Kindergarten longitudinal study: Factor analysis and prediction findings

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Goal 1: **Understanding the components underlying early literacy and numeracy ability in order to develop a screening test for children at risk in kindergarten.**

The aim of the current analysis was to identify the main skills that represent early literacy and numeracy, according to the many measures performed by the children in kindergarten. This analysis was done on the whole sample (1082 children). This was obtained by conducting principal component analysis with varimax rotation on the measures of emergent academic achievements separately for literacy and math.

All literacy measures included in the factor analysis, shown in Table 1, yielded three major factors: oral-language knowledge (factor 1), phonological awareness (factor 2), and alphabetic and orthographic knowledge (factor 3). The first factor, including vocabulary, non-word derivation, and word consequential production (verbs and adjectives) measures, accounted for 28.66% of the variance. The second factor, including first and last consonant isolation measures, accounted for 21.62% of the variance. The third factor, including word recognition, letter naming, and identification measures, accounted for 20.66% of the variance. These three factors accounted in total for 70% of the variance.

All math measures included in the factor analysis, reported in Table 2, yielded three major factors: numbering competence (factor 1), numerical relations (factor 2), and arithmetic operations (factor 3). The first factor, which comprised number naming and counting (forward and backward), accounted for 26.29% of the variance. The second factor, which included arithmetic facts calculation and arithmetic story problems solving measures, accounted for 23.60% of the variance. The third factor, which included magnitude comparison (symbolic and non-symbolic) measures, accounted for 19.70% of the variance. These three factors accounted in total for 69% of the variance.

Table 1: Principal component factor analysis with varimax rotation: factor loadings of the early literacy measures

	Component		
	Factor 1: Oral-language knowledge	Factor 2: Phonological awareness	Factor 3: Alphabetic and orthographic knowledge
Letter naming			.899
Letter identification			.891
Word recognition			.660
Plural	.819		
Nonword derivation task (SHALAZ)	.563		
Vocabulary	.815		
Consequential verb production	.810		
Consequential adjective production	.809		
Last consonant isolation (CVC)		.729	
First consonant isolation (CCVC)		.868	
First consonant isolation (CVC)		.850	

Table 2: Principal component factor analysis with varimax rotation: Factor loadings of the early numeracy tests

	Component		
	Factor 1: Numbering competence	Factor 2: Numerical relations	Factor 3: Arithmetic operations
Number naming	.580		
Ascending counting	.837		
Descending counting	.811		
Arithmetic facts			.683
Arithmetic story problems			.866
Non-symbolic magnitude comparison		.919	
Symbolic magnitude comparison		.866	

Goal 2: Characterizing the profiles of kindergarten children according to their early academic abilities in order to develop a refined intervention.

Profiles of early academic abilities:

In order to conclude whether specific profiles of early literacy and numeracy skills can be found as early as kindergarten age, the children were divided according to their performance on the different factors of the linguistic and numeric abilities. Based on this analysis, children from the entire sample at the end of kindergarten (1082 children) were divided into groups according to their performance on the early literacy and numeracy skills.

Cutoff point criteria in the low achieving category, in early literacy and numeracy, were determined using cutoff scores below the 25% of the distribution. Alternately, children whose scores were in the top 45% of the early literacy and mathematics measures were defined as typically achieving. These cutoff points created a sample of 674 children with specific profiles.

Accordingly, children were classified into one of four subgroups in accordance with their academic performance: (1) Low mathematics (LM) and low literacy (LL) - 18% of the children, (2) Low mathematical but typical literacy (TL) - 8% of the children, (3) Low literacy (LL) but typical mathematics (TM) - 9% of the children, (4) Typical achieving in mathematics and literacy (TM+TL) - 65% of the children. Bar graphs reflecting the subgroups' standard scores in literacy and math factors are shown in Figure 1.

Figure 1: Academic subgroups' performance in early literacy and math

Academic Subgroups Performance in Early Literacy and Math

Error Bars: 95% CI
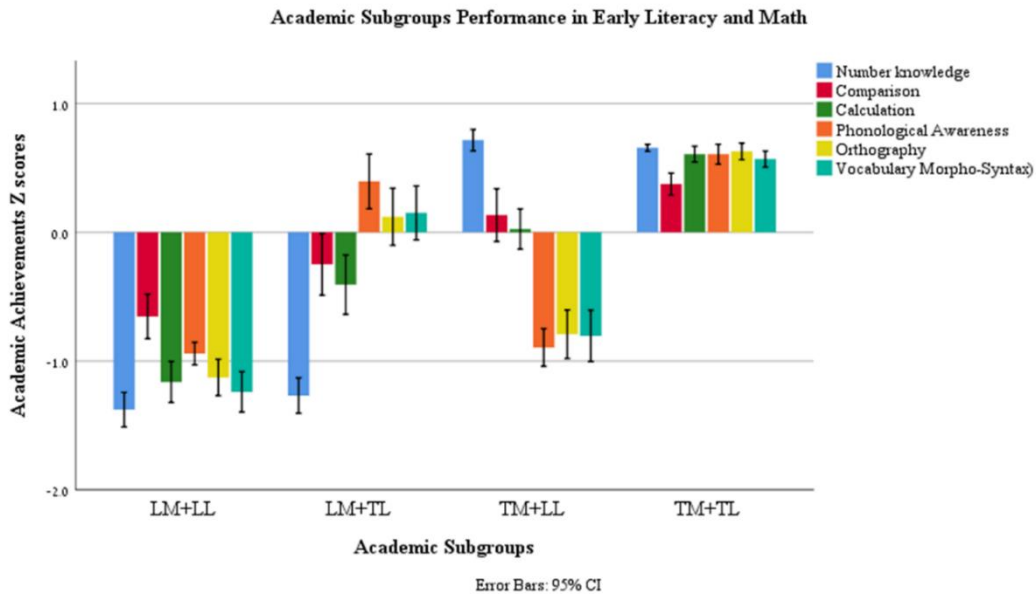
As can be seen from the figure, four distinctive groups can be identified according to early academic profiles in kindergarten. Based on this analysis a mapping tool will be designed, and kindergarten teachers will be given tools enabling them to identify children with difficulties in the different academic domains. Based on these profiles, an intervention will be conducted for each child, so that the children receive the additional support needed according to their abilities. Individual children will thus receive only linguistic, only numeric, or a combined intervention, which will all include cognitive and emotional support as well. This newly acquired knowledge will be transferred via professional developments designed for kindergarten teachers.