COMPUTER GRAPHICS TRAINING OF SPATIAL ABILITY WITH DIRECT MANIPULATION

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Computer graphics with the possibility of direct (user-controlled) manipulation can visualise or simulate mental operations required for solving problems by describing the various aspects of spatial abilities. We shall base our investigation on the so-called "pictoralistic thesis", which states that mental image processing operations are based, among others, on the visual experience of objects and object manipulations. The reseach problems are: How should a learning software be structured to support the process of solving item-like spatial perception problems by user-controlled direct manipulations? (Software development problem) How effective is user-controlled direct manipulation in computer-supported solving of item-like spatial perception training problems as compared to the conventional way of solving such problems in printed form, which relies on mental operations only, or compared to a combination comprising of computerised and pencil-and-paper item-like problems which are presented consecutively? (Software evaluation problem)

The development of the modular training program "Fold –Rotate – Tilt – Cut" was based on corresponding standardised tests, which fit to certain facettes of spatial ability. This will provide suitable criteria for analysing the effectiveness of our training software.

The main results from an investigation using a control group design with about eighty 9-graders per treatment, which is first completed for the modules Fold and Rotate: All the treatments are of significant efficiency. The module Fold and it's combination with paper and pencil tasks are equally effective, but these two treatments are significantly more efficient than the treatment paper and pencil tasks. The treatments module Rotate and paper and pencil tasks are equally efficient, but the combination of module Rotate with paper and pencil tasks is more efficient than these two treatments etc. These results have corresponding interpretations ...

References:

Clemens, H. D. , Battista M. T. (1992). Geometry and Spatial Reasoning. In: Grouws, D. A. (1992). Handbook of Research on Mathematics Teaching and Learning. New York: Simon & Schuster Macmillan, p. 420-464

Maier, P.H. (1999). Räumliches Vorstellungsvermögen (Spatial Ability). Donauwörth: Auer

Schumann, H. (1998). Development and Evaluation of a Computer Represented Spatial Ability Test. Proceedings of the 22nd International Conference for the Psychology of Mathematics Education (PME 22), South Africa (July 12th – 17th 1998). Editors: Olivier, A. and Newstead, K., University of Stellenbosch, Volume 4, p. 302

Schumann, H., Alavidze, T. (2002). Falten – Rotieren – Kippen – Schneiden (Fold –Rotate – Tilt – Cut). Übungsprogramm für das Training der Raumvorstellung (Practice Program for Training Spatial Ability). Beta-Version, University of Education Weingarten