A Situated Learning Model Using Immersive Virtual Environment in Design Education

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Abstract

Although the Studio course serves as the core learning environment of Architectural education, there is no clear understanding how architectural knowledge is gained and can be assessed for the purpose of further improvement. This paper suggests a model for examining 'Telos' ('learning direction') in Architectural Education. The 'Telos' is structured by Knowledge Construction Actions (KCA) units that represent the learner's decisions that were brought to the learning session, or what is termed "Crit". These assumptions were tested in the physical domain of an Immersive Virtual Environment (IVE) that provides the learners a virtual 'presence' of their design in full-scale view, which, to the author's claim, contribute in promoting students' comprehension. Once defined, KCA can be assessed and provide the 'Telos' structure thus serve as a basis for assessing student's progress and contribute to learning environment's improvement. IVE was provided in a classroom equipped with a 2.4 x 7.0 m screen with a 75° edge-free field of view and body movement tracking cameras. The research observed a Studio Course that used IVE and the Studio class. Crits were followed by means of observations, recordings and documentations. Results revealed IVE provided high KCA activity, and contributed to students' skill improvement.

Key words: Immersion, Design education, Learning process, Constructivism**,** Design process

Introduction

Design Education is currently based on the connection between social environment and design activity (de la Harpe et al, 2009; Goldschmidt, 2002; Ochsner, 2000; Oh et al., 2013; Schön, 1987). This model has to overcome communication difficulties, as well as bridging the limitations of the representation tools in use (Goldschmidt, 1991(b); Kalay, 2004, 2006; Oxman, 1999, Oxman, 2008; Purcell and Gero, 1998; Schön and Wiggins, 1992; Suwa and Tversky, 1997; Reffat 2002; Zeisel, 2006). This study adds the physical settings of the learning environment to this model. Figure 1 demonstrates this approach and objective by defining the Architectural Learning 'Telos' as a situated active process that stands in direct and inseparable relation to its components.

The author was greatly inspired by the definition of the Constructivist learning 'Telos'

("learning direction") (Lave, 1996), that defines knowledge as an active process, personally constructed in direct relation to his social learning environment. This environment, known as the learner's "Community of Practice" (CP) (Lave & Wegner, 1991) encourages diverse learning directions. Architectural education also supports these principles, by offering the students a shared learning model at the Studio classroom. This research depicts the Architectural 'Telos' that was created in the physical domain of an Immersive Virtual Environment (IVE) and the traditional Studio, showing the impact of the learning environment on the learning process.

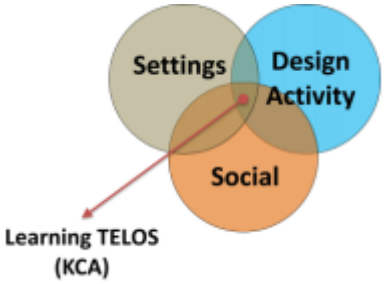

Figure 1. Learning Telos.

IVE's settings correspond with Slater et al.'s definition for IVE (1995) by providing a virtual 'walk' at the design product in real-scale and embodied perception. Since the architectural product is perceived solely post its construction, the design process occurs over scaled and mostly static representation. However, built environments surround the user and are dynamically perceived by all of the senses. Yet, in a course of Architectural Education, since the student's project is never realized, his spatial perception and thus, knowledge acquisition are limited. This study claims that IVE has potential to overcome this limitation by affording students virtual "presence" in their non-built environments, and thus offering them a richer experience and understanding of their design products.

Methodology

The research aims for a definition of the Architectural Learning 'Telos' as a situated process, hence, suggests a 'Telos' approach that is structured by units of Knowledge Construction Actions (KCA) (Sopher, 2015). Each KCA unit has its own pattern of action (Figure 2) and data arriving from the three domains: (a) The physical settings; (b) The social environment; (c) Design activity. Crit sessions serve as the encounter points for the 'Telos' domains. Settings contain all physical conditions, such as physical classroom conditions, representation tools and observation mode used during the crit. The Social Domain contains all participants" remarks. Design Activity contains student's perceptual and reasoning capacities.

The pattern of Actions was defined in two categories: (a) Strategic actions - in which a change occurs in the theory in use (Argiris and Schön, 1978 in Chatti, 2013); (b) Methodic actions - in which the designed form is reshaped, including: shift, connection, integration and reaction.

Figure 2. KCA Pattern

The research adapted Dreyfus & Dreyfus (1980) scale of skill acquisition relating to the student's perception of changes expressed in the learner's design product. The skill level was determined by the student's ability to recognize similarities and saliences in his design.

Case Study

The research observed a novel Studio course in the Faculty of Architecture and Town Planning at the Technion, Israel, instructed by professor Fisher-Gewirtzman that used IVE as part of their educational environment (Figures 3, 4). Crit sessions were alternately held at the Studio and the Visualization laboratory's IVE (VisLab). Four design projects were followed by means of observations, recordings and documentations of the design products presented at each crit session. Protocol and Design analysis were used for retrieving students' KCA patterns. These patterns were assessed quantitatively determining their frequency during the course.

Figure 3. Studio crit.

Figure 4. IVE crit

Interviews provided feedback of the participants' impressions and personal experience of the course structure and IVE.

Results

KCA Patterns

Each project's frequency of KCA patterns was viewed according to their appearance in the learning environment (figure 5, Table 3.1). KCA assessment provided a higher elaboration of KCA patterns by students who were using IVE Crit. The highest KCA methodic pattern-'Reaction' frequency was achieved after IVE crits, reflecting this environment's significant affordance in providing feedback and stimulation to the student.

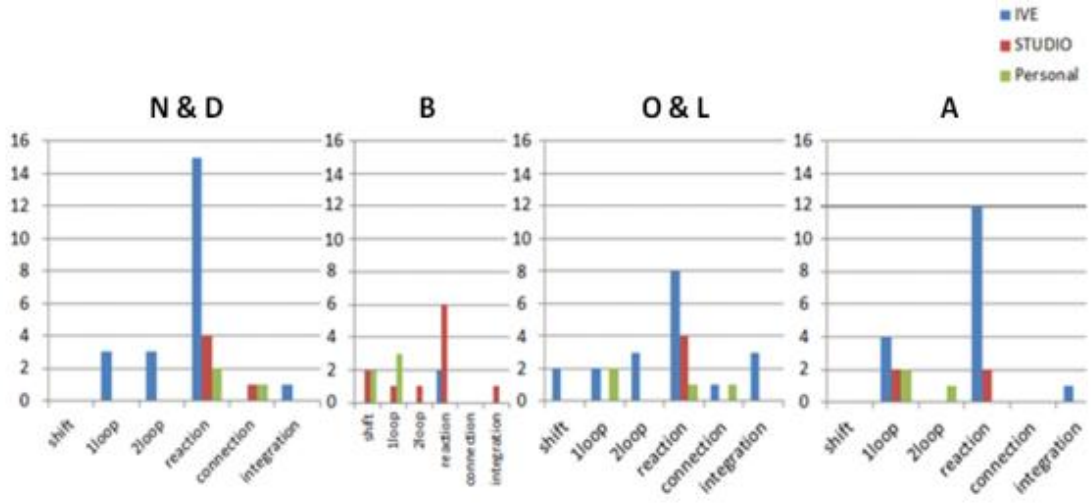

Figure 5. KCA frequency in the learning environment

Table 3.1. Idea manipulation KCA frequency within learning environment

KCA	IVE	Personal	Studio
Shift	33.33%	33.33%	33.33%
Reaction	66.07%	5.35%	28.57%
Connection	25%	50%	25%
Integration	83.33%	0%	16.66%

Skill Levels

Results in figure 6 show that in most cases, an increase in the skill level occurred following the VisLab crit.

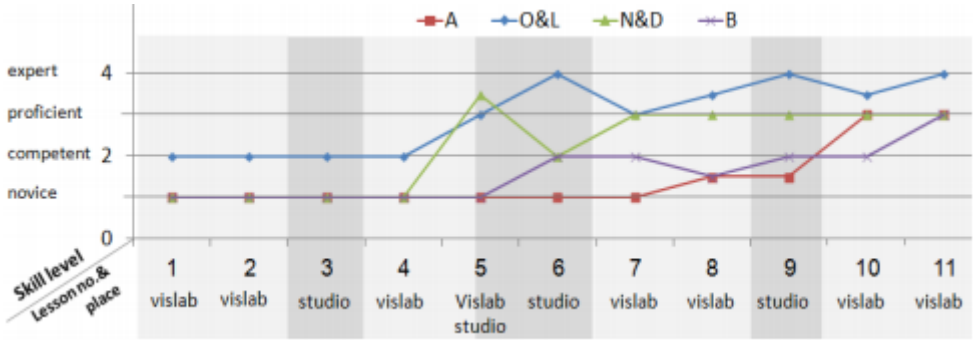

Figure 6. Skill acquisition levels

Conclusions

A significant and innovative conclusion arising from this research suggests KCA unit as a methodical framework for the examination of the learning 'Telos'. The theoretical and methodological design of this research enabled understanding the process and structure of Architectural knowledge acquisition as a situated activity, that can be assessed and contribute to a more accurate creation of an Architectural curriculum.

Although this research was performed on a small scale, it nevertheless provides positive evidence that IVE enhances diverse architectural learning 'Telos', by

strengthening knowledge acquisition in providing improved feedback, reflective thinking opportunities and peer involvement.

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References

Chatti, M.A. (2013). The LaaN Theory, in Downes S, Siemens G& Kop R (Eds.), Personal learning environments, networks, and knowledge. Retrieved from www.elearn.rwth-aachen.de/dl1151|Mohamed_ Chatti_LaaN_preprint.pdf

Dede, C., Clarke, J., Ketelhut, D. J., Nelson, B., & Bowman, C. (2005, April). Students' motivation and learning of science in a multi-user virtual environment. In *American Educational Research Association Conference, Montreal, Canada*.

De La Harpe, B., Peterson, J. F., Frankham, N., Zehner, R., Neale, D., Musgrave, E., & McDermott, R. (2009). Assessment focus in studio: What is most prominent in architecture, art and design?. *International Journal of Art & Design Education*, *28*(1), 37-51.

Dreyfus S. E. & Dreyfus, H. L. (1980) A five stage model of the mental activities involved in directed skill acquisition, University of California Berkeley (Unpublished report)

Gibson, J. J. (1978). The ecological approach to the visual perception of pictures. *Leonardo*, 227-235.

Goldschmidt, G. (1991). The dialectics of sketching. *Creativity research journal*, *4*(2), 123-143.

Goldschmidt, G. (2002). One-on-one: A pedagogic base for design instruction in the studio. In *Proceedings of the Design Research Society International Conference* (pp. 430-437).

Kalay, Y. E. (2004). Virtual learning environments. *Journal of Information Technology in Construction*, *9*, 195-207.

Kalay, EY (2004) *Architecture's new media*: *Principles, Theories, and Methods of Computer-Aided design*, MIT Press, USA

Kalay, E.Y (2006): The impact of information technology on design methods, products and practice, *Design studies,* 27, pp 357-380

O'Regan, J. K., Myin, E., & Noë, A. (2005). Skill, corporality and alerting capacity in an account of sensory consciousness. *Progress in brain research*,*150*, 55-592.

Lave, J. (1996). Teaching, as learning, in practice. *Mind, culture, and activity*,*3*(3), 149-164.

Lave, J and Wenger, E (1991) *Situated learning, legitimate peripheral participation*, Cambridge University press

Oh, Y., Ishizaki, S., Gross, M. D., & Do, E. Y. L. (2013). A theoretical framework of design critiquing in architecture studios. *Design Studies*, *34*(3), 302-325.

Ochsner, J. K. (2000). Behind the mask: a psychoanalytic perspective on interaction in the design studio. *Journal of Architectural Education*, *53*(4), 194-206.

Oxman, R. (1999). Educating the designerly thinker. *design Studies*, *20*(2), 105-122.

Oxman, R (2008). Digital architecture as a challenge for design pedagogy, *Design studies*, 29, 99-120

Pessoa, L., Thompson, E., and Noë, A (1998). Finding out about filling-in: A guide to perceptual completion for visual science and the philosophy of perception**,** *Behavioral and brain sciences*, *21*, 723–802

Purcell, A. T. and Gero, J. S. (1998). Drawings and the design process, *Design studies*, *19*, 389-430

Reffat, R. M. (2006). Computing in architectural design: reflections and an approach to new generations of CAAD. *Jornal of Information Technology in Construction (ITCON)*, *11*, 655-668.

Schön, A.D (1987). *Educating the reflective practitioner*, Jossey-Bass inc, San-Francisco

Schön, A.D and Wiggins, G (1992). Kinds of seeing and their functions in designing, *Design Studies,13*(2), 135-156

Slater, M., Usoh, M., & Steed, A. (1995). Taking steps: the influence of a walking technique on presence in virtual reality. *ACM Transactions on Computer-Human Interaction (TOCHI)*, *2*(3), 201-219.

Sopher, H. (January, 2015) Immersive Virtual Environment in design education: a new Crit learning model, *Proceedings of Places for Learning Experiences: Think, Make, Change Symposium*, the Faculty of Education and at the Research Dissemination Center (KEDEA) ,Aristotle University, Thessaloniki, Greece

Suwa, M. & Tversky, B. (1997). What do architects and students perceive in their design sketches: a protocol analysis, *Design Studies*, 18, pp 385-403

Wenger, E (1998) *Communities of Practice*, Cambridge University Press, USA

Yan, W., & Kalay, Y. E. (2006). Geometric, cognitive and behavioral modeling of environmental users. In *Design Computing and Cognition'06* (pp. 61-79). Springer Netherlands.

Zeisel, J. (2006). *Inquiry by design: Environment/behavior/neuroscience in architecture, interiors, landscape, and planning*. WW Norton & Co.