

ONLINE ASSESSMENT OF COMBINATORIAL REASONING AMONG SECOND GRADE STUDENTS

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Combinatorial reasoning is a fundamental thinking process, and plays a central role in scientific reasoning, problem-solving, and creativity (English, 1993; Lockwood, 2013; Wu & Molnár, 2018). To monitor the development of students' combinatorial reasoning, and to carry out evidence-based interventions, easy-to-use assessment instruments are necessary. However, due to their constraints, traditional paper-and-pencil or face-to-face testing cannot be used for regular assessments in everyday school practice in early ages. Computerized testing may offer solutions to these problems (Csapó et al., 2014), especially when scoring constructs is extremely time consuming, as in the case of combinatorial reasoning. The purpose of the present study was to develop an easy-to-use online instrument to assess combinatorial reasoning in the first phase of elementary school, and to analyze its usability in a classroom context. Participants were 3315 second grade students (mean age=8.8 years, SD=0.5 years); altogether 173 classes from 107 primary schools were involved. An online instrument based on the digitized version of a former curriculum independent paper-and-pencil test was developed (Csapó, 1988). It contained 9 items covering different operations of combinatorial reasoning processes. Students solved the test delivered via the eDia platform in their schools' ICT rooms. Students listened to pre-recorded voice instructions via headsets, and completed the tasks by moving objects on the screen using the drag-and-drop function. Scoring was automated by applying a formula which took into account the number of correct, redundant, and wrong constructs; immediate feedback was provided at the end of testing. The reliability of the test was good, Cronbach's $\alpha=.83$. The corrected item-total correlations were also sufficient, the values ranged between .35 and .63. The mean of student achievement was 51.8%, thus the difficulty of the test was ideal for the targeted age cohort. Standard deviation was 21.2%, which implied that the tasks had sufficient differentiating power to reveal individual differences. The tendency for bimodal distribution may indicate that students used different strategies according to their level of cognitive development. Most of the students were able to complete the test within one 45-minute school lesson (M=21.8 min, SD=8.0 min). Only 28 students (0.84%) failed to complete the test within the allocated time frame. In sum, the online instrument proved to be reliable, the psychometric properties of the test were good. Due to the advantages of online delivery, that is, automated scoring and immediate feedback, this test may be used for diagnostic purposes in an everyday school context in the first grades of elementary school. Further studies should explore the applicability of the instrument in younger age cohorts, while log file data analysis would help to gain a deeper understanding of the nature of combinatorial reasoning processes.

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