

INDUCTIVE REASONING AND EARLY NUMERACY IN KINDERGARTEN: RELATION AND DEVELOPMENT

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Kindergarten age children learn mathematics through their experiences. They use operations of inductive reasoning to solve manipulative tasks of comparison, serialization, classification and finding analogies, thus inductive reasoning could also develop through learning mathematics (English, 2004). In order to develop efficient programs in kindergarten settings to foster reasoning and mathematical skills, there is a need for detailed explorations of the development and relationship between the two constructs (Demetriou et al., 2017). The aim of this study is to analyse the development of inductive reasoning and early numeracy in kindergarten and to examine the relationship between the two constructs in different age cohorts. 252 children participated in the study from 13 kindergartens ($M_{\text{age}}=6.41$, $SD=.52$; males 50.0%). The sample was divided into quartiles based on the age of the children (mean ages were $M=5.7$, 6.2 , 6.6 , 7.0 years, respectively). The inductive reasoning test consisted of 34 items and contained figural series, analogies and classification tasks (Cronbach's $\alpha=.90$; $M=57.1$, $SD=22.6$). The early numeracy test also comprised of 34 items, assessing number word sequence, basic counting and magnitudes as well as numerals (Cronbach's $\alpha=.84$; $M=63.1$, $SD=16.6$). All instruments were online tests, developed and delivered via the eDia platform (Csapó & Molnár, 2017). Data administration was carried out on tablets. In order to familiarize children with the test environment, a tablet use instrument was also administered (we found a ceiling effect: $M=95.1\%$, $SD=7.5$). Age had a significant effect on both constructs (inductive reasoning: $F_{(3, 239)}=7.01$, $p<.01$; early numeracy: $F_{(3, 192)}=3.70$, $p=.013$). However, the post hoc analyses of Tukey's b tests showed that in the case of inductive reasoning only the youngest age cohort differed significantly from the other age cohorts ($M_1=46.0\%$, $M_2=59.8\%$, $M_3=61.1\%$, $M_4=61.2\%$). In the case of early numeracy there was a significant difference between the youngest and the third age cohorts ($M_1=57.4\%$, $M_2=63.0\%$, $M_3=68.8\%$, $M_4=63.0\%$). Medium positive correlation was found between inductive reasoning and early numeracy on sample level ($r=.59$, $p<.01$). Coefficients on different age cohorts were $r=.43$, $.58$, $.63$, $.62$. Based on our results, the development of inductive reasoning has remained unaffected between 6 and 7 years. Early numeracy has developed in the examined age period, however, there is a decline in the oldest age cohort. In this age cohort there are some children older than the suggested school entry age, thus some of them may have been held back because of learning difficulties. Empirical evidence for the positive interdependence of inductive reasoning and early numeracy was provided, and our results indicate that the relation is becoming stronger as a function of age. Our findings highlight the need for more structured instruction for developing thinking skills in kindergarten through mathematics content and in general as well.

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