European Online Journal of Natural and Social Sciences 2017;
Vol.6, No 3 pp. 406-416
ISSN 1805-3602
www.european-science.com

Examining the Academic Success of the Students in Drawing Techniques Course: The Case of Freshmen in Landscape Architecture

Serap Yılmaz*, Sema Mumcu, Tuğba Düzenli
Department of Landscape Architecture, Faculty of Forestry, Karadeniz Technical University,
Address: 61080 Trabzon and Turkey
*E-mail: serapciveleks@gmail.com; Tel.: +90-462-3774578

Received for publication: 17 April 2017.
Accepted for publication: 26 July 2017.

Abstract

In Landscape Architecture education the students are expected to produce a unique and creative product and express this product in two or three dimensions. For this aim drawing techniques related to visualizing the design are instructed in the first year of landscape architecture education in the Drawing Techniques course using conventional methods of expression. As a result, the students can express themselves and acquire the ability to use the lines and the pencil. Knowing how to draw enables students to obtain basic knowledge about what to express and how; acquiring the ability to use the pencil provide them the opportunity to draw quality images - good sketches. After learning these skills, it will become easier for them to transfer their thoughts to digital media and to express their designs in digital media.

In Landscape architecture education, to improve freshmen's technical drawing skills, practices related to two (plan, profile-view) and three (perspectives) dimensional drawing techniques are conducted within the scope of Drawing Techniques course. In the present study, the practices that are implemented by freshmen who took Drawing Techniques course during five semesters between 2012-2017 academic years were examined. The change in the drawing performance of the students in practices was analyzed. It was also examined whether the two or three dimensional drawing techniques led to this change and whether the type of drawing techniques utilized affected their level of making mistakes and the variety of those mistakes.

Keywords: Technical drawing, Drawing performance, Landscape architecture

Introduction

The objective of landscape architecture education is to educate inquisitive individuals who could conceive and perceive in three dimensions, transfer abstract ideas into concrete objects, convey her or his creativity to an aesthetic level, and establish the relationship between form and function. In this context, the students are expected to produce a unique and creative product and to express this product using a visual language. The student could do this by visualizing his or her thoughts and with the ability of cognitive rotation (Maier, 1994). This allows the student both to visualize what she or he designed in his mind and to show and tell her or his thoughts to herself or himself and others. Hence, landscape architecture is among the professions that require to visualize and manipulate the objects and situations and play with these visualizations, and especially work with graphical images like architecture, design and engineering. It could be observed that spatial language affects these occupational groups significantly (Yurt & Sünbül, 2011; Yıldız & Tüzün, 2011; Özcan et al., 2016). In the training for these occupations, the focus is primarily on learning visualization techniques, i.e. drawing techniques, for the development of the skills of thinking in images, forms and lines, perceiving and reasoning three-dimensional objects. Thus, students can

express their designs using verbal and numerical symbols as well as tools such as diagrams, sketch work, and three-dimensional modeling, and can reduce this process to a single language using drawing techniques (Bilgiç & Konak, 2016). Furthermore, the student can learn the common language of describing the presented design product to different professional groups with drawing techniques. These techniques can be scrutinized under two categories: traditional and digital (Goldschmidt & Smolkoy, 2006; Jones, 1992; Shaw, 1994); The traditional drawing technique includes hand drawings, and the digital drawing technique includes drawings produced using drawing software. It is necessary to commence the learning process of the student to express herself or himself with hand drawings (Biggio et al., 2015, Tagliabue, 2011). Since the hand movements are followed by the eye during drawing by hand, the brain-hand coordination is better established. And hence the student internalizes the drawings with the sense of touch; it would be easier for the student to create three-dimensional images from her or his thoughts and to rotate them in her or his mind (Tagliabue, 2011; Biggio et al., 2015). However, when drawing in the digital media, the internalization created by the sense of touch is incomplete. Thus, drawing in a digital media is not sufficient to acquire the skills of presentation and three-dimensional vision that are necessary for the development of the student (Tagliabue, 2011; Biggio et al., 2015).

In this context, in the first year of Landscape Architecture education, primarily students take the drawing techniques course to initially achieve the skills to express their thoughts in two dimensions and then to think, perceive and express in three dimensions. Throughout the course, the student is primarily instructed how to use the lines and the pencil since knowledge on the types of lines provides the student basic knowledge on how to express what and knowledge on the use of pencil enables the student to draw quality lines. Following this process, traditional presentation techniques are instructed. Because it is very difficult for the freshmen student to interpret and visualize the designed product (Akbulut, 2010, Bilda & Gero, 2004, Svoboda, 1992), since she or he is not trained in drawing techniques, the student could experience problems in drawing the objects she or he designed in her or his mind or in expressing her or his thoughts with her or his drawings adequately. When they complete the drawing techniques course, students could overcome these problems; they could express their designs using drawing techniques. However, studies on learning drawing techniques demonstrated that the type of secondary education and gender have an impact on the learning levels. It was observed that particularly males and technical high school graduates seem to be more successful in recognizing the two-dimensional components of a three-dimensional form and could create a three-dimensional object using two-dimensional information (Sorby, 2007; Stavridou & Kakana, 2008; Debelak et al. Al., 2015). Nevertheless, Sorby (2007) reported that although individuals may differ in spatial performance, most of their spatial skills can be improved through training and practice. Thus, the content of the courses that aim to improve the spatial skills of the students such as the drawing techniques course and the applications conducted in these courses should comprehensively focus on the academic performances of the students. Based on that fact, in the first phase, the variations in student achievements after the practices were analyzed and the present study aimed to respond the following research questions:

- Is there a correlation between gender and academic performance?
- Are students who are successful in two-dimensional drawings also successful in three-dimensional drawings?

In the next section of the present paper, detailed information is provided on the definition of drawing and the aim and functions of the drawing techniques course in landscape architecture education to better understand the content of course applications.

Drawing techniques course and the process

Drawing is about visualizing the thoughts and impressions to render them as a concrete presentation. Before inventing writing, humankind expressed itself using drawings (Us, 2009). Because, drawing is a natural way for individuals to express their thoughts clearly and allows them to express extensive information on a limited space due to its tw-dimensional nature (Bresler, 2016). Drawing based on certain principles is referred to as technical drawing. Technical drawing is a language created using lines, signs and symbols based on certain drawing techniques and an alphabet used for communication between architects, engineers and other technical staff. Thus, technical drawing is a common language that allows the professional groups in different parts of the world to understand each other, communicate and transfer ideas (Bilgiç & Konak, 2016).

Technical drawing is effectively used at every stage of the design process as shown in Table 1. Because, drawing is the common language and a tool for designers to express themselves, choices and possibilities (Pallasmaa, 2009, Nerdinger 2004). Thus, in landscape architecture education, drawing techniques course is provided as a theoretical and practical base to instruct drawing techniques for freshmen and to improve their graphic skills. Because an individual with graphical skills could (Stavridou & Kakana, 2008; Biggio et al., 2015): (I) express three-dimensional forms; (II) define two-dimensional components (vertical projections or views) of three-dimensional forms; (III) and draw three-dimensional objects based on two-dimensional data (vertical projection / plan). Sorby (2007) reported that the presence of such a skill would represent a successful transition from analytical to holistic as a result of the development of spatial skills. With holistic thinking, the student will be able to visualize and translate the whole object, not step by step, but in the mind at once. Thus, the most important objective of the drawing techniques course to acquire the skills to achieve three-dimensional forms using two-dimensional data and to draw three-dimensional presentations in two dimensions, not only visualization. Thus, the students who would complete the course could;

- Acquire technical drawing skills (ability to draw two and three dimensonal drawings),
- Develop hand-eye coordination,
- Rotate objects in their minds, and
- Express the things they observe and think.

A student with these skills could draw his / her design based on specific rules and standard presentation forms and create a presentation that includes all the information about the features of the design product (form, functional operation, dimensions and interior / exterior details).

Table 1. Two and three dimensional presentation and drawing techniques

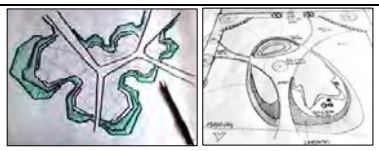
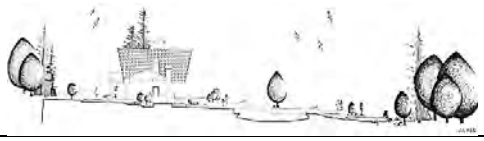
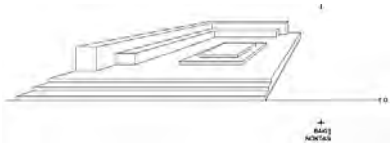
DRAWING TECHNIQUES		
Two-dimensional presentations	**Analyses**	
	Concept	
	Design/Scetch	
	Plans	
	Sections	
	Elevations	
Three-dimensional presentations	**Perspectives**	
	Models	

Table 2. Course syllabus

		Application Question	Aim
2D drawing ↓	**App. 1**	• What are the types of pencil and how to hold them? • What are the types of lines and how to draw them?	• To instruct the student that the pencil establishes the physical connection between the eye, thought and the hand. • To instruct the student about holding the pencil with correct techniques and how to draw different types of lines.
	App. 2	• What is scale?	• To instruct the student about the transfer of the actual measures to the drawing area.
	Apps. 3-4-5	• What is plan-section-elevation and how to draw these?	• To instruct the student how to present an object/landscape using plan-section-elevation.
3D drawing	**Apps. 6-7**	• How landscape components are drawn in plan-section-elevation?	• To instruct the student how to draw landscape components such as trees, furniture, stairs, etc..
	App. 8	• What is axonometric projection and how is it drawn?	• To instruct the student on three-dimensional drawing techniques to present objects/landscape the way they are observed in reality.
	Apps. 9-10-11-12	• What is central perspective and how is it drawn?	

The course covers a 12-week period (Table 2) and each class includes two parts; in the first section, the theoretical information on the topic is instructed by the faculty member and the information about how to use this knowledge in practice is explained through examples. In the second part, an application on the topic is conducted and the students are monitored to see how much they learned about the instructed topic, feedback is provided and the application is repeated when necessary.

Applications in drawing techniques course focus on two-dimensional drawing of an object initially, how to rotate an object in the mind, the views of an object from different perspectives and how to reflect all these factors on a drawing (Plan, section-elevation). Then, applications on how to obtain a three-dimensional presentation of an object using two-dimensional data (perspective) are conducted, and then applications on presenting a landscape design with two and three dimensional presentations are conducted. The present study focused on the correlation between the learning levels of the students and gender, which is assessed based on the grades the students received in the applications conducted in the class.

Methodology

The present study was conducted during the drawing techniques course in the Department of Landscape Architecture at Karadeniz Technical University and the study included 373 freshmen during five semesters in 2012-2017 academic years. The study aims to identify the effects of increasing complexity of the practices conducted by students over time on their achievements and

levels of learning, and the correlation between academic performance and gender. Because previous studies on the topic demonstrated that there were differences between students in several parameters such as perception, expression and attention to detail (Demirbaş & Demirkan, 2003, Kolb & Kolb, 2005, Tucker, 2007, Tucker, 2009, Mostafa & Mostafa, 2010). Thus, the assessments were conducted in two stages. In the first stage, the variations in students' achievement levels during the applications were analyzed. Whether the instructed drawing technique (two or three dimensional) was effective on student achievement and whether gender was effective on the same is investigated at this stage. In the second stage, it was investigated whether the students were also successful in three-dimensional drawing if they were successful in two-dimensional drawing.

Data Collection and Analysis

The study data included the practice notes taken during five semesters between 2012 and 2017, each semester was considered separately. Mean scores for each student on her or his two-dimensional and three-dimensional drawing applications were taken. To ensure the validity and reliability of the study, all statistical considerations were conducted with these numerical data.

Data analyses were conducted with Independent-Samples and Paired Samples T-test, correlation and arithmetic mean values using SPSS (v. 23.0) software. It was found that all the test results were statistically significant.

Findings and Discussion

Participants

71.6% of the students evaluated in the study were females and 28.4% were males. The distribution of the gender of the students based on the years of the study are presented in Table 3.

Table 3. Student gender distribution based on the years of the study

	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
Female	47	55	66	67	49
Male	36	25	15	14	16

Analyses on the gender and academic performance of the students

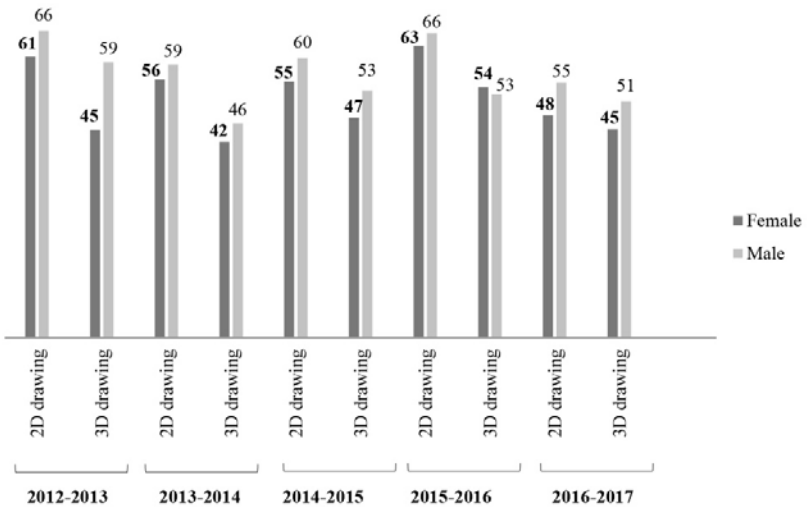


Figure 1. Distribution of the average student grades based on student gender and semesters

Applications conducted during the course are grouped into two-dimensional drawings (plan-section-elevation) and three-dimensional drawings (perspective types). The averages of the student grades in these applications were taken and distributed based on the student gender and the semesters and presented in Figure 1.

The average student grades for the five semesters were calculated to determine the academic performance (Table 4). Correlations between student gender and two-dimensional drawing and three-dimensional drawing achievements were evaluated. Independent-Samples T test was conducted to determine whether the effect of differences in gender were statistically significant on learning two-dimensional drawing and three-dimensional drawing skills. Test results indicated that gender affected learning two-dimensional drawing and three-dimensional drawing skills ($p < 0.05$) (Table 5). An analysis of correlation was conducted with the grade averages of the students' grades in course applications to determine the direction of the abovementioned correlation in academic performance during the five semesters, and the analysis results demonstrated that there was a positive and significant medium level correlation between learning 2D drawing and gender ($r = 0.560$ **; $p < 0.01$) and learning 3D drawing and gender ($r = 0.568$ **; $p < 0.01$).

Table 4. Total grade averages of students during five semesters based on gender

	Gender	N	Mean	Std. Deviation	Std. Error Mean
2D drawing	Female	267	54,69	19,267	1,179
	Male	106	61,10	15,807	1,535
3D drawing	Female	267	45,43	19,515	1,194
	Male	106	51,76	17,007	1,652

Table 5. Independent-Samples T testi results on academic performance

	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
2D drawing	-3,316	372	,001	-6,418	-10,232	-2,604
3D drawing	-3,105	372	,002	-6,330	-10,347	-2,312

Based on the above analyses, it was determined that male students were more successful than female students in learning two and three dimensional drawings in five semesters. It was revealed in previous studies that male students were more successful in spatial skills when compared to female students. Linn & Petersen (1985) found that males performed better than females, especially in mental rotation tasks. Maeda &Yoon (2013), Sorby (2007) and Debelak et al. (2014) supported this idea by arguing that there was a strong gender difference favoring males in skill to mentally rotate three-dimensional objects. Stavridou & Kakana (2008) also examined the ability of students to draw two and three dimensional objects and found that males were more successful. These results obtained in previous studies supported the findings of the present study that males achieved better results in learning two- and three-dimensional drawing skills when compared to female students.

Study findings confirmed the results of the previous research on effects of gender on drawing skills (Debelak et al., 2014; Biggio et al., 2015). These findings demonstrated that females experienced difficulties in learning to produce a three-dimensional image of the object, or in drawing a three-dimensional render of an object based on two-dimensional data.

The fact that males were more successful in two-dimensional and three-dimensional drawing techniques was related to their better performance in mental rotation tasks when compared to the females, as Linn & Petersen (1985) stated. Because males focus on visualizing the entire object using a holistic strategy and females visualize the objects using an "analytical strategy" (Linn & Petersen, 1985; Sorby, 2007).

Determination of the correlation between learning 2D and 3D drawing skills

To determine the response to the question “Do the students' achievement levels in the 2D drawings during the course also positively affect the achievement levels in the 3D drawings?” correlation analysis was conducted. The findings demonstrated that there was a very high positive and significant correlation between learning 2D and 3D drawing skills ($r = 0,709$ **; $p < 0,01$). The average grades obtained to determine the academic performance of the students are analyzed for each year and it was observed that the mean grades in 2D drawing applications and the mean grades in 3D drawing applications by the same student were within a similar range (Figure 2-6). Differences between these values were statistically significant (Table 6).

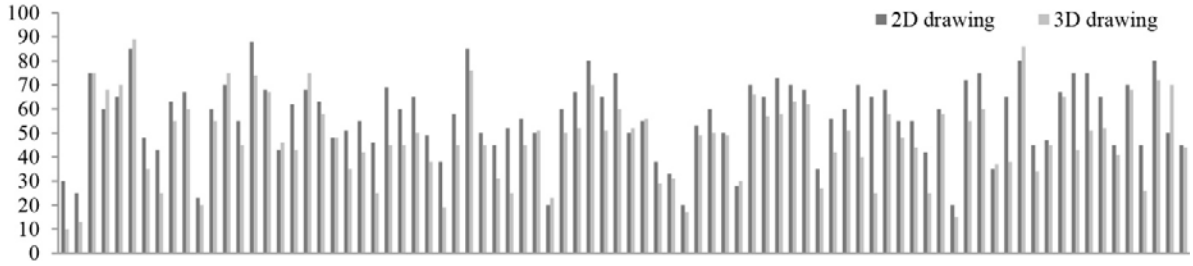


Figure 2. Mean grades of students in 2012-2013 academic years

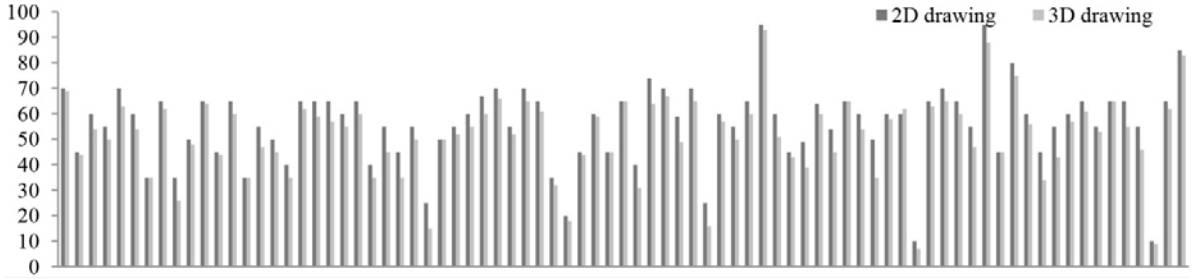


Figure 3. Mean grades of students in 2013-2014 academic years

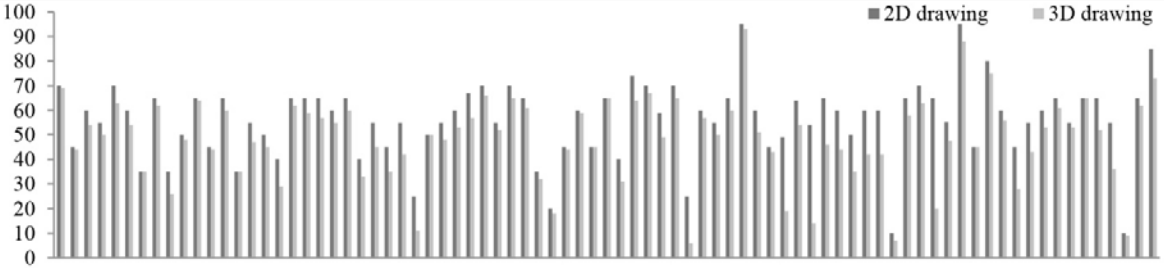


Figure 4. Mean grades of students in 2014-2015 academic years

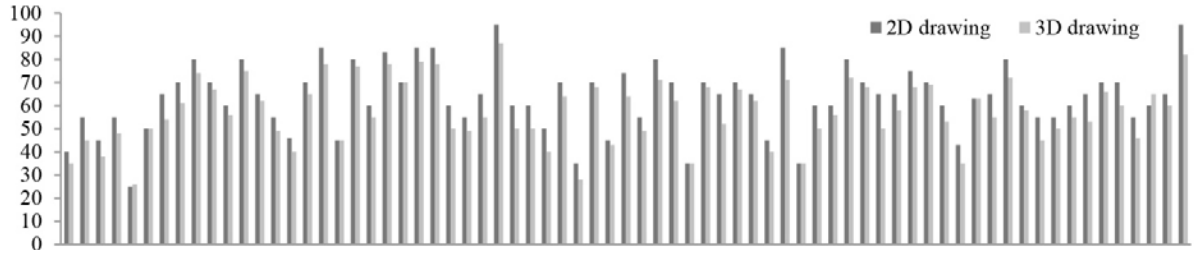


Figure 5. Mean grades of students in 2015-2016 academic years

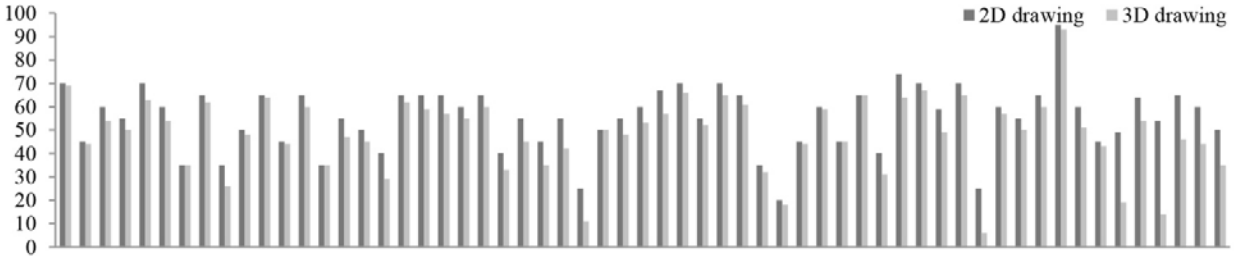


Figure 6. Mean grades of students in 2016-2017 academic years

Table 6. Differences between 2D drawing and 3D drawing mean grades

		Mean	sd	t	df	Sig. (2-tailed)
2012-2013	2D drawing– 3D drawing	8,83	9,88	8,186	83	,000
2013-2014	2D drawing– 3D drawing	4,71	3,48	12,186	80	,000
2014-2015	2D drawing– 3D drawing	7,69	8,00	8,64	80	,000
2015-2016	2D drawing– 3D drawing	6,05	3,94	12,92	70	,000
2016-2017	2D drawing– 3D drawing	7,18	7,24	7,675	59	,000

The above findings demonstrated that both female and students who were successful in two dimensional drawing were also successful in three dimensional drawing applications. This was consistent with the findings of previous studies. Individuals with spatial skills are successful in rotating two-dimensional drawings in their minds, in imagining their three-dimensional versions, and in visual thinking (Kömürcüoğlu Turan & Altaş, 2003; Kang et al., 2004; Sorby, 2007, Stavridou & Kakana, 2008) and this finding does not differ based on gender. Thus, these individuals internalize the drawings when drawing two-dimensional drawings and are more successful in developing three-dimensional image producing strategies (Tagliabue, 2011). If an individual fails to create a vision/object in his or her mind, it is difficult for that individual to express the same object or image in two dimensions.

Conclusion

The development of the drawing skills allows to materialize the thoughts designed in the brain the best possible way. This skill is a tool that enables the designer to express himself / herself in design-oriented departments such as landscape architecture and visualize the design problems and render these problems assessable and resolvable. The pencil in the hand of the designer is the bridge between the mind that designs and the drawing that is formed on paper (Pallasmaa, 2009). Thus, the designer should bond strongly with the pen and rule it well. In this context, the drawing techniques course which develops the visualization of objects and situations by the individual and the ability of the individual to play on these images is very important in landscape architecture education that requires knowledge on graphical images and technical language. Spatial abilities are known to be the cornerstone of high-level thinking, reasoning and creative processes. Nevertheless, studies has shown that males are more successful, especially in their ability to mentally rotate three-dimensional objects. Based on the findings of the present study, it was determined that

- Male students were more successful in both two and three dimensional drawings when compared to female students, and
- Students who were successful in two-dimensional drawings were also successful in three-dimensional drawings and gender had no effect on this correlation.

However, this does not indicate that females would not succeed in spatial skills because these skills can be improved through training and practice. Female students can be encouraged to choose professions such as architecture and engineering by improving their achievement levels, or the female students in these departments can be prevented from dropping out of the school due to the sense of frustration and failure. Thus, equality in accessing educational opportunities can be achieved with adequate interventions to the content and practice of the drawing techniques course. Thus, course syllabus of courses in design oriented department curricula such as drawing techniques that aim to develop spatial skills of students should be considered in detail. Furthermore, future studies that would contribute to the development of the drawing, three-dimensional perception and approaching three-dimensional perception from two dimensional perception skills of students in drawing techniques course should be conducted.

References

Akbulut, D. (2010). The effects of different student backgrounds in basic design education. Procedia Soc. Behav. Sci.5331-5338.

Bilda Z. & J. S. Gero (2004). Analysis of a blindfolded architect's design session in Gero. In: B. J. S. Tversky and T. Knight (Ed.). Visual and Spatial Reasoning in Design III, Key Centre of Design Computing and Cognition. Australia: University of Sydney, pp: 121-136

Bilgiç Erten, D. & N. Konak (2016). The Effect of “Descriptive Geometry” “Technical Drawing” and “Perspective” Lessons to the Architectural Education’s Intellectual Infrastructure and Prof. Dr. Yılmaz MORÇÖL . Journal of Architectural and Life 1(1), 1-12.

Bresler, M. (2016) Understanding formal arrow-connected diagrams and free-form sketches. Czech Technical University. Ph.D. thesis. Prague, Czech Republic

Debelak, R., Gittler, G. & M. Arendasy (2014). On gender differences in mental rotation processing speed. Learning and Individual Differences, 29, 8-17.

Demirbaş, Ö.O. & H. Demirkan (2003). Focus on architectural design process through learning styles. Design Studies, 24(5), 437-456.

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

Jones, J.C. (1992). Design methods. New York: Van Nostrand Reinhold

Kolb, A. Y. & D.A. Kolb (2005). Learning styles and learning spaces: enhancing experiential learning in higher education. Academy of Management Learning and Education. 4, 193-212.

Kömürcüoğlu, Turan N. & N. E. Altaş (2003). Concept in design process. *Serie A: Architecture, Planning, Design*, 1(2), 15-26. (In Turkish)

Linn, M. C. & A. C. Petersen (1985). Emergence and characterization of sex differences in spatial ability:A meta-analysis. Child Development, 56, 1479-1498.

Noriega Biggio M., S.M. Vázquez & S.M. García (2015). From representation to construction: A study of graphic skillsin students newly admitted to architecture and design courses. Universidad de Buenos Aires, Argentina, technical paper. Australasian Journal of Engineering Education, 20(1), 95-102.

Maeda, Y. & S. Yoon (2013). A meta-analysis on gender differences in mental rotation ability measured by the purdue spatial visualization tests: visualization of rotations (PSVT:R). Educational Psychology Review, 25(1), 69-94.

Maier, P. H. (1994). Raeumliches vorstellungsvermoegen. Wien: Lang.

Mostafa M. & H. Mostafa (2010). How do architects think? Learning styles and architectural education. International Journal of Architectural Research, 4(2-3), 310-317.

Nerdinger, W. (2004). Dinner for Architects. New York:W. W. Norton & Company, Inc.

Özcan, K. V., M. Akbay & T. Karakuş (2016). Effects Of Gaming Habits Of University Students On Their Spatial Skills. *Kastamonu Education Journal*, 24(1) 37-52. (In Turkish)

Pallasmaa, J. (2009). The Thinking Hand Existential and Embodied Wisdom in Architecture. West Sussex, UK: John Wiley & Sons Ltd.

Shaw, M. (1995). Comparing Architectural Design Styles. IEEE Software, 12(6), 27-41.

Sorby, S.A. (2007). Developing 3D spatial skills for engineering students, Australasian Journal of Engineering Education, 13(1), 1-11.

Stavridou, F. & D. Kakana (2008). Graphic Abilities in Relation to Mathematical and Scientific Ability in Adolescents. Educational Research, 50(1), 75-93.

Svoboda, J. (1992). The Secret of Theatrical Space. TD&T 5(28), 14,19.

Tagliabue, B. (2011). Conversando con. Benedetta Tagliabue. EGA. Revista de Expresión Gráfica Arquitectónica, 16 (17), 15-27.

Tucker, R. (2007) Southern drift: the learning styles of first and third year students of built environment. Architectural Science Review, 50(3), 246-255.

Tucker, R. (2009). Getting old and heading south: the academic success of southerner learners in design cohorts. Higher Education Research and Development, 28(2), 195-207.

Us, F. (2009). Importance of Perceptor Movement in Representation of Architectural Space. *Design + Theory*, 5(7), 82-98. (In Turkish)

Yıldız, B. & Tüzün, H. (2011). Effects of using three-dimensional virtual environments and concrete manipulatives on spatial ability. Hacettepe University Journal of Education, (41), 498-508.

Yurt, E. & A. M. Sünbül (2011). Effect of Modeling-Based Activities Developed Using Virtual Environments and Concrete Objects on Spatial Thinking and Mental Rotation Skills. *Educational Sciences: Theory & Practice*, 12(3), 1975-1992. (In Turkish)