



Synthesis of Multimedia Effects on Literacy Achievements in Children at Risk

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Synthesis of Multimedia Effects on Literacy Achievements in Children at Risk

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Introduction: Redefinition of literacy

- In the old days: ability to read and write.
- Now we have multimedia: integration of text, images and sound, presented electronically/digitally.
- Examples: TV, DVDs, (all sorts of) computer software, electronic books, talking books, internet, video games, smart phone apps, interactive toys, and more.
- Literacy is now: ability to communicate through multimedia.
- Multimedia thought to be more efficient than verbal/written delivery of instruction:
 - Clark & Paivio, 1991
 - NAEYC (National Association for the Education of Young People), 1996:
 - 'used appropriately, technology can enhance children's cognitive and social abilities'
 - 'computers should be integrated into early childhood practice physically, functionally, and philosophically'



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Introduction: Theory on multimedia

- Pro
 - Dual coding (visual and auditory) results in enhanced comprehension (Sadoski & Paivio, 2007).
 - Supports 'children of the digital age' (Marsh, 2005).
- Con
 - Use of technology is developmentally inappropriate, cognitive overload (Kirschner, 2002).
 - Teacher resistance to incorporating technology into lessons (Turbill, 2001).
 - It costs a lot, but produces little (Yelland, 2005).
 - Use of technology undermines the very nature of childhood, 'death of childhood' (Buckingham, 2000).
- Overviews: Buckingham, 2000; Lankshear & Knobel, 2003; Stephen & Plowman, 2003.



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Introduction: The practice

- Rideout & Hamel, 2006:
 - 1,000 American households with children under age 6 surveyed.
 - in a typical day, 83% use some type of screen media.
 - 27% reports that their children use a computer several times a week or more.
 - 69% felt computers helped their children's learning.
- Therefore, in-depth research on the topic is long overdue.



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Review of research (I)

- Kamil, Intrator & Kim (2000) reviewed 350 articles on the effects of multimedia on literacy:
 - only few related to early literacy.
 - multimedia facilitate comprehension through 'mental model building'.
 - children who come from language and cultural minority backgrounds can benefit from multimedia.
- Lankshear & Knobel (2003) found only 22 articles focusing on young children:
 - majority of these 22 studies dealt with decoding.
 - effects of technology on early literacy development were 'radically under-researched'.



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Review of research (II)

- Burnett (2009) reviewed 22 quantitative and 16 qualitative studies on technology and literacy:
 - technology was used in the same way as traditional print teaching methods.
 - strengths of multimedia were not exploited at all.
 - therefore, effects difficult to ascertain.
- Zucker, Moody & McKenna (2009) looked at effects of E-books in 7 randomised trial studies and 20 narrative:
 - small to medium effect sizes for comprehension.
 - effect on decoding could not be assessed (only 2 studies).
 - mixed results in narrative studies: overall positive, but sometimes more time was spent on games than educational content (De Jong & Bus, 2002).



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Review of research (III - CAI)

- Mainframe computers were too expensive and too slow (Fletcher & Atkinson, 1972; Krendl & Williams, 1990; Slavin, 1991).
- Meta-analytic studies found effect sizes of 0.25 (SE = 0.07), Kulik & Kulik (1991) and 0.16 (SE = 0.08), Ouyang (1993).
- Qualitative studies:
 - Torgesen & Horen (1992): computer should be integrated with teacher-driven curriculum.
 - Van der Leij (1994): concentrating on a specific subskill is more effective.
 - Wise & Olson (1998): talking computers should be combined with PA training.
 - National Reading Panel (2000): talking computers promising (20 studies reviewed).



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Review of research (IV - CAI continued)

- Blok, Oostdam, Otter & Overmaat (2002):
 - 45 studies with 75 experimental conditions.
 - overall effect size: 0.254 (SE = 0.056).
 - variance of effect size could be explained by:
 - pretest scores: 34%.
 - language of instruction: 27%, English-medium studies 0.319 SD more effective than non-English.
 - overall disappointing, especially as in all studies children at risk of literacy underachievement took part.
- Have computers become more effective over the last decade?



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Questions of the current study

- 1. Can multimedia facilitate the early literacy development of young children (0-8 years old) at risk of literacy underachievement (e.g., dyslexic children, low-SES children, linguistic/cultural minority children)?
- 2. If so how? Which literacy-related learning outcomes are most influenced by the use of multimedia?
- Work in progress:
- 3. Which multimedia applications are more effective?
- 4. Are there any multimedia application X literacy outcome interactions?
- 5. What works in multimedia? How do parameters of multimedia applications affect effect sizes?



Method: We looked for...

- Quantitative research published in peer-reviewed journals between 2000 and 2010, with children 0-8 years as participants.
- Children at risk for literacy failure.
- Also mainstream children.
- Studies with at least one of the following outcomes: Alphabetic Knowledge, PA, RAN, Writing, Phonological Memory, Reading Readiness, Oral Language, Visual Processing and Concepts of Print (NELP, National Institute for Literacy, 2008).
- Published in English.



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Method: How we looked for studies...

- Multimedia and early literacy search terms devised by:
 - Cross-checking reference lists found in most recent meta studies and in results of pilot searches.
 - Consulting reference books:
 - Handbook of Early Literacy Research
 - Handbook of Research on New Literacies
 - International Handbook of Literacy and Technology, Vol II
- Data bases searched:
 - PsychINFO
 - ERIC



Results: Searches (I)

- References for several hundred (!) potential studies were located.
- Abstracts were examined and subsequently 92 studies were downloaded for further inspection.
- Again abstracts reviewed and, if needed, full texts were evaluated: 51 studies complied with the search criteria.
- Sixteen had to be excluded, because one or more relevant statistics were missing.
- Of the 35 remaining, 24 reported on children at risk:
 - 7 studies on second language learners
 - 7 studies on low-SES children
 - 10 studies with underachieving readers
- Applications dealt with:
 - Embedded multimedia in teachers' reading lessons (2)
 - Subtitled video (1)
 - E-books (13)
 - Computer Assisted Instruction (18)



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Results: Searches (II)

- Altogether we found 325 literacy outcomes.
- Final categorisation:
 - Alphabetic Knowledge
 - Phonological Awareness
 - Rapid Automatic Naming
 - Concepts of Print
 - Vocabulary
 - Comprehension
 - Non-word Reading (decoding)
 - Reading (word recognition)
 - Spelling
 - Syntax
- Majority of studies conducted in English-speaking countries:
 - USA (14), UK (4), Canada (2)
 - Israel (5, Hebrew), Netherlands (10, Dutch)



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Results:

Analysis method

- Comparison groups:
 - children at risk who did not received an intervention, or performed a control task.
 - mainstream children receiving the same intervention as the children at risk (from same studies as at risk children).
 - mainstream children who received literacy-related interventions in studies in which no at risk children participated (unrelated studies).
- Meta-analysis:
 - Cohen's d : difference between mean at pretest and mean at posttest, divided by pooled variance.
 - Small samples: corrections by means of Hedges' g .
 - For every outcome category for which we had at least 4 outcomes a mean effect size, based on the random effects model was computed.
 - Also computed: 95% confidence interval for each effect.
 - See: Borenstein, Hedges, Higgins & Rothstein, 2009).



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Results:

Effect sizes (I)

- Alphabetic Knowledge
 - ES = 0.64 (0.49 - 0.79, 15 outcomes)
 - in untreated children at risk: ES = 0.89 (0.66 - 1.13, 6 outcomes)
- Phonological Awareness
 - ES = 0.75 (0.68 - 0.83, 51 outcomes)
 - in untreated children at risk: ES = 0.15 (15 outcomes)
 - in mainstream children: ES = 0.73 (0.55 in unrelated studies)
- Rapid Automatic Naming
 - ES = 0.21 (0.05 - 0.38, 8 outcomes)
 - in untreated children at risk: ES = 0.41 (6 outcomes)



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Results:

Effect sizes (II)

- Concepts of Print
 - ES = 0.86 (0.61 - 1.11, 6 outcomes)
 - in mainstream children: ES = 0.46 (0.22 - 0.70 in 6 unrelated studies)
- Vocabulary
 - ES = 0.68 (0.57 - 0.80, 28 outcomes)
 - in untreated children at risk: ES = 0.56 (0.40 - 0.73, 11 outcomes)
- Comprehension
 - ES = 0.52 (-0.27 - 1.31, 12 outcomes)
 - very few outcomes (3 in each group)



Results:

Effect sizes (III)

- Non-word Reading (Decoding)
 - ES = 0.53 (0.39 - 0.67, 13 outcomes)
 - only 3 outcomes in comparison groups
- Reading (Word recognition)
 - ES = 0.60 (0.52 - 0.68, 44 outcomes)
 - in untreated children at risk: ES = 0.77 (0.54 - 1.00, 8 outcomes)
- Spelling
 - ES = 1.11 (0.90 - 1.32, 5 outcomes)
 - in untreated children at risk similar ES (2 outcomes)
- Syntax
 - As Spelling, few studies, similar effects in untreated children



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Discussion (I)

- First study to indicate that literacy-related multimedia applications have a substantial effect on literacy learning outcomes of children at risk.
- Large effects on Phonological Awareness and Concepts of Print.
- Medium effects on Comprehension and Non-word Reading (Decoding).
- Multimedia applications do not have an effect on Alphabetic Knowledge, Vocabulary, and Reading (Word recognition) beyond regular instruction.
- At least overall medium effects found if appropriate control groups were used (not 'do nothing').



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Discussion (II)

- Effect sizes in current study are substantially larger than in previous studies: Have we learnt to exploit the added value of multimedia applications? Or have things changed with respect to the use of multimedia applications? Or...?
- More replications (in non-English speaking countries) needed.
- Publication bias: exclusion of 16 (!) studies.
- More research needed with respect to Comprehension.



Encore: Delving deeper at CAI

- 17 studies (8 in US, 2 in Canada, 1 in France, 5 in Netherlands, and 1 in Israel)
- 8 of them: multi-componential (Lexia, Waterford, IntelliTools, ABRACADABRA, CET)
- Not included: Troia (2004) and Borman, Benson & Overman 2009) Fast ForWord
- For Fast ForWord see: What Works Clearinghouse, http://ies.ed.gov/ncee/wwc/pdf/WWC_Fast_Forword_092806.pdf



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CAI results I

- Alphabetic Knowledge
 - ES = 1.161 (0.64 - 1.68, 9 studies, 11 outcomes)
 - no control groups used
- Phonological Awareness
 - ES = 0.86 (0.77 - 0.96, 11 studies, 13 outcomes)
 - in control groups: .14 (0.07- .36, 6 studies, 7 outcomes)
- Rapid Automatic Naming
 - ES = -0.20 (0.00 - -0.40, 2 studies/outcomes)
 - in control groups: -.48 (-0.17- -.79, 2 studies, 6 outcomes)



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CAI results II

- Concepts of Print
 - ES = 0.30 (0.80 - 0.19, 3 studies/outcomes)
 - no control groups
- Vocabulary
 - ES = 0.70 (0.85 - 0.54, 4 studies, 8 outcomes)
 - control groups: -0.38 - 0.68 (2 studies, 4 outcomes)
- Comprehension
 - ES = 0.50 (0.25 - 0.75, 4 studies, 6 outcomes)
 - only one study with 4 control groups (ES = .21)



CAI results III

- Non-word Reading (Decoding)
 - ES = 0.57 (0.39 - 0.76, 5 studies, 8 outcomes)
 - only 2 studies with control groups: ES = 0.87 and 0.06
- Reading (Word recognition)
 - ES = 1.85 (1.30 - 2.41, 10 studies, 14 outcomes)
 - only 3 studies with 4 control groups (ES: 0.47 and 10.99!!)
- Spelling
 - ES = 1.163 (0.15 - 2.18, 5 studies, 5 outcomes)
 - only 3 control groups (ES = 0.83, 0.92 and 0.98)
- Syntax
 - No CAI in this area



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Conclusion for effectivity of CAI (and E-books)

- Use CAI to train Alphabetic Knowledge and PA (but you can also do that with E-books)
- Give up on RAN
- Use E-books for Concepts of Print
- CAI and E-books can both be used to train Vocabulary, but much more research is needed here
- Too few studies available to be sure about effects on Comprehension
- Decoding can be learnt by both CAI and E-books, but CAI is much more effective on Word recognition
- More studies needed for Spelling and Syntax



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