Understanding and supporting teaching repertoire development

an ecological approach

Fred Janssen
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.

Line of growth

Posterior adductor muscle

Anterior adductor muscle

Scalpel blade

Scalpel

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.

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Explain new theory

Present the research question

Present the method

Students collect data

Student interpret the results using theory

ICLON, Leiden University Graduate School of Teaching
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

Theoretically possible courses of actions → Filter 1 → Ecology → Feasible action opportunity set → Filter 2 → Ecological goal pursuit → Realized actions
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

- Fostering students learning
- Establishing and maintaining order
- Attaining goals additionally required
- Attaining other personally valued goals

Covering (mandatory) content (opportunity)
Promoting willingness to learn (try)
Adjusting to students’ abilities (can)
Assessing students’ learning
Building mutual trust
Establishing classroom norms
Communicating clear expectations
Monitoring and sustaining (group-) activity, direction and momentum

How

Lesson segment → Lesson segment → Lesson segment → Lesson segment → Lesson segment → Lesson segment → Lesson segment

Limited time and resources; Multidimensionality; History; Uncertainty (design/enactment) and Publicity; Simultaneity; Immediacy (enactment)

Lesson segment dimensions:
- Task(-s) / Location/seating /Participants/ Rules, procedures/ Resources
Why reforms fail again and again: An ecological explanation

Why
- Fostering students learning
- Establishing and maintaining order
- Attaining goals additionally required
- Attaining other personally valued goals

How
- Covering (mandatory) content (opportunity)
- Promoting willingness to learn (try)
- Adjusting to students' abilities (can)
- Assessing students' learning
- Building mutual trust
- Establishing classroom norms
- Communicating clear expectations
- Monitoring and sustaining (group-) activity, direction and momentum

Potential conflicts:
- Limited time and resources; Multidimensionality; History; Uncertainty (design/enactment) and Publicity; Simultaneity; Immediacy (enactment)

Lesson segment dimensions:
- Task(s) / Location/seating /Participants/ Rules, procedures/ Resources
## Filter 2: Ecological rationality

<table>
<thead>
<tr>
<th><strong>Olympian Agency</strong></th>
<th><strong>Ecological Agency</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Context doesn’t matter</td>
<td>Ecology ‘has plans for people’</td>
</tr>
<tr>
<td>People pursue one overarching goal</td>
<td>People pursue multiple goals simultaneously</td>
</tr>
<tr>
<td></td>
<td>• Multifinality</td>
</tr>
<tr>
<td>View from nowhere</td>
<td>Knowledge is perspectival</td>
</tr>
<tr>
<td>• Complete knowledge</td>
<td>• Multiple perspectival montage</td>
</tr>
<tr>
<td>Action alternatives and consequences are known or developed from scratch</td>
<td>Action alternatives need to be developed with limited time and resources</td>
</tr>
<tr>
<td>• General complex methods</td>
<td>• Innovation by recombination (modularity)</td>
</tr>
<tr>
<td>• Design from scratch</td>
<td>• Recognition based heuristic search</td>
</tr>
<tr>
<td>People chose the best</td>
<td>People try to improve their current situation</td>
</tr>
<tr>
<td>• Optimizing</td>
<td>• Satisficing</td>
</tr>
</tbody>
</table>
Goal system Ilse

- Good results
- Pupils notice biology in and around them
- Enjoying teaching

Offering pupils structure
- Pupils understand the subject matter

Motivating pupils
- Check whether pupils can apply the knowledge

Keeping order
- Closing with a difficult question

- Explaining the lesson plan
- Explaining new subject matter with examples
- Pupils work on book assignments

Explanation
Part Task
Whole Task
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 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?

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

Students develop a sense of wonder

Students learn to ask and answer questions about nature

Students pass the test

I enjoy teaching

Classroom order

Students learn how to do research

The practical can be completed within 50 minutes with easily available materials

Students know the theory

To motivate students

Every student knows what to do

Students collect data

Explain new theory

Present the research question

Present the method

Students interpret the results using theory
## Bridging trajectory exemplified for open inquiry

<table>
<thead>
<tr>
<th>Cookbook frame</th>
<th>Theory T</th>
<th>Question T</th>
<th>Material/Method T</th>
<th>Data col&amp;ana St</th>
<th>Explaining results St</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Open inquiry frame</th>
<th>Question St (adap) Material T</th>
<th>Tentative Explanation St (adap)</th>
<th>Method St (adap)</th>
<th>Data col/ana St (adap)</th>
<th>Explaining results St(adap)</th>
<th>Theory T (adap)</th>
</tr>
</thead>
</table>
## Bridging trajectory

<table>
<thead>
<tr>
<th>Regular lab</th>
<th>Theory (T)</th>
<th>Question (T)</th>
<th>Material/Method (T)</th>
<th>Data collection &amp; analysis (St)</th>
<th>Explaining results (St)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joyce</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>First step</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Question (T) &amp; Tentative answer by the students (St)</td>
<td>Theory (T)</td>
<td>Material/Method (T)</td>
<td>Data collection &amp; analysis (St)</td>
<td>Explaining results (St)</td>
</tr>
<tr>
<td><strong>Second step</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Question (T) &amp; Tentative answer by the students (St)</td>
<td>Theory (T)</td>
<td>Material (T) Method (St adap)</td>
<td>Data collection &amp; analysis (St)</td>
<td>Explaining results (St)</td>
</tr>
<tr>
<td><strong>Third step</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Question (T)</td>
<td>Tentative explanation (St) Theory (T)</td>
<td>Material (T) Method (St adap)</td>
<td>Date collection &amp; analysis (St)</td>
<td>Explaining results (St)</td>
</tr>
<tr>
<td><strong>Fourth step</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Question (St) Material (T) &amp; Tentative explanation (St)</td>
<td>Tentative explanation (St)</td>
<td>Material (T) Method (St adap)</td>
<td>Data collection &amp; analysis (St)</td>
<td>Explaining results (St). Theory (T)</td>
</tr>
</tbody>
</table>
Teaching repertoire development

[Diagram showing a chart with axes labeled 'Innovation' on the y-axis and 'Efficiency' on the x-axis. The chart includes quadrants labeled 'Optimal Learning Route', 'Frustrated novice', 'Routine expert', and 'Adaptive expert'.]
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

<table>
<thead>
<tr>
<th>Opleiden van academische docenten</th>
<th>Professionaliseren en wetenschapsoriëntatie</th>
<th>Onderzoek naar onderwijs</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 1e graads &amp; 2e graads (meerdere trajecten)</td>
<td>• Wetenschapsoriëntatie PO</td>
<td>• 3 Hoogleraren</td>
</tr>
<tr>
<td>• 330 studenten</td>
<td>• Wetenschapsoriëntatie VO</td>
<td>• 2 UHD’s / 5 UD’s</td>
</tr>
<tr>
<td>• Vakdidactici alfa, bèta, gamma &amp; onderwijskundigen</td>
<td>• VO-HO aansluiting</td>
<td>• 45 lopende PhD projecten / 55 gerealiseerde dissertaties</td>
</tr>
<tr>
<td>• 18 schoolvakken</td>
<td>• ONZ netwerk &gt; 60 scholen i.s.m. de faculteiten</td>
<td>• 240 wetenschappelijke publicaties / 102 professionele publicaties (in de laatste 5 jaar)</td>
</tr>
<tr>
<td>• Samen opleiden met 9 opleidingsscholen waarbij 90% van alle VO scholen in de regio Zuid Holland zijn aangesloten</td>
<td>• Docentprofessionalisering (PO, VO, HO)</td>
<td>• Structurele samenwerkingsverbanden en publiceren met met 7 universiteiten uit de top 50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Nieuwe taak: coördinatie en versterking HO onderzoek</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Goede universitaire, regionale, nationale en internationale verankering</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Opleiden, professionaliseren en onderzoek m.b.t. de gehele keten (po,vo, ho)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Uitstekende beoordelingen van visitatiecommissies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Werken vanuit een gemeenschappelijke kennisbasis</td>
</tr>
</tbody>
</table>
**ICLON Knowledge base**

**12 Teaching - Learning principles**

For understanding and supporting student and teacher agency development

<table>
<thead>
<tr>
<th>Principle</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adaptive</strong></td>
<td>Learning is promoted when teaching support is tailored to what a pupil or student needs...</td>
</tr>
<tr>
<td><strong>Collaborative learning</strong></td>
<td>Learning is promoted when pupils...</td>
</tr>
<tr>
<td><strong>Language awareness</strong></td>
<td>Learning is enhanced when attention is paid to both conceptual and linguistic aspects of the...</td>
</tr>
<tr>
<td><strong>Formative</strong></td>
<td>Learning is enhanced when evaluation is used to learn from it...</td>
</tr>
<tr>
<td><strong>Goal system-based</strong></td>
<td>Learning is promoted when it builds productively on existing multiple goals...</td>
</tr>
<tr>
<td><strong>Inclusive</strong></td>
<td>Learning is promoted when the needs of all learners are met and all learners are included...</td>
</tr>
<tr>
<td><strong>Inquiry-based</strong></td>
<td>Learning is enhanced when researchable questions are asked for which data are collected to infer...</td>
</tr>
<tr>
<td><strong>Modular</strong></td>
<td>Learning is promoted when teachers rearrange their existing building blocks for educational...</td>
</tr>
<tr>
<td><strong>Multiple perspective-based</strong></td>
<td>Learning is promoted when it is...</td>
</tr>
<tr>
<td><strong>Safe and participatory</strong></td>
<td>Learning is enhanced when place with (active) participation of all involved, in a safe learning...</td>
</tr>
<tr>
<td><strong>Self-regulated</strong></td>
<td>Learning is promoted when pupils and students progressively self-regulate their learning...</td>
</tr>
<tr>
<td><strong>Whole task-based</strong></td>
<td>Learning is promoted when subject matter is taught in the context of an authentic task...</td>
</tr>
</tbody>
</table>
Selected publications


