Visual Perception Skills Testing: Preliminary Results

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ABSTRACT

Good visual perception skills are important in the effective manipulation of Tangible User Interfaces. This paper reports on the application of a test set we have developed specifically to quantify the visual perception skills of children when matching a physical object to its flat representation on paper. A pilot evaluation, with two groups of children from differing socio-economic backgrounds, was conducted to quantify their ability to make the mental transformation from tangible objects to the drawings that represent those objects. Our test instrument is described. We found a marked difference between the two groups in their ability to make the transformation.

Keywords TUI, RockBlocks, Tangible Programming Environment, Visual Perception.

INTRODUCTION

Township schools in South Africa do not provide children with good visualization skills [3]. Visualization skills are required to successfully use portable Tangible User Interfaces (TUI's) like RockBlocks [2] and GameBlocks [4] when constructing Tangible Programme sequences.

We devised a test set to compare the visualization skills of children from affluent suburban areas to that of children from townships. The specific visualization skill tested is a child's ability to map a 3D object to its 2D representation [3]. We piloted the test set at two schools in South Africa. Both schools practice the Montessori Method [1] of early-childhood schooling. School A is situated in an affluent suburb in the city of Pretoria. School B serves a township and is located approximately 70 km distant from School A.

The ages of the subjects varied between five and six years.

METHOD

The group of testers consisted of two males and one female. Tasks of giving instruction, taking notes, and taking photos were divided among the testers. The two pre-school care centers were identified and contacted to obtain informed consent for our tests. The two subject groups, of mixed gender, consisted of 10 children from School A and 16 children from School B. Instructions were given in English, being the medium of instruction at both schools. If needed, the instructions were also given in the testee's mother tongue, for instance the Sepedi language.
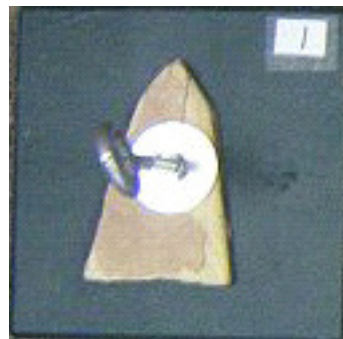
Figure 1: Top view of a TUI (Rock#1) used in the tests. Soft rock has been shaped into an arrow and mounted on painted wood using a galvanized bolt with a ring at the end. It is marked '1' to distinguish it from the other three TUI's.

Each testee completed the test set, comprising of four tests, sequentially. Test subjects were not informed what the correct answer to each test was. The tests were conducted with only one test subject in the room.
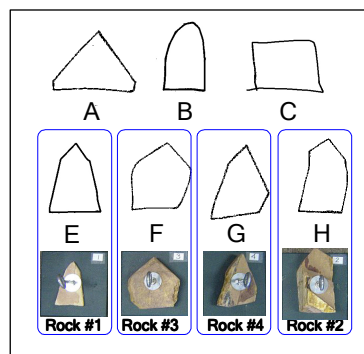
Figure 2: Images on paper of fictitious objects (top).

The 3D objects used in the tests and their representations (bottom).

In each test, four RockBlock TUI's (Figure 2, bottom) are used as the 3D test objects. Seven drawings on A4 paper sheets are the 2D objects. Of these seven drawings, four (Figure 2, EFGH) respectively represent the TUI's Rock#1,3,4,2. The other three drawings (Figure 2, ABC) do not represent any 3D object in the test. The sheets are placed on the floor in a matrix of four rows with four drawings (Figure 3) in each row. A row consists of the complete set of three drawings

{ABC} and one drawing in the set {EFGH}. Each row corresponds to a test as indicated.

Instructions given were to find a single 3D object which best matched any single drawing in the applicable row. Answers were indicated by placing the chosen object onto the chosen drawing. For each test, the same set of four 3D objects was placed above the appropriate row of drawings. After each test, the test instructor moved the four 3D objects to the next row. Special attention was paid to the positioning and orientation of the 3D objects so as to appear random.
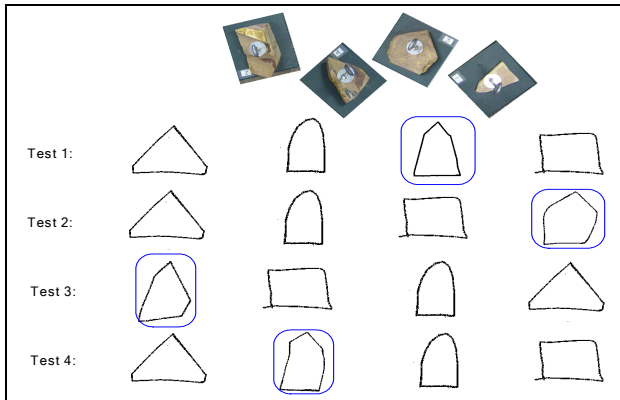

Figure 3: Physical configuration of the four tests. Blue outlines indicate the correct answers.

RESULTS

School A always performed better than School B (Figure 4). Except for one instance, all individuals from School A performed as well or better than individuals from School B (Figure 5). Half of the testees from School A had an average score of 100% (*), with no testee scoring less than 50%. In the case of School B, 38% of the testees had an average score of 0% (**) with no testee having an average score of more than 75% (***). Results from School A have a median of 75%, and standard deviation of 30%. For School B these values are 25% and 24% respectively.

DISCUSSION and CONCLUSIONS

In South Africa there is a significant difference in the daily activities of children from differing socio-economic backgrounds. Typically, children attending School A interact mostly with electronic technology and books, both presenting information in a 2D format. In contrast, children from School B interact mostly with 3D environments by playing outdoors and climbing trees.

This pilot study indicates that there is a difference between the initial visualization abilities of the two tested groups. However, this difference diminished as the tests progressed (Figure 4). A possible explanation is that children from School B became accustomed to the 2D representations, and children from School A became over-confident and less meticulous.

It can be expected that differing visual perception skills will manifest as differing performance levels when children participate in Tangible Programming Environments. A solution could be the development of TUI's that are not sensitive to varying levels of visual perception skills. Further tests are planned to affirm the findings of this pilot.
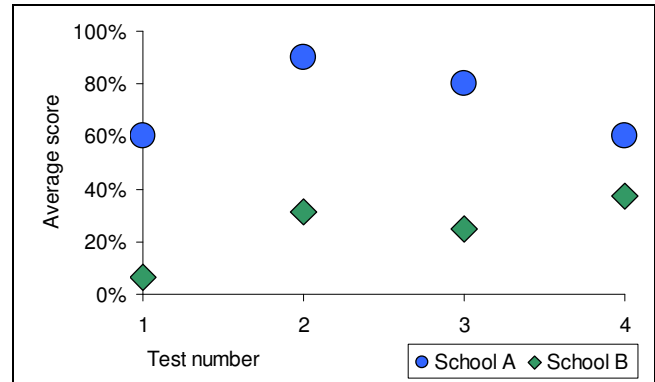
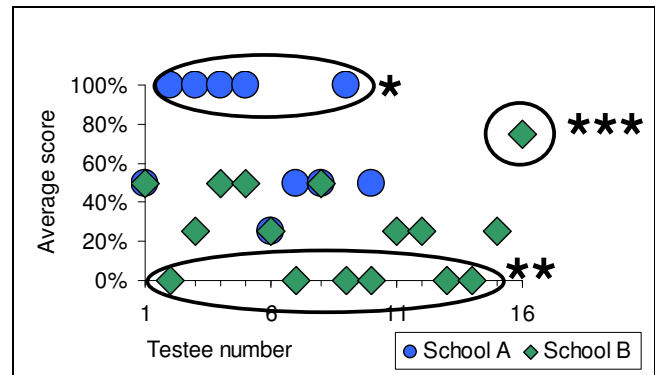

Figure 4: Average score for each of the groups, per test.

Figure 5: Average score of all tests, per testee.

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