

This is the Preprint of H.A. Cohen and D.G. Green, *Evaluation of the Cognitive Goals of Ozna ki: Enhancement of Spatial Projective Abilities*, in : "ACM Topics in Instructional Computing", A.M. Wildberger and R.G. Montanelli. eds., SIGCUE (Special Interest Group in Computers in Education) of the ACM (Association for Computer Machinery, New York, 19 78, pp 69-90.

4.5 CONCLUSION

In a course of just eight lessons with OZNAKI, children have demonstrated pronounced improvement in projection. In spatial tasks generally the comparative improvements were sufficiently consistent that, despite the small sample sizes involved (22 or 27 an each of the various distinct groups), statistical analysis confirms that good results can be achieved with such short exposure to OZNAKI highlights the importance of the Projection Module as a paradigm for the development of other courses of instruction involving computer embodiment of mathematics. In all phases, the hardware/software and the lesson structure, the module was designed with definite cognitive goals in mind. Having definite objectives, it was possible to measure effectiveness in reaching these objectives.

Where does the OZNAKI Project go from here? Other teaching modules have been conceived to include such topics as properties of number, ideas of algebra, permutations, lattices, symmetry, patterns, and tune blocks. For such modules, the experiments described in this paper give a model for evaluation. In addition it would be desirable to conduct further studies on students who have had considerable involvement an OZNAKI.

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APPENDIX

SYLLABUS OF THE PROJECTION MODULE

LESSON 1

- (a) Introduction to RIZARD'S BOX, ZONKY, and the symbol/command idea.
- (b) Pupils take turns at imitating the NAKI while the others guide them around obstacles. They are taught to repeat this game whenever they have trouble Working out directions for ZONKY etc.
- (c) Guiding ZONKY around an obstacle course, giving it as many commands at one time as possible.

LESSON 2

- (a) Students teach each other how to "walk around the table" (knowing initially how to go forward, back, right, and left only).
- (b) Discussion on how we learn: the pupils are shown how they translate a simple parental command, such as "get up and go to school" into a complex series of learned routines (e.g. dressing, having breakfast).
- (c) Teaching ZONKY how to draw closed figures.

LESSON 3

- (a) Pattern-drawing with ZONKY (polygons, circle). Attention is given to the relation between the commands given and the path ZONKY draws, emphasizing that patterns always result from repetition of the basic algorithm "forward and turn". They discover, in the process, that the smaller the turn on each repetition, the greater is the number of sides in the resulting polygon - thus showing a circle to be like a polygon with many sides - and that increasing the step length on repetitions of an algorithm produces a spiral.
- (b) Creating new patterns by altering existing routines (e.g. zig-zag).

LESSON 4

- (a) Music with ZONKY: creating rhythms and simple tunes.
- (b) Drawing simple patterns on the screen with OZ: e.g. Xmas tree.
- (c) Problems involving music and screen drawing.

LESSON 5

- (a) Running mazes with WHAM. One command at a time. Two. Three. As many as possible before the <Do<It>.
- (b) Use of macros.

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LESSON 6

- (a) Pattern-drawing with WHAM (squares, crosses, squirrel etc) involving iteration of just one macro command.
- (b) Introduction to WHAM calculator. Simple numeric algorithms.

LESSON 7

- (a) Discussion on the problem-solving methods learnt and their application to other activities. These methods include the "divide and conquer" approach to complex problems and the "debugging" concept.
- (b) Introduction to LIFE.
- (c) Drawing elementary LIFE patterns (e.g. line, glider).

LESSON 8

- (a) Harder patterns in LIFE (e.g the glider gun).
- (b) Students experiment with their own s complex patterns). patterns..
- (c) Revision of the whole course with selected problem and challenge mini-projects (i.e. drawing complex patterns)

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