ABSTRACT

VISUAL THINKING NETWORKING PROMOTES LONG TERM MEANINGFUL LEARNING AND ACHIEVEMENT FOR 9TH GRADE EARTH SCIENCE STUDENTS

An experimental and interview-based design was used to test the efficacy of visual thinking networking (VTN), a new generation of metacognitive learning strategies. Students constructed network diagrams using semantic and figural elements to represent knowledge relationships. The findings indicated the importance of using color in VTN strategies. The use of color promoted the encoding and reconstruction of earth science knowledge in memory and enhanced higher order thinking skills of problem solving.

Fifty-six ninth grade earth science students (13-15 years of age) in a suburban school district outside New York City were randomly assigned to three classes with the same instructor. Five major positive findings emerged in the areas of problem solving achievement, organization of knowledge in memory, problem solving strategy dimensionality, conceptual understanding, and gender differences.

A multi-covariate analysis was conducted on the pre-post gain scores of the AGI/NSTA Earth Science Examination (Part 1). Students who used the color VTN strategies had a significantly higher mean gain score on the problem solving criterion test items than students who used the black/white VTN ($p = .003$) and the writing strategies for learning science ($p < .001$). During a think-out-loud problem solving interview, students who used the color VTN strategies: (1) significantly recalled more earth science knowledge than students who used the black/white VTN ($p = .021$) and the writing strategies ($p < .001$); (2) significantly recalled more interrelated earth science knowledge than students who used black/white VTN strategies ($p = .048$) and the writing strategy ($p < .001$); (3) significantly used a greater number of action verbs than students who used the writing strategy ($p = .033$). Students with low abstract reasoning aptitude who used the color VTNs had a significantly higher mean number of conceptually accurate propositions than students who used the black/white VTN ($p = .018$) and the writing strategies ($p = .010$). Gender influenced the choice of VTN strategy. Females used significantly more color VTN strategies, while males used predominately black/white VTN strategies ($p = .01$).

A neurocognitive model, the encoding activation theory of the anterior cingulate (ENACT-AC), is proposed as an explanation for these findings.