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INTRODUCTION

Foundations of Language, Literacy, and Numeracy Learning

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Basic education is largely aimed at fostering children's language, literacy, and numeracy learning in perspective of knowledge acquisition. Throughout the curriculum, language plays a crucial part in children's development. Not only do they expand their communication skills, they also expand both the breadth and depth of their vocabularies. Moreover, they learn to pay attention to the formal aspects of language and develop a metalinguistic awareness in which implicit knowledge of both the functions and structure of language is made explicit. Such awareness paves the way to the emergence of literacy and numeracy skills. Children learn that written words can be divided into single letters which represent speech sounds, and that numbers may represent quantities. Over the years, they learn to read and write narrative and expository text, and to solve elementary mathematical problems of various kinds. In this issue, the focus is on the foundations of such language, literacy, and numeracy learning in the elementary grades.

In the early primary grades, language learning is highly focused on. As children make considerable progress in their conceptual development, their vocabulary grows rapidly. To increase their stock of content words, children need to link the correct meanings to word forms. Step by step, children learn to demarcate the meaning of each word. With regard to the attempt to increase the stock of content words, one should note that children do not learn by making simple associations between specific sound patterns and meanings. Research into vocabulary development has actually shown that children continuously use information from the context to make assumptions as to the possible semantic boundaries that characterise the underlying concept of a certain word form (Clark, 2004). Indeed, it has been found that lexical development is most successful when words are presented in a context-rich environment. With respect to basic literacy skills, children must learn that words can be represented as strings of letters which can be mapped onto phonemes. And in the case of complex words, children must learn that morphological constituents may underlie complex words (Verhoeven & Perfetti, 2011). In the process of learning to read, children start out with elementary decoding skills in order to apply these with greater accuracy and speed. Over the years, word identification becomes more and more automatised, as the meaning of morphemes develops as the result of direct recognition of multi-letter units and whole words (Ziegler & Goswami, 2005). Automatic word recognition enables children to devote their attention to meaning rather than form, which frees cognitive capacity for text

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comprehension instead of word decoding, allowing the learner to use reading as a tool for knowledge elaboration (Perfetti & Stafura, 2014; Verhoeven & van Leeuwe, 2009). Children in kindergarten gain vocabulary by storybook reading, and older children by reading texts themselves. The relation between vocabulary and reading comprehension is bidirectional. Children with a large vocabulary are better comprehenders, and better comprehenders learn more new words from reading texts (Perfetti & Stafura, 2014).

One commonly assumes that both cognitive and linguistic factors have a great impact on reading acquisition. There is general agreement that in the case of alphabetic writing systems the acquisition of literacy involves the rediscovering of the principles of phonological recoding (Ehri, 2005, 2014). In the process of understanding written language, children start out from a limited collection of words that have personal meaning to them. As a next step, they discover the alphabetic principle on the basis of an analysis of familiar words involving their constituent sounds and letters. Phonological recoding can be seen as an inductive learning mechanism on the basis of which children learn to crack the code by mapping letters to sounds, even as phonological mediation remains an obligatory component of lexical access that is routinely activated in advanced reading (see Share, 2004). Given the fact that visual word identification consists of making a familiar phonological form connected to an orthographic form, one can assume that the quality of phonological processing plays an essential role in children's early understanding of the alphabetic principle (Anthony & Francis, 2005).

With regard to basic numeracy skills, children must learn that numbers may refer to nominal, cardinal, and ordinal relations between objects and that number operations allow the addition or subtraction of numbers (Geary, Hamson, & Hoard, 2000). Basic arithmetic involves the addition and subtraction of small numbers (Cowan, Donlan, Newton, & Lloyd, 2005) and a distinction can be made between canonical problem types (i.e., arithmetic problems with small numbers) and more advanced problems (i.e., word problems) (cf. Stanescu-Cosson et al., 2000), and both have a strong link to language representations (Dehaene, Piazza, Pinel, & Cohen, 2003).

For bilingual children, the importance of language in elementary school can hinder their learning. Second-language learners are often behind in vocabulary and grammatical skills, which may complicate second-language reading comprehension processes. Transfer from a first language may have positive effects on the second-language reading process (Hernandez, Li, & MacWhinney, 2005; Verhoeven, 2007). It has indeed been found that positive transfer or overlap with the first language at the level of phonology and orthography may help second-language learners in building up word decoding skills in the second language.

In this Special Issue of the *International Journal of Disability, Development & Education*,[1] a set of eight research-based articles is presented examining the foundations of language, literacy, and numeracy learning in children while taking a cross-cultural perspective. An attempt is made to arrive at greater insight into the basic processes in sustained vocabulary learning, the initial steps in orthographic learning in both first and second languages, the effects of reading skill on inference generation and word learning from text, and the cognitive and linguistic precursors of basic arithmetic skills.

In the opening article, Damhuis, Segers, and Verhoeven go into the long-term effects of explicit versus implicit instruction on the breadth and depth of vocabulary in kindergarten. They follow a pre-test intervention–post-test retention test design with two experimental groups learning sets of words counterbalanced to be taught first explicitly or first implicitly along with a no-treatment control group. They found that the two forms of instruction enhanced broader vocabulary knowledge, and that explicit

instruction also stimulated more in-depth vocabulary knowledge, at post-test and at retention test. Interestingly, in the implicit instruction condition, children with low short-term memory were found to gain more breadth of vocabulary in the short run, but to forget more in the long run, whereas in the explicit condition, verbal short-term memory and vocabulary facilitated vocabulary breadth in the long run.

In the next article, Beyermann and Penke report on an auditory lexical decision experiment examining to what extent orthographic consistency has an impact on German spoken-word processing at different stages of reading development. Second-graders, third-graders, fifth-graders and university students took part in a lexical decision experiment in which spoken monosyllabic words were exposed with either orthographically consistent or inconsistent rimes. They found orthographic consistency to have an impact on spoken-word performances across the varying stages of reading development. The results indicate that from an early stage of reading development, orthographic knowledge and phonological knowledge are highly connected.

In the subsequent article, van Gorp, Segers, and Verhoeven describe the direct, transfer, and retention effects of a repeated reading intervention study of single CVC (consonant in the onset and a vowel and consonant in the rime) words in kindergartners with partial letter knowledge. Following a pre-test intervention–post-test–transfer test–retention test design, children participated in a 10-session intervention in one of two feedback conditions on CVC orthographic word patterns: whole word versus whole word + segmented phonemes feedback. Results showed an equal increase in reading speed and accuracy in the two feedback conditions. Strong transfer and retention effects were also evidenced, which indicates that repeated reading in kindergarten can be seen as an effective method to improve reading speed and reading accuracy on both trained and untrained words.

In the follow-up article, Pasquarella, Deacon, Chen, Commissaire, and Au-Yeung examined the within-language and cross-language relationships between orthographic processing and word reading in French and English across Grades 1 and 2 in French Immersion classrooms. Regression analyses showed that orthographic processing in Grade 1 did not predict word reading in Grade 2, in either language. Instead, within both languages, word reading in Grade 1 predicted orthographic processing in Grade 2. Cross-linguistically, French word reading was a unique predictor of growth in English orthographic processing. Theoretical and practical implications of the relationships between orthographic processing and word reading in bilinguals are discussed.

Next, Carlson, van den Broek, McMaster, Rapp, Bohn-Gettler, Kendeou, and White go into a study examining differences between fourth-grade readers with different levels of comprehension skill when engaging in a causal questioning activity during reading and the varied effects on inference generation. Pupils with different levels of comprehension skill read narrative texts aloud and were asked causal questions at specific points during reading, with their responses being analysed for the types of inferences being made. The results showed no main effect of comprehension skill in terms of readers' text-based inferences made in response to the causal questions. However, readers differed in their use of knowledge-based inferences in response to the causal questions and, in particular, knowledge-based inferences that connected to related text information.

In the next article, de Leeuw, Segers, and Verhoeven focus on how incidental word learning is influenced by context, task, and reader characteristics in fifth-grade students. The effect of words' meanings being inferred from local or global contexts was tested as a function of task (gap filling, inference questions and summary writing in comparison with simple text reading) and reader (vocabulary knowledge, working memory).

Words were found to be better learned in local than global contexts, and better learned in complex reading tasks (inference questions and summary writing) than in simple reading tasks. Vocabulary knowledge was related to overall incidental word learning from text, and working memory to vocabulary gain from answering inference questions. The article concludes that incidental word learning from text is the optimal higher-level task in local contexts, in the case of high vocabulary on the part of the child.

In the following article, Chang, Xu, Perfetti, Zhang, and Chen show that learning to read a second language is especially challenging when a target second language requires learning new graphic forms. An *in vivo* classroom design was followed to extend previous research. The authors hypothesised that learning Chinese characters is enhanced by a grouped sequence of characters that share sub-character graphic components, and that four different encoding methods that have been investigated in laboratory studies—handwriting, visual chunking, passive reading, and stroke-reporting—would yield differential effects. The study found that the grouped approach facilitated character production compared with the distributed approach and that visual-chunking outperformed the other three encoding methods under the grouped sequence.

In the final article, Kleemans, Segers, and Verhoeven focus on the role of both cognitive factors (non-verbal intelligence, working memory) and linguistic factors (phonological awareness, grammatical ability) in basic arithmetic skills (addition and subtraction) in first-language and second-language learners from second-grade classrooms in the Netherlands. They found that the second-language learners scored lower than first-language learners on phonological awareness, grammatical ability, and basic arithmetic skills (i.e., addition and subtraction), but not on non-verbal intelligence and working memory. For both groups, the same precursors applied to the variation in basic arithmetic skills: non-verbal intelligence, working memory, phonological awareness, and grammatical ability. The authors concluded that both cognitive and linguistic factors relate to arithmetic abilities in young first-language and second-language learners.

Note

1. A selection of papers presented at the Sixth European Graduate School on Literacy Acquisition, 25–30 August 2012, Egmond aan Zee, The Netherlands.

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