The use of VR technology in the assessment of applicants to graduate schools of architecture

Guillermo Vasquez de Velasco, Kameshwari Viswanadha

Department of Architecture, Texas A&M University, United States of America

vasquez@archone.tamu.edu, v_kameshwari@yahoo.com

Schools of architecture in North, Central and South America offer admissions on the basis of grade point average and standardized exams on academic aptitude. These indicators may describe the aptitude of students as far as general academic performance is concerned but are limited on describing the creative potential of the applicant. The authors of this paper question this practice and suggest the development of a 3-dimensional environment for the assessment of the creative aptitude of future students. The paper also describes the implementation of a prototype of the testing environment and subsequent experimentation.

VRML, cognition, skills, testing, admissions

Current practice

Schools of architecture offer admission based on a score system that combines their grade point average (GPA) and standardized testing results. We have searched for a relationship between design studio performance in graduate school and the GRE scores of our students. The results have failed to confirm a relationship. We have also tested the relationship between high GPA in undergraduate programs and high performance in graduate studios. Once more the results are not conclusive on showing a reliable relationship. Our observations suggest that a good student in general is not necessarily a good design student.

At graduate level the challenge of assessing the potential of an applicant is critical. Graduate programs are smaller than their undergraduate counterparts and therefore we cannot afford to offer admission to students that will weed themselves out of the program after a first semester or the first year of studies. For instance, in the case of the Master of Architecture Program at Texas A&M University, we offer 48 admissions every fall semester and look forward to the graduation of at least 45 students every year. The margin for attrition is very limited. Further more, some of the students admitted will be offered financial awards that may amount up to $30,000 and it is certainly embarrassing for admission officers when a student holding a financial award delivers a poor design studio performance.

Development of an on-line, VRML testing environment

Clements and Battista (1992) define spatial ability as consisting of “cognitive processes by which mental representations for spatial objects, relationships, and transformations are constructed and manipulated”.

The American Psychological Association (APA) offers guidelines for the search and development of psychological tests. However, all of these make reference to tests delivered making use of 2-dimensional media or 3-dimensional objects. The most common methods of assessing spatial ability are based on the following tests: Surface Development, Block Rotation, Perspectives, and Visual Memory. These are generic tests.

Galen Buckwalter and others (1999) suggest that tests of spatial rotation ability that are administered in a Virtual Reality environment may prove to be a superior method of assessing spatial cognition.

With our current ability to simulate 3-dimensional space by means of VRML code and growing ability to deliver such simulations by means of immersive environments, it is evident that we can potentially improve the way we test for spatial ability. In such a framework, we are interested in the development of a VRML-based test environment that may be administered on-line to students that apply for admission to Master of Architecture Programs as an additional factor of assessment in the process of admissions.

In 2001, within the Master of Science in Architecture at Texas A&M University, Kameshwari Viswanadha developed a prototype of such a testing environment. The Digital Charrette (Viswanadha, 2001) was a VRML-based testing application that could be delivered via the Internet and was able to address 4 tests, namely: identify viewpoints, volumetric subtraction, volumetric addition, and the creation of a positive model with a negative reference.

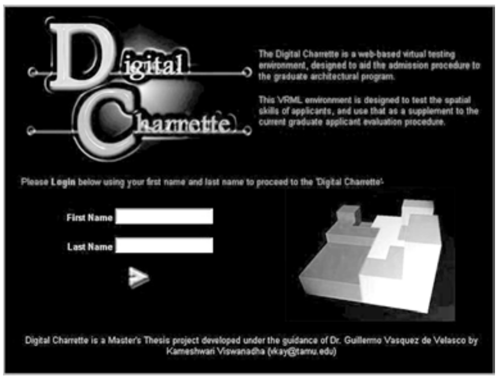


Figure 1. Login into the Digital Charrette

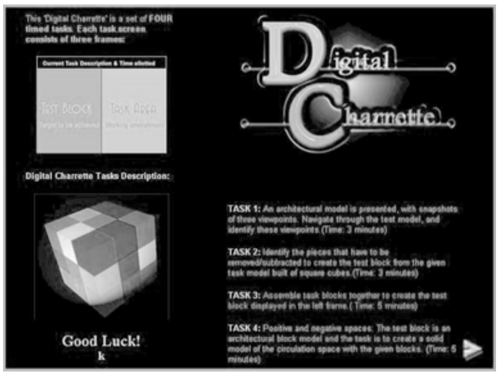
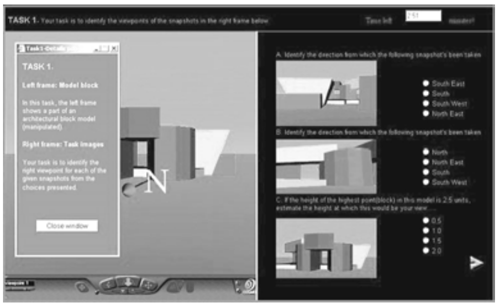


Figure 2. Task Description

Task 1: Identifying viewpoints for a VRML model (Time allotted- 3 minutes)

The first task involved examination of an architectural block model (manipulated to increase complexity). The subject's challenge was to identify the viewpoint for each of three given snapshots of the model.

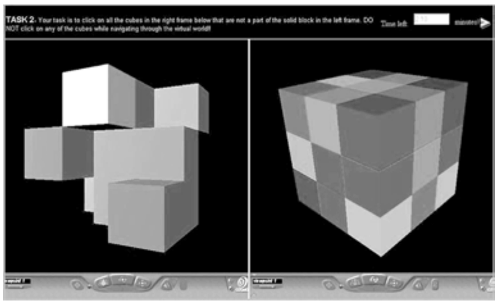


These were multiple-choice questions, with four choices for each question.

The first two questions involved identifying the direction from which the view was perceived (North direction was presented in the architectural model). The last question required identification of the relative height of the viewpoint from ground level (Value of the highest point in the model).

Figure 3. Task One: Identifying viewpoints in a VRML model

Task 2: Subtractive task (Time allotted- 3 minutes)



The subject was presented with a monochromatic model block A and a task block B constructed with multicolored building blocks. The subjects had to identify the elements to be deducted from the segmented task block B, so that it was identical to the model block A. This was a subtractive task. There was an anchor element in the model block identical to one in the segmented task block to help the subjects establish their reference point in the virtual environment.

Figure 4. Task Two: Subtractive task

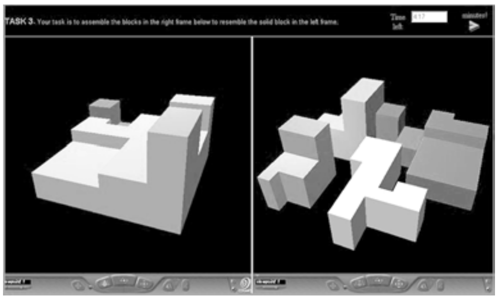


Figure 5: Task Three: Additive task

Task 3: Additive task (Time allotted- 3 minutes)

The third task involved putting together five task blocks, which upon assembly would be identical to the model block. There is an immovable anchor element in this task, similar to task two, which gives the subjects a reference point in the VRML environment.

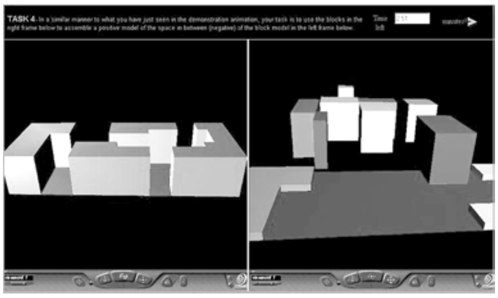


Figure 6. Task Four: Positive model of negative space

Task 4: Creating positive model with a negative reference (Time allotted- 5 minutes)

The subject involved visualization of the negative space within the model block, and building a positive model of the same with the task blocks provided. This task is modeled more closely to reflect an architectural context.

Experimentation

In late 2001 the Digital Charrette was tested among a small number of graduate students of architecture and a positive relationship was found between their performance in the VRML-based test and their design studio grades. These are preliminary results that point towards a positive potential that should be subject of further study.

The study population was restricted to senior undergraduate students, taking the Summer 2001 design studio, at the Department of Architecture, Texas A&M University. In the evaluation that took about 45 minutes, the subjects first completed a pre-task questionnaire. The testing began with a practice session in which the subjects could learn to manipulate objects and move through a VRML world. The subjects then logged in and worked on the four timed tasks within the Digital Charrette. Finally, they submitted their reactions to their experience with the Digital Charrette on a post-task questionnaire.

Six out of 13 subjects were able to solve Task 1-a, 1-b and Task 3; 2 out of 13 accomplished Task 1-c; 1 out of 13 finished Task 2; and none of the participants were able to accomplish Task 4.

The scores of the students on these exercises were compared to their previous design studio performance at the end of the Spring 2001 semester. The design studio grade data was collected from the subjects on a voluntary basis for use in this analysis.

The hypothesis that the performance of the subjects would be reflected in their design studio grades was proved true. A positive relation was found between the Digital Charrette scores of the subjects and the design studio grades. However, the reverse was not found to be true. Subjects who had high design studio grades did not necessarily perform well on the Digital Charrette tasks.

The performance of the subjects on the Digital Charrette tasks showed no dependency on either experience with digital games, experience with VRML or experience with 3D modeling & other architectural software.

The study population perceived the Digital Charrette as a good evaluator of their spatial skills. In the detailed feedback section of the post-task questionnaire, all 13 subjects included positive comments on the overall prototype concept and implementation. The study population seemed confident of being able to perform better if they were more experienced with the VRML environment. Most of the subjects had positive comments on the interface & navigation design. The four tasks address concepts that should be a part of any architecture student's set of skills.

Conclusions

It is possible to create a 3-dimensional VRML environment containing tasks that may challenge our special abilities. Such an environment can be easily served through the Internet and can be utilized with considerable level of transparency by individuals without previous experience on the use of VRML environments. In any case it is advisable to inform test-takers about the fundamental hardware, software and network specifications that are desirable and provide them with an open-ended period of time to get acquainted with the nature of the VRML testing environment.

We have observed a direct relation between good performance in the test and good performance in design studios. At the same time we have not been able to observe a direct relation between poor performance in the test and low studio grades. It is possible that students with poor performance in the test manage to obtain good studio grades based on hard work and not because of their spatial abilities. This possibility needs to be further studied.

Based on our observations it appears to be feasible and fair the inclusion of an on-line, VRML test of spatial abilities as part of the application requirements for schools of architecture. As in the case of any other singular performance indicator, this should not be the only criterion used in the assessment of an applicant.

More research is required in order to further identify the level of reliability of the test in measuring spatial abilities and the impact that such abilities have in design studio performance.

Referencias

Buckwalter G.J. et al : 1999, The Use of Virtual Reality in the Assessment of Spatial Skills. International Conference of Neuropsychology on the Internet [on-line]. [cited 3 February 2001] Available from: <http://www.uninet.edu/union99/congress/confs/val/01Galen.html>

Clements, D.H., and Battista, M.T. (1992). T*he development of a Logo-based elementary school geometry curriculum (Final Report)*. NSF Grant No.: MDR–8651668. Buffalo, NY/Kent, OH: State University of New York at Buffalo/Kent State University.

Viswanadha, K. : 2001, Digital Charrette: *A Web Based Tool to Supplement the Admission Procedure to Graduate Architectural Degree Programs,* Master of Science in Architecture Thesis, Texas A&M University, College Station