Available online at www.sciencedirect.com

ScienceDirect

Procedia - Social and Behavioral Sciences 116 (2014) 5053 – 5057

Procedia
Social and Behavioral Sciences

5th World Conference on Educational Sciences - WCES 2013

Correlations between the visualizer/imager cognitive style and achievement in digital modeling tasks

Şule Taşlı Pektaş*

Bilkent University, Faculty of Art, Design and Architecture, 06800, Bilkent/Ankara, Turkey

Abstract

This paper studies the relationships between Wholist-Analytic (WA) and Verbalizer-Imager (VI) cognitive style dimensions and performance in designing and modeling with traditional and digital design media. An empirical research revealed that design performance in both media positively correlated with being at the Imager side of the cognitive styles continuum. The WA dimension was found to be independent from performance. The Bonferroni tests indicated that the digital modeling mean scores of the Imagers were significantly higher than that of the Verbalizers. The findings suggest that modeling with computers requires specific cognitive actions that may favor visual type of individuals. Implications of the findings on design education are discussed and suggestions are made for further research.

Selection and/or peer-review under responsibility of Academic World Education and Research Center.

Keywords: Cognitive styles; design performance; modeling performance; traditional design media; digital design media.

1. Introduction

The interactions between individual differences of learners and the use of digital media in design education constitute an interesting research field. It is widely accepted that there may be some characteristics of learners that affect their performance in digital and traditional design tasks; however, such issues have not been studied systematically, yet. Some studies compared design performance in digital and traditional media with a focus on the advantages and the disadvantages of each (Stones and Cassidy, 2007; Coyne, Park and Wiszniewski, 2002), but the effects of user characteristics have remained unexplored. Within this perspective, the present paper analyzes the relations between cognitive styles and performance in traditional and digital design media.

Cognitive styles are regarded as innate and relatively permanent cognitive traits that refer to individuals' typical or habitual modes of processing information. Many cognitive style definitions had been made in different studies and this rendered the research field scattered and elusive. Riding and Cheema, in their highly cited article, (1991) attempted to unite existing approaches and claimed that different cognitive style definitions can be clustered around two bipolar axes: Wholist-Analytic and Verbalizer-Imager. The Wholist-Analytic (WA) dimension describes individuals' tendency to process information either as a whole or through dividing into parts. It is assumed that Analytic individuals have a tendency to abstract things from their environment and to process information in a sequential manner, while Wholists are more likely to see "the whole picture" and to use intuition. Verbalizer-Imager

* Corresponding author name. Tel.: +90-312-2902593
E-mail address: tasli@bilkent.edu.tr

Selection and/or peer-review under responsibility of Academic World Education and Research Center.
doi:10.1016/j.sbspro.2014.01.1072

(VI) dimension refers to individuals' inclination toward coding information either verbally or pictorially. These two dimensions are assumed to be independent from each other. The framework proposed by Riding and Cheema (1991) was presented as a computer-based tool called Cognitive Styles Analysis (CSA) (Riding, 1991). The CSA has been recognized as the most widely used cognitive styles instrument later not only because it synthesized various approaches to cognitive styles construct but also its reliability and validity were established well via empirical research.

Previous studies suggested that the VI cognitive style dimension is related to design and modeling performance with Imagers outperforming Verbalizers. Pektas (2010) studied the interactions between interior architecture students' cognitive styles and their performance in 2D modeling and design tasks in digital media. She found that Imager students scored higher than Verbalizers did in both modeling and creativity measures. Atkinson (2006) investigated teacher trainees' performance in design tasks and discussed that Imagers were the most successful cognitive style group both on the VI dimension and among the other cognitive styles as described by CSA. Yukhina (2007) examined the relationships between the VI cognitive styles and design performance among architecture students and concluded that visual individuals tended to have a better quality of their design solutions than was observed among the verbal students.

Some studies investigated the relations between the WA cognitive style dimension and attainment in design. On the contrary with the assumptions of design theorists, existing studies indicated that Analytics performed better than Wholists in design tasks (Roberts 2006; Atkinson 2006). Roberts (2006) studied the relationships between the WA cognitive styles of Cognitive Styles Analysis (CSA) and the design studio performance of architectural design undergraduates at particular stages of architectural education and observed that Analytics achieved better than Wholists in the early years in architectural education, but the difference disappeared at the later years of education. Atkinson (2006) investigated teacher trainees' performance in design and technology tasks and found that Analytics were the most successful group on the WA dimension, although the differences between the groups were small.

However, to the best of the author's knowledge, this study is the first to compare traditional and digital media with a cognitive styles perspective. In order to investigate the effects of cognitive styles on students' performances in traditional and digital design media, a research was conducted among interior architecture undergraduates. This paper reports the findings of the study. The implications of the findings are discussed with reference to Computer Aided Design (CAD) discourse and to the author's many years of experience in CAD teaching. The limitations of the study are also addressed and suggestions are made for further research.

2. Methodology

2.1. Research questions

The particular research questions of the study are presented below:

- What are the cognitive style characteristics of the sample group?
- Is there any relationship between design students' cognitive styles and design performance in traditional media?
- Is there any relationship between design students' cognitive styles and design performance in digital media?
- Is there any relationship between design students' cognitive styles and modeling performance in traditional media?
- Is there any relationship between design students' cognitive styles and modeling performance in digital media?

2.2. Subjects

The sample consisted of sophomore students of the Department of Interior Architecture and Environmental Design, in Bilkent University. The sample consisted of 77 students whose ages ranged from 18 to 24. The mean age was 20.36 and the standard deviation was 1.43. There were 61 females (%79) and 16 males (%21).

2.3. Measures

Cognitive styles of the students were identified by the CSA (Riding, 1991). Every member of the sample completed the CSA in the manner prescribed in the CSA administration documentation (Riding, 1991). The participants were informed about their cognitive styles at the end of the study. Regarding the performance in traditional and digital media, the data were collected from a traditional design studio, a manual drawing course, and an introductory CAD course. The CAD course included separate modeling and design modules. The performance in modeling and design tasks in both media were measured by the students' term grades in the corresponding courses. The letter grades (F-A) were converted to numerical values (0-100) and included in the analysis.

3. Analysis and results

3.1. Cognitive style characteristics of the sample group

The VI ratios ranged from 0.83 to 1.74 with a mean of 1.09 (SD = 0.18) and a median of 1.05. There were 24 (31%) Verbalizers, 21 (27%) Bimodals, and 32 (42%) Imagers. The WA ratios ranged from 0.56 to 3.03 with a mean of 1.56 (SD = 0.62) and a median of 1.45. There were 16 Wholists (21%), 21 Intermediates (27%) and 40 (52%) Analytics.

3.2. Cognitive styles and performance

The associations between the modeling/design performance grades and the cognitive style raw scores were analyzed first through the Pearson's Correlation Coefficient. Significant positive correlations were found between the VI ratios and the design performance in traditional ($r=0.24$, $p<0.05$) and in digital ($r=0.22$, $p=0.06$) media. The largest correlation was found between the digital modeling scores and the Verbalizer-Imager dimension raw scores ($r=0.38$, $p<0.001$). The WA cognitive style dimension was observed to be independent from performance. Then, the sample was grouped by the cognitive style categories defined in the CSA administration documentation (Riding, 1991); Imager-Bimodal-Verbalizer in one dimension and Analytic-Intermediate-Wholist on the other (Table 1). The analysis of variance (ANOVA) tests were conducted in order to find out if the cognitive styles had any effect on modeling and design performance. The ANOVA indicated that there were statistically significant mean digital modeling score differences only on the VI dimension. These Bonferroni tests revealed that the digital modeling scores of the Imagers were significantly higher than that of the Verbalizers ($p<0.01$), but no other significant difference was found.

Table 1. Design and modeling performance mean scores in traditional and digital design media on the VI and WA cognitive style dimensions

	VI dimension Mean score (SD)			WA dimension Mean score (SD)		
	Imager	Bimodal	Verbalizer	Analytic	Intermediate	Wholist
Design Performance in Traditional Media	76.22	72.76	73.33	74.08	73.29	76.56
	(9.51)	(11.11)	(6.08)	(9.01)	(8.38)	(10.44)
Design Performance in Digital Media	75.88	75.71	71.46	72.65	75.14	78.06
	(16.21)	(16.77)	(15.24)	(16.14)	(15.34)	(16.76)
Modeling Performance in Traditional Media	78.61	78.62	77.77	77.68	77.33	81.31
	(6.91)	(9.02)	(5.89)	(6.35)	(6.81)	(9.10)
Modeling Performance in Digital Media	86.09	79.41	75.10	80.11	80.76	82.78
	(10.95)	(9.44)	(17.57)	(15.24)	(10.88)	(13.69)

4. Discussion and conclusions

This study provided valuable insights into the cognitive styles of design students and how cognitive styles may affect performance in traditional and digital design media. Although the importance of visual thinking in design was widely acknowledged in the literature, few studies empirically investigated representational issues in typical complex design problems (Goldschmidt and Smolkov, 2006). This study suggests that one aspect contributing to visual design thinking may be the Verbalizer-Imager cognitive style dimension. Another interesting finding of the study was the significant correlation between attainment in digital modeling and being close to the Imager end of the Verbalizer-Imager range. Such a relation was not significant between the VI cognitive style dimension and modeling in traditional media. This implies that, compared to its manual counterpart, working with computers entails specific cognitive actions that favor visual type of individuals. In what ways does digital modeling differ from manual techniques? The interaction between digital tools and cognitive processes of designers is still a growing area of study. However, we basically know that modeling with digital design tools requires both procedural and declarative modes of thinking i.e. mentally breaking an object into simple objects and executing a series of commands (Hamade et al. 2007). This coincides with the "draw and modify" working principle of the current commercial CAD software i.e. complex forms are derived by modifying simpler forms (Coyne, Park and Wiszniewski, 2002). Moreover, previous research showed that reinterpretation and "seeing" occurred more frequently while working in digital design media than when using traditional materials (Won, 2001). This was accounted for by the high speed of working and the impermanence of digital mark or "see, move, see" that digital working supports very well. Thus, it can be proposed that Imager students performed better in digital modeling than Verbalizers did, because working with digital modeling tools requires intensive processing of images in mind. Further detailed studies are needed to analyze cognitive actions of individuals with different VI cognitive style characteristics. Considering the pervasiveness of digital applications in design education, insights into such issues would facilitate for developing teaching strategies and course designs that are well-adopted to individual differences of learners. The author hopes that this study would raise important questions and contribute to the body of knowledge in the field.

Acknowledgements

The author would like to thank the students participated in the study.

References

Atkinson, S. (2006). Factors influencing successful achievement in contrasting design and technology activities in higher education. *International Journal of Technology and Design Education*, 16, 193–213.

Goldschmidt, G. & Smolkov, M. (2006). Variances in the impact of visual stimuli on design problem solving performance, *Design Studies*, 27, 549–569.

Hamade, R. F., Artail, H. A. & Jaber, M. Y. (2007). Evaluating the learning process of mechanical CAD students, *Computers and Education*, 49, 640–661.

Riding, R. & Cheema, I. (1991). Cognitive styles: an overview and integration, *Educational Psychology*, 11, 193–216.

Riding, R. (1991). Cognitive styles analysis, Learning and Training Technology, Birmingham, UK.

Roberts, A. (2006). Cognitive styles and student progression in architectural design education, *Design Studies*, 27, 167–181.

Stones, C. & Cassidy, T. (2007). Comparing synthesis strategies of novice graphic designers using digital and traditional design tools, *Design Studies*, 28(1), 59–72.

Coyne, R., Park, H. & Wiszniewski, D. (2002). Design devices: digital drawing and the pursuit of difference, *Design Studies*, 23(3), 263–286.

Yukhina, E. (2007). Cognitive abilities & learning styles in design processes and judgments of architecture students, Ph.D. Dissertation, Faculty of Architecture, the University of Sydney.

Pektas, S. T. (2010). Effects of cognitive styles on 2D modeling and design performance in digital media, *International Journal of Technology and Design Education*, 20(1), 63-76.

Won, P. H. (2001). The comparison between visual thinking using computer and conventional media in the concept generation stages in design, *Automation in Construction*, 10, 319–325.