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Mathematics in Kindergarten: Training or play?

Main results and video analysis on time on task in play-based approaches vs. teacher-directed training programmes

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Overview

- Research context, research question and design
- Main results on play based vs teacher directed maths education in Kindergarten
- Video study: methods and results
- Conclusion

Research context: selected approaches and results

Programme		Approach	Results
	Komm ins Zahlenland [Follow me into the land of numbers] (Friedrich & Galgczy, 2006)	story-based programme	Good effects (Friedrich & Munz, 2006; Pauen & Pahnke, 2008) No effects (Krajewski et al. 2008)
	Mathe 2000 [Maths 2000] (Wittmann, 2009)	Learning activities including play based on mathematical theory	Good effects (Pauen & Pahnke, 2008)
	Mengen zählen Zahlen (MzZ), [Quantites, counting and numbers] (Ennemoser & Krajewski, 2007)	Early training of quantity, based on theories of cognitive development	Good effects, significantly better than *follow me*… (Krajewski et al. 2008)

Context and research question

- Play is essential for the children in that age group and therefore for kindergarten pedagogy (Golinkoff 2010, Walsh et al 2006)

- Lack of evidence: how effective are training-based approaches compared with play-based approaches for different ability groups of children?

What are the effects on learning outcome and motivation in relation to children's characteristics (math skills, SES etc) of two different approaches to fostering numeracy skills in Kindergarten, comparing a training programme with a play-based approach?

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Hypotheses

- H1: Children learning with play-based approach of early numeracy show a greater gain in numeracy skills compared to the children in the control group.

- H2: The intervention groups (play-based versus training programme) equally improve numeracy skills.

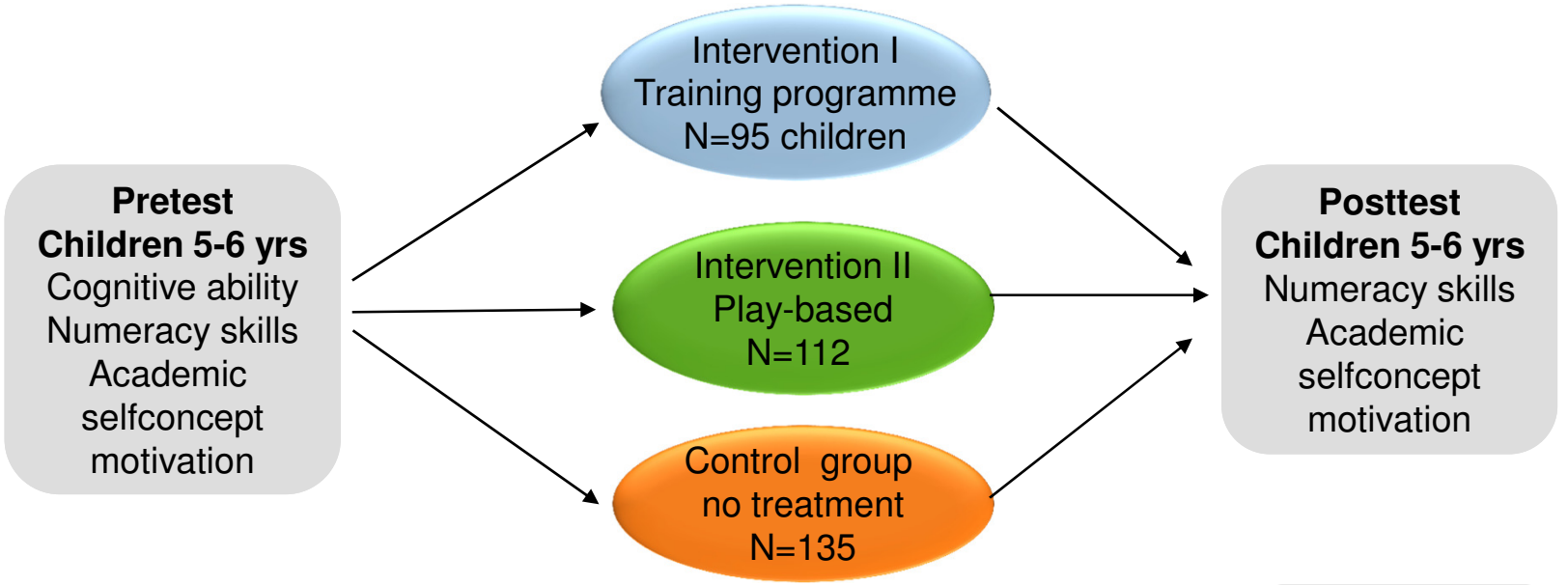
- H3: The effectiveness of the two interventions (play-based versus training programme) on learning outcome and motivation depends on children‘s characteristics, particularly their pre-test level of numeracy skills.

Research design

March 2010

24 times half an hour over 8 weeks

June 2010



Pretest
Children 5-6 yrs
Cognitive ability
Numeracy skills
Academic selfconcept
motivation

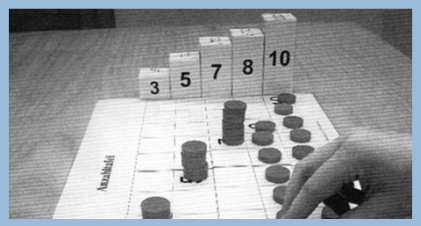
Posttest
Children 5-6 yrs
Numeracy skills
Academic selfconcept
motivation

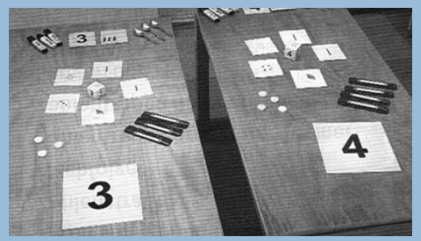
Parent questionnaire
socio-economic background, attitudes to learning and play

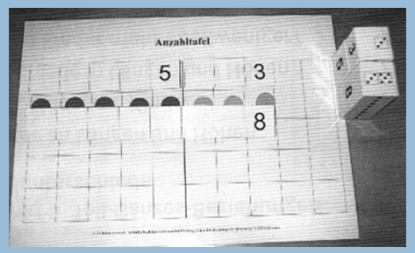
Video study

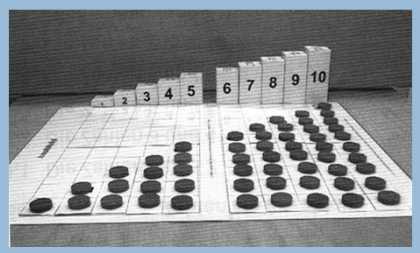
Teachers: interview, questionnaire:
attitudes to learning and play, teaching style

Intervention I: Mengen zählen Zahlen
Training programme







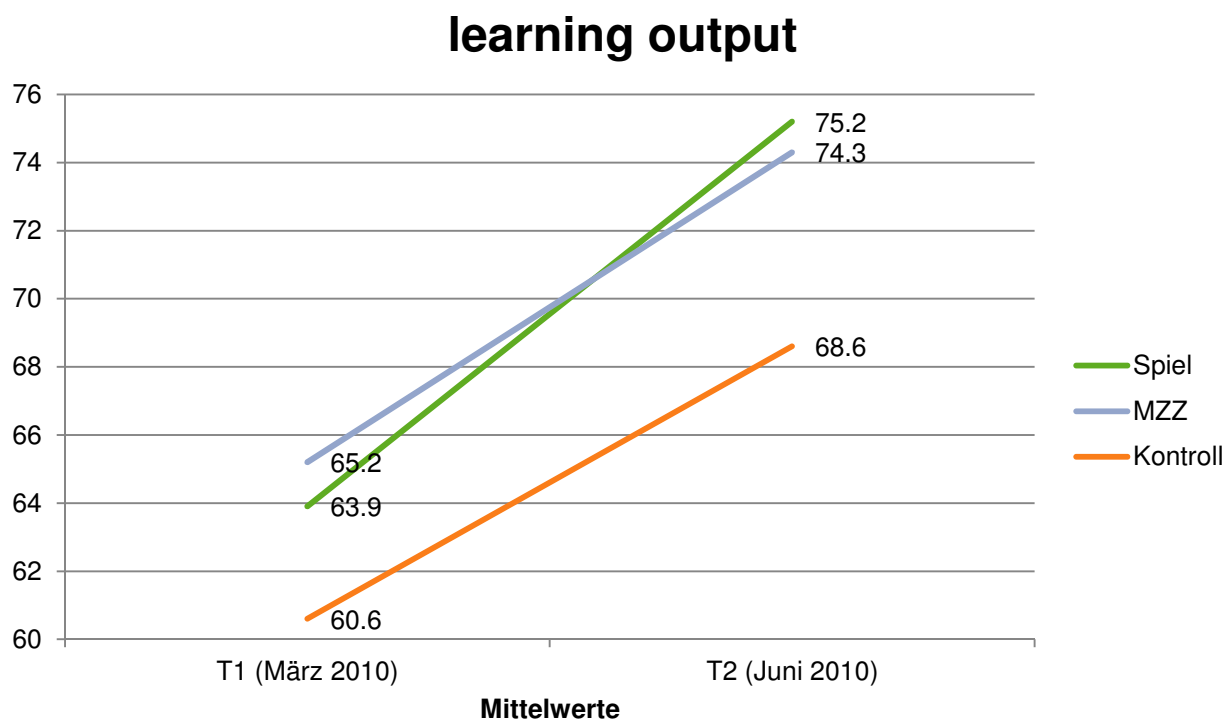


- 24 units of half an hour over 8 weeks
- Developed for groups of 4-6 children
- Highly teacher-led
- Programme structures content and sequence with an elaborate teacher manual.
- Emphasis on supporting mathematical actions with mathematical wording
- Developed by Krajewski et al., 2007

Intervention II: Play-based early numeracy

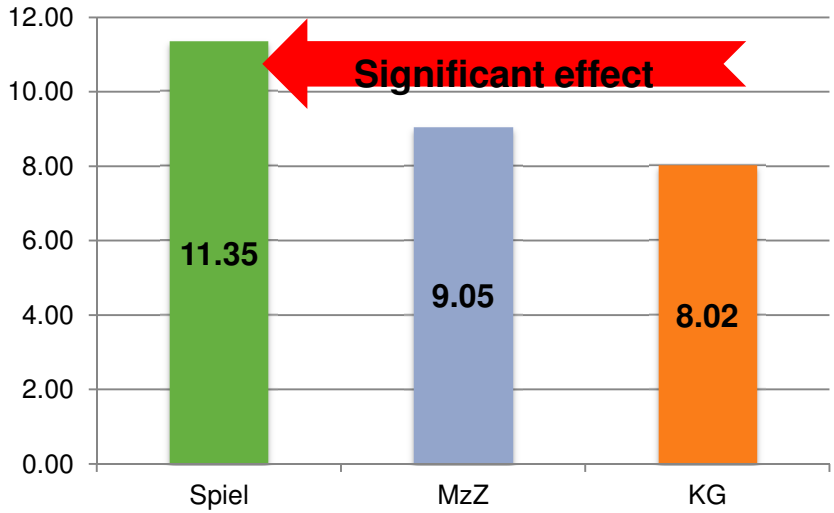
- 24 times half an hour over 8 weeks
- 12 games for groups of 2 - 7 children
- Mostly children driven
- Limited choice of games
- Introduction by the teacher
- Mathematical content equal to training except mathematical wording/verbalisation
- Developed by research team Hauser et al.

Overall effects I



- Two factor analysis of variance with repeated measure: significant interaction effect (time * group) $F = 4.04$, $df = 2$, $p = 0.019$, $eta^2 = 0.025$ (partial η^2)

Overall effects II



Scheffé Test				
		Delta Mean	Standard-deviation	Sig.
Play vs training		-2.30 (n.s.)	1.21	0.084
Play vs control		-3.33*	1.18	**0.01**
Training vs control		-1.03 (n.s.)	1.11	0.326

Video study, methods: Data collection

- **Time:** one unit of the intervention of half an hour, mid-programme

- **Footage training programme**
- 2 fixed cameras focussing on the class
- 1 hand-held camera following the teacher

- **Footage play-based fostering**
- 5 fixed cameras focussing on a play each
- 1 hand-held camera following the teacher

- **Data available for analysis**
- parents' video consent
- play-based: 78%; training: 72%

Video study I: analysis

- **Software:** videograph
- **Unit of analysis:** capturing moments every 20 sec as a turn
- **Categorizing:** exclusively one code per child and turn
- **Interrater Reliability** (according to Früh, 2001): Overall: $CR_{mean} = 0.80$, ranging from $CR_{ga} = 0.74$ to $CR_{mv\_a} = 0.86$
- **Units for statistical calculation:** duration of time

SpiF: 27 Min. 01.2 Sek. *MzZ: 28 Min. 12.1Sek.*

(t-Test: n.s.; p = 0.279)

Video study II: codes and categories

Theoretical frame of reference:

- Time on task as one of the relevant factors for learing outcome (i.e.Seidel & Shavelson, 2007)
- Münchner Aufmerksamkeitsinventar [Munich attentiveness inventory] (MAI, Helmke, 1988)

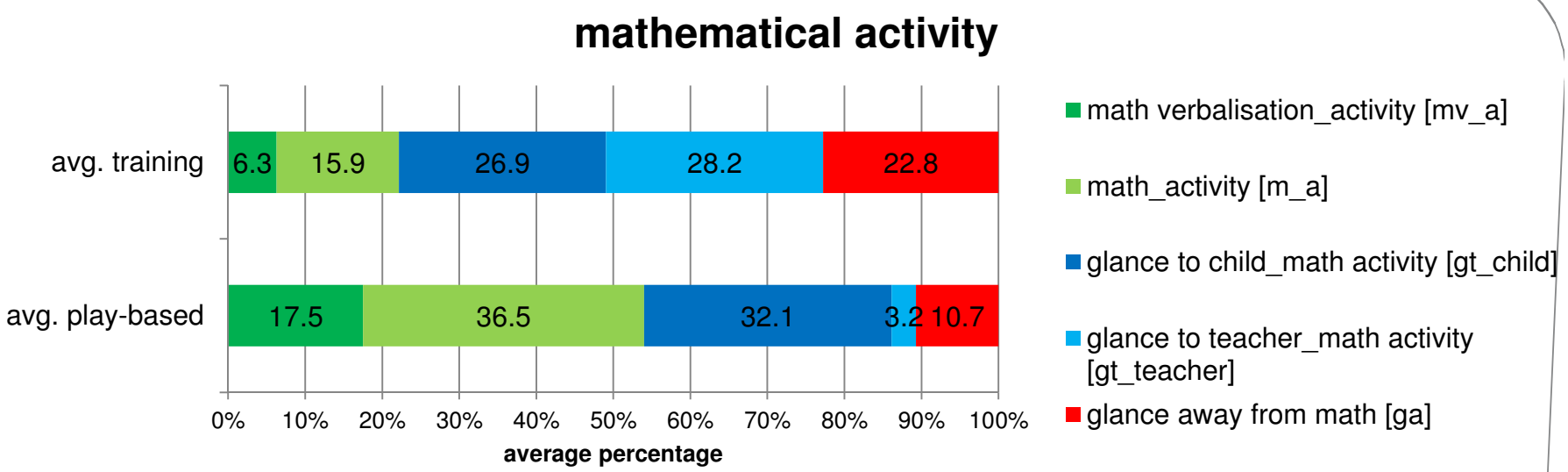
Categories developped for video study:

		Attentiveness			
low					**high**
0 = No task	1 = off-task [ga]	2 = on-task [gt_teacher]	3 = on-task [gt_child]	4= on-task [m_a]	5 = on-task [mv_a]
No task given	Glance away from maths activity, also disruptive behaviour	Glance to the teacher involved in maths activity	Glance to the child involved in maths activity	Child is involved in maths activity	Child is involved in maths activity and verbalizes

Video study methods: categorizing (example)

- **Child 24:** looks at his cards, just put down a card, starts counting. → m_a (4=on task glance on math activity)
- **Child 27:** verbalises mathematical content: Have you got number 10? → mv_a (5= on task verbalizing)
- **Child 23:** first looked at her cards, but now looks at the child **(24)** involved in maths activity probably interested what he answers → gt_child (3 = on-task glance to the child involved in math activity)

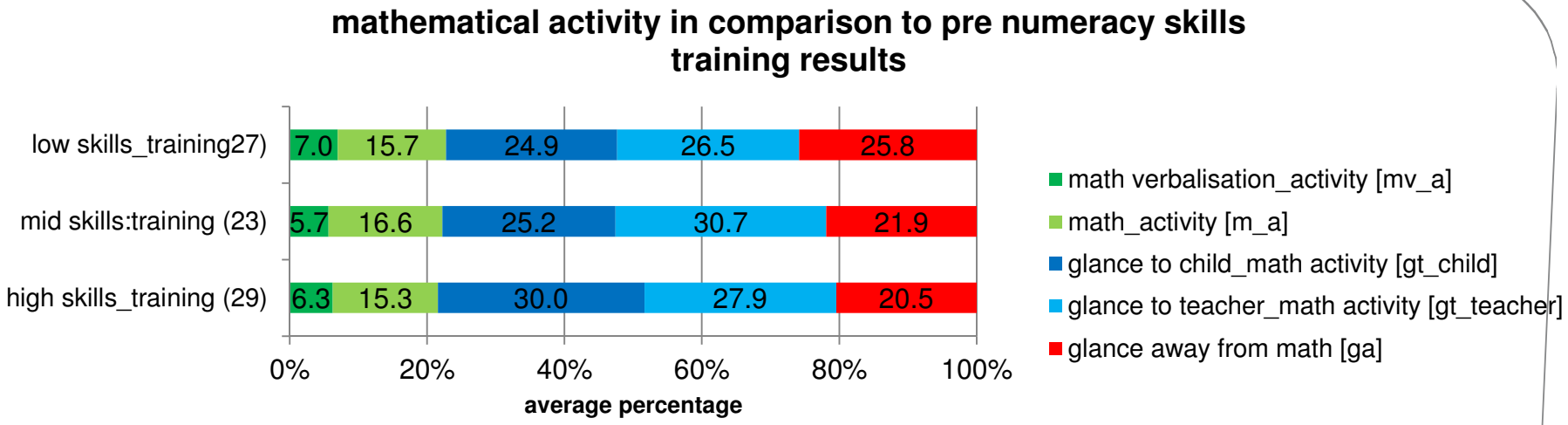
Video study results: time on task play-based versus training

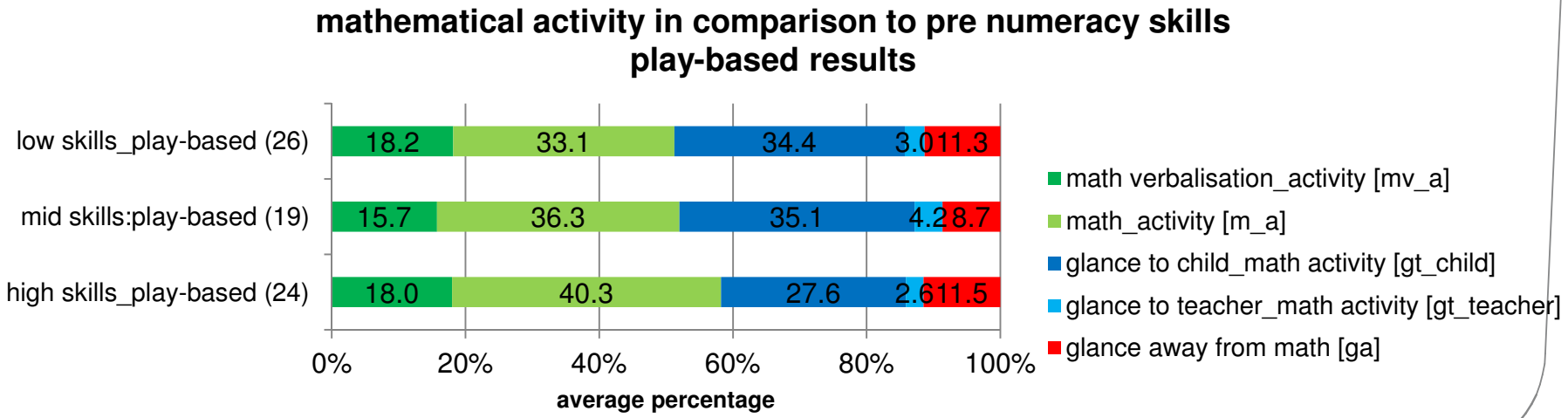


	mv_a	m_a	gt_child	gt_teacher	ga	N_cod
training	103.80	259.49	439.49	462.15	372.53	51.54
play-based	267.25	558.55	491.16	048.41	163.48	91.88
Sign.	***	***	n.s.	***	***	n.s.

Tab.: All categories show significant differences (Bonferoni) except glance to teacher involved in math activity and not codable

Video study results: Time on task in relation to competencies and intervention





Summary and conclusions

- The main results show that play-based fostering is more effective than the fostering in the control group and is as effective as the training programme
- Clear behaviour differences between play-based fostering and training programme
- Children are more active and are more often involved in mathematics activity when learning with the play-based fostering compared to training programme
- The pattern of activity is related to the intervention and not to the child‘s maths competence

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