is enhanced when it takes place with (active) participation of all involved, in a safe learning...



##### Self-regulated

Learning is promoted when pupils and students progressively self-regulate their learning...



##### Whole task-based

Learning is promoted when subject matter is taught in the context of an authentic task...

## Selected publications

- Janssen, F.J.J.M., Westbroek, H.B., Doyle, W. & Driel, van J.H. (2013). How to make innovations practical. *Teachers College Record*, 115 (7), 1-43.
- Janssen, F.J.J.M., Westbroek, H.B. & van Driel, J.H. (2014). How to make guided discovery learning practical for student teachers. *Instructional Science*, 42, 67-90.
- Janssen, F.J.J.M. , Westbroek, H.B. & W. Doyle (2014) The practical turn in teacher education. Designing a preparation sequence for core practice frames. *Journal of Teacher Education*, 65(3), 195-206
- Janssen, F.J.J.M., Westbroek, H.B. & W. Doyle (2015). Practicality studies: How to move from what works in principle to what works in practice. *Journal of the Learning Sciences*, 24(1), 176-186
- Janssen, F.J.J.M. & B. van Berkel (2015). Making philosophies of science education practical for science teachers. *Science & Education*, 24 (3) 229-258.
- Janssen, F.J.J.M., Grossman, P. & H.B. Westbroek (2015). Facilitating decomposition and recomposition in practice based teacher education. The power of modularity. *Teaching and Teacher Education*, 51, 137-146.
- Davis E. A., Janssen, F. J.J.M., & Van Driel, J. H. (2016). Teachers and science curriculum materials: where we are and where we need to go. *Studies in Science Education*, 52(2), 127-160.
- Westbroek, H.B., Janssen, F.J.J.M., & Doyle, W. (2016). Perfectly Reasonable in a Practical World: Understanding Chemistry Teacher Responses to a Change Proposal. *Research in Science Education*,
- Janssen, F.J.J.M., Könings, K.D. & J.J.G. van Merriënboer (2017). Participatory educational design: How to improve mutual learning and the quality and usability of the design? *European Journal of Education*, 52, 268-279.
- Janssen, F.J.J.M. & J.H. Van Driel (2017). Developing a repertoire for teaching biology. In Sickel,A.J. & S.B. Witzig. *Designing and Teaching the Secondary Science Methods Course: An International Perspective* (pp. 91-109). Rotterdam: Sense Publishers.
- Janssen, F.J.J.M., Westbroek, H.B., Landa, I., Van der Ploeg, B, & J. Muijlwijk-Koezen (2020). Perspectives for teaching about how science works. In McComas, W. (ed). *Nature of Science in Science Instruction. Rationales and Strategies* (p. 253-271). Cham: Springer.
- Janssen, F.J.J.M., Westbroek, H.B., H. Borko (submitted). The indispensable role of the goal construct for understanding and changing teaching practice. *Professional development in Education*.
- Janssen, F.J.J.M., Westbroek, H.B.. & W. Doyle (in preparation). An ecological approach to teacher learning. *Educational Researcher*.