EDUCATING PRE-SERVICE PHYSICS TEACHERS AT HÖGSKOLAN DALARNA IN SWEDEN*

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Supported in part by the Swedish National Agency for Higher Education

*Most of the work done while the author was employed at Högskolan Dalarna, Sweden.

PERC2000, Guelph, 2000-08-03
Background and general context

- Two separate school systems in Sweden: Compulsory school (grade 1-9, 7-16 years old) and Upper secondary ("Gymnasium", grade 10-12, 16-19 years old).
- Physics is taught as a separate and compulsory subject in compulsory school grade 7-9 (13-16 year old)
- In Upper secondary school students specialise and those who chose science specialisation take physics (partly calculus based) every year but also, for example, at least two foreign languages.
This study

• Implementation of microcomputer based labs (MBL) in mechanics at a smaller Swedish university.
• Mainly pre-service teachers preparing to be certified for math and science teaching in grade 4-9.
• Minimum physics requirement is full-time study of physics during one semester (20 weeks) to be certified.
• Young-Freedman “University physics” was used as the text (including modern physics) + some electronics + a short astronomy course
• Different instructors had different educational “views” which led to different ways of implementing MBL-labs.
Pre-service 1995/96

- First use of MBL and video analysis in teacher education. Material in Swedish written by me using “MBL-pedagogy”
- 5 (3 h) labs
- Kinematics and force and motion labs
- No lab on Newton III
- “Good” learning results except for Newton III
Pre-service 1998/99

- Reduction of number of labs and contact hours for economical reasons
- 3 (3 h) mechanics labs
- Labs “improved” by the lab-instructor into “formula verification” labs. MBL-technology but not MBL-pedagogy.
- Lab on Newton III but no one on kinematics
- Poor learning results and especially for N III
- Difference in gain between male vs female and low vs high pre-test scores. Low gains for females and low pre.
- # students holding a force-follows velocity view did not change during the course and increased among the girls.
Pre-service 1999/2000

- Same lab-instructor as in 1995/96
- 3 (3 h) MBL-labs
- 2 labs were the same as in 98/99 (formula verification)
- The Newton III-lab were changed into active engagement mode
- Similar learning results compared with 98/99 except for Newton III
- Similar gains for male vs female and low vs high pre-test scores.
## FCI-results

<table>
<thead>
<tr>
<th>Course</th>
<th>Year</th>
<th>Main student body</th>
<th>&quot;Method&quot;</th>
<th>Pretest Average (FCI)</th>
<th>Posttest Average (FCI)</th>
<th>Gain (G) (FCI)</th>
<th>Normalised gain (g) (FCI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preservice</td>
<td>95/96</td>
<td>Preservice Science Teachers (grade 4-9)</td>
<td>Early MBL implementation</td>
<td>~50%</td>
<td>71%</td>
<td>~21%</td>
<td>~42%</td>
</tr>
<tr>
<td>Mechanics I</td>
<td>97/98</td>
<td>Engineering</td>
<td>Full MBL + some other reforms</td>
<td>51%</td>
<td>73%</td>
<td>22%</td>
<td>45%</td>
</tr>
<tr>
<td>Preservice</td>
<td>98/99</td>
<td>Preservice Science Teachers (grade 4-9)</td>
<td>Only MBL-technology NOT MBL-pedagogy</td>
<td>49%</td>
<td>65%</td>
<td>16%</td>
<td>31%</td>
</tr>
<tr>
<td>Preservice</td>
<td>99/00</td>
<td>Preservice Science Teachers (grade 4-9)</td>
<td>Partial MBL-pedagogy</td>
<td>35%</td>
<td>67%</td>
<td>32%</td>
<td>49%</td>
</tr>
<tr>
<td>Traditional</td>
<td>97/98</td>
<td>Engineering</td>
<td>Traditional</td>
<td>~50%</td>
<td>58%</td>
<td>~8%</td>
<td>~16%</td>
</tr>
</tbody>
</table>
### FMCE-results

<table>
<thead>
<tr>
<th>Course</th>
<th>Year</th>
<th>Main student body</th>
<th>&quot;Method&quot;</th>
<th>Pretest Average (FMCE)</th>
<th>Posttest Average (FMCE)</th>
<th>Gain (G) (FMCE)</th>
<th>Normalised gain (g) (FMCE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanics I (Case 2)</td>
<td>97/98</td>
<td>Engineering</td>
<td>Full MBL + some other reforms</td>
<td>29%</td>
<td>72%</td>
<td>43%</td>
<td>61%</td>
</tr>
<tr>
<td>Preservice (Case 3)</td>
<td>98/99</td>
<td>Preservice Science Teachers (grade 4-9)</td>
<td>Only MBL-technology NOT MBL-pedagogy</td>
<td>33%</td>
<td>53%</td>
<td>20%</td>
<td>30%</td>
</tr>
<tr>
<td>Preservice (Case 4)</td>
<td>99/00</td>
<td>Preservice Science Teachers (grade 4-9)</td>
<td>Partial MBL-pedagogy</td>
<td>27%</td>
<td>62%</td>
<td>35%</td>
<td>49%</td>
</tr>
</tbody>
</table>
Summary and conclusion

• MBL can give good learning gains when implemented in a sound pedagogical way.
• MBL can not be implemented as technology only. Pedagogy is more important than technology!
• Instructors educational views must be taken in consideration and addressed when implementing reformed curricula! A curriculum reform or a pedagogical intervention can be undone by an instructor!