Fostering Inclusive Learning in Adaptive Learning Environments for Primary Science Education

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Problem-Based Starting Situation: (Inter-)national Demands

(1) Standards in Inclusive Education

Inclusion

(adapted from Aehnelt 2013)

- UN-Convention on the Rights of Persons with Disabilities, Article 24: ensuring an "inclusive education system at all levels" (United Nations 2006)
- German standards: change of perspective towards inclusive education: expansion of inclusive educational opportunities (KMK 2011)

→ Obligation to realize inclusive education

National demands for inclusive education in school (KMK 2011, 2014)

International demands for inclusion (United Nations 2006)

(Inter-)national standards for early science education

Primary science education in inclusive learning settings

(2) Standards in Primary Science Education

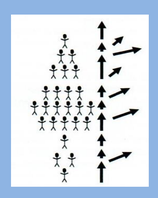
Scientific Literacy
"science for all" (1847, James Wilkinson)
(Labudde & Möller 2012, Duit et al. 2001, Gräber et al. 2002, Bybee 1997)

Content-related and conceptual understanding

Scientific understanding

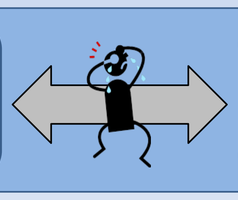
Motivational and self-related outcomes

Lifelong learning



Aim:
reaching optimum multiple learning effects according to the students' individual learning ability

Discrepancy: Consider the demands of inclusive education ⟷ Realize the requirements of inclusive education



Research Demands

Desideratum for research that explicitly addresses inclusive learning and that further on connects inclusion and scientific learning (Fischer et al. 2014, Klauß 2014)

An Empirical Experimental Classroom Study (mixed methods)

Research Question

How can we **create adaptive learning environments for inclusive learning settings in primary science education** that reach individual optimum multiple learning effects including cognitive, motivational and self-related outcomes?

Research Aims

- Examining learning conditions and opportunities for an individual optimum development for *all* children with regard to their individual opportunities and in order to reach optimum multiple learning effects
- Developing didactical material for primary schools' science subject „renewable energies" to support the practical use in school

Assumptions

Constructivist learning environments
active, constructivistic, **cooperative**, largely self-directed and situated
(Gerstenmaier & Mandl 1995)

✓ Structuring / Scaffolding on macro and micro level (Einsiedler 2011)
✓Affective and cognitive activation
✓Adaptive teaching (Helmke 2006)
✓Motivation (Deci & Ryan 2002)

enabling individual access possibilities
(basal-perceptually – concrete-objectively – illustratively – abstract-conceptually)
(Franz & Lange 2014, Terfloth & Klauß 2014)

Feelings of competence, social relatedness and autonomy (Deci & Ryan 2002) for *all* pupils

Multiple Learning Effects
including cognitive, motivational and self-related outcomes (Blumberg 2008)

Research Design and Organization of the Study

(Blumberg, Hellmich & Fromme 2015)

Multi-Way Procedure:

04/2014 – 04/2015	Development of didactical material and test instruments
05/2015 - 06/2015	Pilot Study
07/2015 – 10/2015	Qualitative and quantitative evaluation and further development of the didactical material and test instruments
10/2015 – 04/2016	Main Study

Pilot Study

- Testing the material in two inclusive fourth grade classes (41 pupils)
- 4 double lessons (90 min), topic "renewable energies":
  1. introduction 2. solar energy 3. wind energy 4. water energy
- Methods:
  cognitive and motivational pre- and post-testing, interim evaluation after every lesson and **evaluation at the end of all lessons (self-determination-theory)**, observation by students, videotaped lessons

Instruments (examples)

Focus on pupils' evaluation at the end of all lessons - Variables and Scales:

Scale (number of items)	α	Sample Item (four rating likert scales)
Feeling of Competence (4)	.831	Did you understand much in these lessons?
Feeling of Social Relatedness (4)	.893	Did you have the feeling of being part of your group?
Feeling of Autonomy (4)	.829	Did you have the feeling of participating in how to solve a task?

Questionnaire and supporting material

First Results of the Pilot Study (41 4th graders)

Focus on the interim evaluation after every lesson and the evaluation at the end of all lessons
(four rating likert scales, 4 to 5 items per scale, .α = .614 - .893)

Solar Energy	M	SD
F. o. c.	3.34	.56
F. o. s. r.	3.35	.61
F. o. a.	2.63	.75

Wind Energy	M	SD
F. o. c.	3.31	.55
F. o. s. r.	3.11	.76
F. o. a.	2.64	.78

Water Energy	M	SD
F. o. c.	3.28	.62
F. o. s. r.	3.06	.87
F. o. a.	2.59	.92

All Lessons	M	SD
Feeling of Competence	3.35	.66
Feeling of Social Relatedness	3.02	.87
Feeling of Autonomy	2.63	.88

Pearson-Correlations

Post Scales (four rating likert scales)	F. o. c.	F. o. s. r.	F. o. a.
Intrinsic Motivation (5 items, α = .918) – It was important for me to be able to answer the questions on the topic.	.653**	.387*	.393*
Self-Concept (absolutely) (4 items, α = .700) – I always did well in these lessons.	.715**	.395*	.288
Self-Concept (comparatively) (3 items, α = .798) – I belonged to the low-/ middle-/ high-/ very high-achieving students.	.494**	.490**	.450*
Interest (4 items, α = .939) – I liked this ‹‹Sachunterricht›› very much.	.666**	.384*	.399*

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