

DEVELOPMENT OF DYNAMIC PROBLEM SOLVING FROM GRADE 3 TO 9

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The assessment of 21st century skills (Csapó et al., 2012) has to provide students with an opportunity to demonstrate their skills related to the acquisition and application of knowledge in unknown problem situations. Dynamic problem solving (DPS) is such a cognitive skill (Greiff et al., 2012), needed in today's society, characterized by rapid change. Several studies have been conducted with older students to measure DPS with third generation tests (Greiff et al., 2013), however, only a few examined it from a developmental perspective. The aim of this study is to examine whether students are ready for third generation testing; to outline the developmental trend of DPS estimating the age range when major development takes place, and to locate sensitive periods in which explicit trainings are expected to have the strongest effect.

The samples of the study were drawn from 3rd to 9th grade students of Hungarian primary and secondary schools (N=1,291). The instruments of the studies were computer-based third generation tests of DPS created in accordance with the MicroDYN approach and administered in the eDia platform. First participants had to explore an unfamiliar system and represent their knowledge in a situational model then they had to control the system by reaching given target values. Tests with five different levels of difficulty were constructed that varied by grade. The different tests were connected by common anchor items that allowed the transfer of all results to the same scale. IRT scaling and four-parameter logistic equations were used for the analyses, and coefficient of determination (R^2) was computed to express how well the model described the data. The mean of 9th graders was set to 500 with a standard deviation of 100.

Reliability coefficients ranged between .75 and .87. The logistic curve fitted the empirical data well ($R^2=.98$). The point of inflexion was in grade 6, indicating that a significant turn occurred at this time, namely the speed of development slowed down after grade 6. Across all grades the development of DPS was significant; however, the pace of development was relatively slow, about one fifth of a standard deviation per year. The fastest development (80 points) occurred between grades 5 and 7 on the 500 (100) scale. Thus, this is the most effective time to enhance students' DPS skills. The extrapolation of the fitted logistic curves indicated that substantial development took place before the 3rd grade and some improvement of DPS can also be expected after grade 9. These trends confirm the results on the relatively slow development of thinking skills found in the literature (e.g. Csapó, 1997), suggesting that there is a lack of direct and explicit stimulation of it in schools.

The present study contributes to the issue of assessing 21st century skills by using third generation tests of cross-curricular skills that are inevitable in successful participation in 21st century's Western society.

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