Teachers’ professional development – towards meaningful science teaching

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Aim of the study

To assess the feasibility of developing a self-evaluation instrument for use by science teachers in strengthening a professional critical approach in science teaching in Iceland.

• Analyse the way in which science teachers understand and interpret the demands of the national curriculum for science lessons
• Interpret the results using the framework of Zone of Feasible Innovation (ZFI) for self-evaluation.
Structure of presentation

• Project; *Intentions and Reality*
• Background
• Methods
  – Data collection (The SCIQ questionnaire, documents, on site visits and focus-group interviews).
• Results
  – Survey results – capacity gaps
  – Results from interviews – capacity in schools
• **The Zone of Feasible Innovation (ZFI)**
  Science teachers’ views on assessing ZFI in science teaching
• **Conclusion**
Intentions and Reality

• This study is based on a part of a larger study on the status of science education in schools, funded by the Research Fund in Iceland
  – Questions about the alignment of curriculum intentions and realities in schools and classrooms

• Actual and preferred capacity in the delivery of science in three school districts in Iceland
  – Multi-methods – ISCIQ electronic survey before school visits, on-site interviews (teachers, principals, pupils and district leaders). Analysis of the school environment (inside and outside)
  – 19 schools in three districts (75 science teachers)
    • AC agricultural
    • CC coastal
    • UC urban

• Data collected:
  – In schools in October-December 2006
Teacher views on actual and preferred capacities for science delivery in schools in three Icelandic communities, as assessed by ISCIQ.

- The value of each factor is the mean of seven questions on a scale of 1 (strongly disagree) to 5 (strongly agree).
- The lighter area represents views of teachers on the current capacity and the darker areas the preferred capacity.
Capacity gaps for four extrinsic factors and one intrinsic factor (skills, knowledge and attitudes) as measured by ISCIQ in three Icelandic communities. The minimum value for the gap between current and preferred capacity is zero (0) and the maximum four (4).
Zone of Feasible Innovation (ZFI)

• Teacher beliefs about their own competence in science teaching varies between individuals
  – Their response to challenging situations can depend upon the guidance on how much curriculum change is appropriate in a given context of science teaching and school development.

• Rogan & Grayson (2003) and Rogan (2007) have proposed a theory of curriculum implementation, an idea to assess how much curriculum change is appropriate in a given context.

• The theory is based on three major constructs:
  A. Profile of implementation (in the classroom)
  B. Capacity to support innovation
  C. Support from outside agencies
Theory of curriculum implementation

Six prepositions:

1. Innovation should be just ahead of existing practice. Implementation should occur in manageable steps.
2. Capacity to support innovation should be concurrent with efforts to enrich the profile of implementation.
3. Outside support should be informed by the two constructs, matching outside support with capacity, and capacity with desired implementation.
4. All role players need to reconceptualise the intended changes in their own terms and context.
5. Changing teaching and learning is a change of culture not a technical matter.
6. There should be alignment between the three constructs and the primary level (e.g. the learning experience).
## A. Profile of implementation

<table>
<thead>
<tr>
<th>Ideal</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>Implementation</th>
<th>Classroom interaction</th>
<th>Practical work</th>
<th>The nature and role of science in society</th>
<th>Assessment</th>
</tr>
</thead>
</table>

Vilji og veruleiki

Náttúrufræði- og tæknimenntun
## B. Capacity to support innovation

<table>
<thead>
<tr>
<th>Ideal</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td><strong>Teaching resources</strong></td>
<td><strong>Teacher factors</strong> (background, education)</td>
<td><strong>Learner factors</strong> (e.g. background and personal situation, attitude towards studies)</td>
<td><strong>School ecology and management</strong></td>
</tr>
</tbody>
</table>

- **Ideal**: 4
- **3**
- **2**
- **1**
## C. Support from outside agencies

<table>
<thead>
<tr>
<th>Ideal</th>
<th>Learning Community</th>
<th>School Self-evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Professionalism, compliments for innovation and quality work</td>
<td>School self-evaluation followed by external evaluation</td>
</tr>
<tr>
<td>2</td>
<td>Ideas and encouragement from above</td>
<td>External and self-evaluation</td>
</tr>
<tr>
<td>1</td>
<td>Bureaucracy, instruction from above</td>
<td>Only external evaluation</td>
</tr>
</tbody>
</table>

### Types of encouragement and support

<table>
<thead>
<tr>
<th>Physical resources</th>
<th>Design of professional development</th>
<th>Direct support to learners</th>
<th>Dominant change force evoked by agency</th>
<th>Monitoring mechanisms and accountability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside support</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# B. Capacity to support innovation

<table>
<thead>
<tr>
<th>Ideal</th>
<th>Teacher factors (background, education)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>The teacher has outstanding knowledge in science and excellent teaching skills færni. He shows willingness to change, is resourceful and cooperative. He has a vision for innovation and shows professional initiative and leadership at home and elsewhere.</td>
</tr>
<tr>
<td>3</td>
<td>The teacher is competent with reliable knowledge in science. He takes active part in professional development of his job, is conscientious and tries to improve his teaching.</td>
</tr>
<tr>
<td>2</td>
<td>The teacher basic knowledge and skills to teach science. He works hard and participates in professional development. He is well connected with students and treats them with fairness and respect.</td>
</tr>
<tr>
<td>1</td>
<td>The teacher lacks knowledge in science but is a qualified teacher.</td>
</tr>
</tbody>
</table>
Science teachers view of ZFI

• The theory was adapted to the Icelandic national curriculum and the content of the three major constructs.

• The theory of ZFI and the methods and main findings of *Intentions and Reality* was introduced to two focus-groups of science teachers.

• They were asked if it would be useful to develop and use an instrument based on ZFI to evaluate their own situation, i.e. to assess how much curriculum change is appropriate in their own context.
• The view of the teachers is:
  – The theory of Zone of Feasible Innovation (ZFI) is an useful idea to evaluate the levels of implementation and identify developmental aspirations and potential contributors and constraints to the achievement of implementing the National science curriculum.
  – They would however like to answer the SCIQ-questionnaire to assess their own views.
  – They would like to do the assessment of their own situation in cooperation with all science teachers in each school (and/or with all the schools in a local educational area).
  – Also, they emphasised the importance to have an external specialist to guide them in the evaluation process.
Conclusion

- The theory of Zone of Feasible Innovation is an useful idea to evaluate the levels of implementation.
- The next steps are:
  - to develop the constructs in detail according to the new National science curriculum.
  - ask some teachers in the schools that participated in *Intentions and Reality* to try it out and compare the results with researchers evaluation of their situation.