Multilevel ICT design to support education and learning:
Theory and practice

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Overview
1. Introduction
2. Multilevel theory
3. Method:
   - development research
   - experimental research
4. First results
5. Discussion

1. Introduction

Differences between pupils per competence / school subject area

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>Middle</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning level</td>
<td>Lower</td>
<td>Higher</td>
<td></td>
</tr>
<tr>
<td>Learning steps</td>
<td>Smaller</td>
<td>Greater</td>
<td></td>
</tr>
<tr>
<td>Motivation</td>
<td>Concrete</td>
<td>Abstract</td>
<td></td>
</tr>
<tr>
<td>Structuring</td>
<td>Task-based</td>
<td>Creative</td>
<td></td>
</tr>
<tr>
<td>Working period</td>
<td>Shorter</td>
<td>Longer</td>
<td></td>
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<tr>
<td>Repetition</td>
<td>With variation</td>
<td>New</td>
<td></td>
</tr>
<tr>
<td>Coaching</td>
<td>More often</td>
<td>Less often</td>
<td></td>
</tr>
<tr>
<td>Self-regulation</td>
<td>Less</td>
<td>More</td>
<td></td>
</tr>
</tbody>
</table>

Differences z-scores 2004-2002
Grades 2-4 (red) and 4-6 (blue)

Longitudinal cohort high ability pupils

Causal effects 2002-2004:
- class size: larger number pupils in class, negative effects
- age-based monitoring: negative effects
- class mean performance: higher mean, negative effects

Teacher’s functioning 2002 – 2004:
- acceleration: skipping grade(s) positive effects on motivation and behaviour in class, and on cognitive performance

Research question

HOW TO SUPPORT LEARNING PROCESSES OF PUPILS WITH DIFFERENT ABILITIES, INCLUDING SELF-REGULATION ABILITIES, TO REALISE THAT ALL CAN ACHIEVE ACCORDING TO THEIR POTENTIALS IN PRESCHOOL - PRIMARY SCHOOL?
2. Multilevel theory

Various types of variables
education, instruction, learning, personal
individual, group, school levels
interactions at / between levels
resulting in specific but related
multilevel longitudinal
processes and effects

Learning psychology at pupil level:
Self-regulation and learning tasks

Zimmerman (2000):
Self-regulation: self-generated thoughts, feelings, and
actions that are planned and cyclically adapted to the
attainment of personal goals

Competence-based learning:
- estimation of difficulty level of task - selection
- types of support or coaching of task execution
- assessment or evaluation of results

Systemic design to improve
education and learning

Educational contextual dimensions:
• Differentiation of learning materials and procedures
• Integration by and use of ICT support (in multilevel ways)
• Strategies to improve development and learning
  • Beginning char., prosocial rules, small groups, self-regulation

Four aspects of learning processes:
• Diagnostic, instructional, managerial, systemic

Combining dimensions and aspects: Optimal education

Hypothesis

Compared with their learning in traditional education,
in optimal education – learning conditions
both low and high ability pupils will improve
their social, emotional and cognitive learning processes
in particular because of the adequate integration
of these pupils’ self-regulatory capacities
in the instructional designs.

3. Method

Projects ‘contextual learning model’
• Development of prototype Pedag. Did. Kernel Structure
• Screening of beginning characteristics
• Development of prototype software
• Pilots in preschool / primary school
• Collaborative research and development in practice
• Two experimental longitudinal projects
4. First results

Pedagogical-Didactic Kernel Structure

Competence domains:
- language
- general - cognitive
- social - emotional
- arithmetic / mathematics
- physical - medical
- general - psychological
- motor

Implementation

Pilots in preschool and primary school

- collaboration with pre- / primary school teachers
- screening of beginning characteristics four-year olds
- experiences in practice:
  - collaboration between parents and teachers
  - multi-perspective communication about competence levels
  - introduction of appropriate levels of play / learning materials
  - further specific educational support in prosocial small groups
Reliabilities screening scales, per type of respondent

<table>
<thead>
<tr>
<th>Screening scales (number items)</th>
<th>Day-care</th>
<th>Parents</th>
<th>Preschool</th>
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<tbody>
<tr>
<td>N Alpha N Alpha N Alpha</td>
<td>N Alpha N Alpha N Alpha</td>
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<td></td>
</tr>
<tr>
<td>Social-communicative level (2)</td>
<td>52 .97 134 .97 118 .91</td>
<td></td>
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<tr>
<td>General cognitive level (4)</td>
<td>51 .87 133 .62 117 .82</td>
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<tr>
<td>Language proficiency level (5)</td>
<td>34 .97 113 .82 106 .86</td>
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<tr>
<td>Pre-arithmetic level (4)</td>
<td>30 .89 119 .84 109 .92</td>
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<tr>
<td>Emotional-expressive level (5)</td>
<td>45 .87 131 .87 116 .82</td>
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<tr>
<td>Sensorimotor level (4)</td>
<td>50 .88 124 .77 109 .81</td>
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<tr>
<td>Expected educ. beh./motiv. (4)</td>
<td>48 .93 131 .83 116 .85</td>
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Differences in mean scores

<table>
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<tr>
<th>Screening scales</th>
<th>Mean a</th>
<th>Mean b</th>
<th>Mean c</th>
<th>Mean d</th>
<th>Mean e</th>
<th>Mean f</th>
<th>Mean g</th>
<th>Mean h</th>
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<tr>
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<td>3.32</td>
<td>- .62</td>
<td>3.43</td>
<td>3.41</td>
<td>- .15</td>
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<td>- .32</td>
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<td>- .59</td>
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<td>3.41</td>
<td>1.24</td>
<td>3.28</td>
<td>3.48</td>
<td>1.48</td>
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<td>3.57</td>
<td>- .49</td>
<td>3.39</td>
<td>3.58</td>
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5. Discussion

1. Self-regulation of pupils and criterion-based education and learning
2. Self-regulation of pupils and norm-based pupil monitoring
3. School-based innovation. ICT at multiple levels, and self-regulation of school teams

Some references