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The Roles of Hand Drawing and Computer Assisted Drawing in Landscape Architecture Professional Practice

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조경실무에 있어서 컴퓨터 드로잉과 핸드 드로잉의 역할

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국문초록

조경설계의 도구로서 컴퓨터 드로잉 기술은 핸드드로잉이 제공할 수 없었던 많은 이점을 제공하여 주며, 그 중요성은 현 미국 조경설계 실무 및 교육에서 점점 커 가고 있는 실정이다. 하지만 조경교육 측면에서 핸드드로잉과 컴퓨터 드로잉을 어떻게 균형을 맞추어야 하는지 쉽지 않은 논쟁거리를 제공한다. 이러한 미국 조경교육계의 고민은 미국에 국한된 문제가 아니라 한국 조경교육에서도 진지하게 고려되어야 되는 문제로 보인다. 본 연구는 미국 달라스시와 포트워쓰시를 포함한 미 텍사스주 북부에 위치한 설계사무소에 근무하는 조경기술사를 취득한 조경설계가들을 대상으로 실시한 설문을 통하여 조경실무에 있어서 핸드드로잉과 컴퓨터 드로잉의 역할에 대하여 조사하였다. 달라스시와 포트워쓰시는 Carter & Burgess, HOK, Mesa Design Group, SMR, SWA Group, TBG Partners 등 미국의 대표적인 조경설계사무소 대부분이 본사 혹은 지역사무소를 두고 있는 미 남부의 대표적인 금융, 건(축)설 분야의 대표적인 쌍둥이 도시로 알려져 있다. 설문조사 결과, 몇몇 개인 특성들이 일상적인 조경설계에 있어서 핸드드로잉과 컴퓨터 드로잉의 중요성에 대한 인지와 관계가 있는 것으로 나타났다. 또한 컴퓨터 드로잉 기술이 일상적인 조경설계 과정에서 빈번하게 사용되고 있음에도 불구하고, 핸드드로잉만이 제공할 수 있는 고유 역할이 있는 것으로 나타났다. 특히 조경디자인 아이디어를 발전시키는 과정에 핸드드로잉 기법이 중요한 역할을 하는 것으로 나타났다.

Key Words: Design Process, Design Communication, Hybrid Method, Drawings

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I. Introduction

Drawing is the means to communicate design ideas for architects and landscape architects. It is also a process of design thinking that can be considered as the interaction between creativity of the human brain and the environment. Environmental information can be perceived by a designer through drawings on the paper, and the creative design ideas of a designer can be realized on the land through drawings.

Modern computer technologies have brought many changes in cultures of drawing into design professions such as architecture and landscape architecture. It is widely accepted that computer technology has improved and made drawing easier in terms of constructing perspectives and producing construction documents. In today's professional practice, with the ready availability of computers and software programs that assist the landscape architect, it has been suggested that landscape architecture and architecture may become paperless professions in the near future (Sipes, 2005).

On the contrary, there are also much supports in the literature and through personal interviews for using hand drawing at certain phases of the design process in the profession (Gruzdyz, 2002). Even today, when computer assisted drawing systems have taken over many aspects of architectural practice, most designers still make their study drawings by hand in much the same way architects have made them for the past five hundred years (Herbert, 1993). In 1990, ninety percent of computer applications in design offices were for production drawings, leaving the "creative act of design" virtually unaided by the computer (Dines, 1990). Taking the side of computerization even further, few scientists still believe that organic mechanisms possess physical qualities that cannot be replicated eventually by man- made contraptions (Arnheim, 1997).

Technological advances have enabled landscape architects to use a computer for many aspects of drawing, but the literature suggests that there remains a place and demand for hand drawing in professional practice. There has been limited research into how hand drawing is continuing to be used in professional practice in light of these technological advances. The question exists of whether there remains a need for hand drawing in professional practice design and thus the education of landscape architects. There is also the question of how computers are being used in drawing. The fact that little is known about what is specifically being used in practice leaves the question of how to best prepare a landscape architect student for entering practice or for landscape architects to include computer training in continuing education.

In this light, this study aims to investigate (a) how landscape architects' personal background affects the use of computer technologies and (b) at what design stages hand drawings and computer assisted drawings are used in professional practice. Furthermore this study looks at how computer technologies affect the design process in practice. This is important information for teachers and students alike as there is a limited amount of time to spend teaching drawing in the classroom. Having the knowledge of what practitioners are doing enables teachers to restructure curriculum where necessary and for students to make the most of their education in both hand drawing and computer assisted drawing. The results of this study can be used to guide educators who will be restructuring curriculums in programs of landscape architecture in order to respond to changes in the way of designing in practices. The results of this study are important for practitioners in allocating limited resources and investments in training personnel and in providing the right tools and software for employees.

II. Literature Review

In Tai's (2002: 2003) study, over one hundred landscape architects were surveyed and few felt the computer can improve drawing aspects of the profession or that traditional practice methods will be totally replaced by the computer although there was agreement that there would be an increasingly digital practice in the future. Upon review of fifty-six job listings by the American Society of Landscape Architects (ASLA), January 10, 2005, it was found that thirty-seven (37) of those listings requested that strong hand graphic skills be present in the job candidates (ASLA Job Listings, 2005). Besides CAD skills, hand drawing graphic skills were the most commonly listed skills required for employment. Other graphic requirements listed in order of frequency included CAD experience, graphic skills, design skills, computer generated graphics, drafting ability, and one job listing requesting 3D modeling. Specific computer graphic software listed by these fifty-six employers included AutoCAD, Land Development, Photoshop, 3-D Viz (a three-dimensional visualization program), Illustrator, Arcview GIS (Geographic Information Systems) and Freehand (ASLA, 2005). The review of these job listings showed that hand drawing is important in professional practice in spite of advancing technologies in the computer graphics field.

It is apparent that although manual draftsmanship may no longer be required to enter a design career, those who master the language of drawing are likely to see, to think, and to communicate with more sophistication than those who only master the computer. Aside from this competitive advantage, however, there's a deeper satisfaction to be derived from draftsmanship: "the thrill of vanquishing a monster- sized, fire- breathing design problem with nothing more than a small, sharpened stick" (Doyle, 1999: 3). Clearly both drawings by hand and mouse must be taught in our architecture schools, not as antithetical representations, but as integrated elements of the creative process (Gruzdyz, 2002: 66). "The computer is now able to perform many graphic tasks which were formerly done by hand but there will always be a need for landscape architects who can draw well and draw fast. Graphic skills will have a positive effect on one's ability to develop creative design ideas and on one's success at selling those ideas" (Reid, 1987: 41).

The literature shows that hand drawing is the best way to get an idea from the mind to the paper in form of a sketch or conceptual drawing. It also shows that there are increasingly helpful computer programs to assist in drawing, but that it is not clear that computers will take the place of hand drawing in professional practice. The literature review reveals that little research has been done regarding finding out how hand drawing and computer drawing are being used in specific ways. There are many indications that hand drawing is important in the early phases of design, but there have been no specific studies to support that thesis. It has also been suggested that the computer is able to assist or replace hand drawing in terms of making presentation drawings, perspectives and three-dimensional studies. The literature suggests that plan drawings and construction documents are being widely generated by the computer and that hand drawing has virtually no role in these types of drawings today, yet there has been no specific research to determine if this is true across the entire profession. It is agreed upon that drawing is the method of communication of a landscape architects ideas to a client and that it is important to hand draw as well as use technology to help in producing graphics.

III. Method and Data

1. Study Population

Two hundred eleven surveys were sent to American Society of Landscape Architects (ASLA) full members and full fellows in the Dallas Fort Worth metropolitan area on March 3, 2005. Only Dallas Fort Worth members were selected in order to have the ability to follow-up with telephone calls if necessary in order to obtain a high return rate of surveys. On March 11, 2005, one week after the survey was mailed, a reminder to return the survey was sent by e-mail to those who had not yet responded. These members were found using the ASLA membership directory. The target population was a broad range of individual landscape architects working in various types and sizes of offices. A total of 105 surveys were returned and analyzed representing a 50 % return rate from the target population.

Before implementing the survey to the selected participants, a pretest was conducted using landscape architecture students at the University of Texas at Arlington. Eighteen students were provided the survey in a controlled classroom environment and given the opportunity to complete the survey without interruptions and distractions. It took the students an average of five minutes to complete the survey. The pilot test proved useful in testing the instrument for formatting, appearance and ease of understanding. The survey was then revised to clarify any questions that were confusing or unclear.

2. The Survey Instrument

The survey instrument was a 31 question self-administered survey on the role of hand drawing in professional practice. The first eight questions were close ended in the form of multiple-choice responses. These questions were used to group respondents according to their gender, age, type of professional practice involvement, position, self-proclaimed experience level with computer drawing programs, years of experience, education level and income. The second set of six questions utilized a Likert scale to measure differences of opinions regarding the role of hand drawing and computer drawing in professional practice and the skill level of new graduates. The third set of two questions provided the opportunity for respondents to indicate the type of computer software they used and the tasks they accomplished with the use of the computer. The fourth set of fourteen questions utilized a five point Likert scale in order to measure degrees of importance of hand drawing and computer drawing by landscape architects to accomplish various types of drawings during the design process. A final question was posed to determine if the way respondents design has been affected by the use of computers. There was a blank space made available for respondents to further explain their answer to this question.

Ⅳ. Results

1. Demographics of the Respondents

In Table 1, the gender of the respondents was 79.0 % (n=83) male and 20.2 % (n=22) female. The predominant age of respondents was between 45 and 54 years of age with 43.8 % (n=46) falling in this category. 18.1 % (n=19) were between 25 and 34 years of age, 21.9 % (n=23) were between 35 and 44 years of age, 16.2 % (n=17) were between 55 and 64 years of age. The primary place of employment indicated by the respondents was a small private landscape architecture practice with 35.2 % (n=37) of the respondents indicating so. 12.4 % (n=13) of respondents worked at mid-size private landscape architecture practices, 15.2 % (n=16) worked at large landscape architecture practices, 1.0 % (n=1) at mid-size multi-disciplinary practices, 19.0 % (n=20)

at large multi-disciplinary practices and 17.1 % (n=18) were in public practice. The primary position of the respondents was that of principal with 49.5 % (n=52) of the respondents indicating such. 1.9 % (n=2) were beginning landscape architects with less than five years experience, 6.7 % (n=7) were experienced landscape architects with over five years experience, 20.0 % (n=21) were project managers, and 21.9 % (n=23) were senior managers.

When asked to indicate the level of experience with CAD programs, high level of experience was the most common answer with 38.1 % (n=40) of respondents indicating such. 7.6 % (n=8) indicated no experience, 29.5 % (n=31) indicated minimal experience and 24.8 % (n=26) indicated experience. The most prevalent number of years the respondents have been in professional practice was over 20 years with 53.3 % (n=56) of the respondents indicating such. 2.9 % (n=3) were in practice less than 5 years, 16.2 % (n=17) were in practice from 5 to 9 years, 16.2 % (n=17) were in practice 10 to 14 years, and 11.4 % (n=12) were in practice from 15 to 19 years. When asked their education level, 68.6 % (n=72) of the respondents indicated an education level of BLA and 31.4 % (n=33) an education level of MLA. When asked to indicate their income level, the most common answer was between $50,000 and $74,999 with 32.4 % (n=34) of respondents indicating such. 1.9 % (n=2) indicated an income of less than $25,000, 9.5 % (n=10) indicated an income of between $25,000 and $49,000, 25.7 % (n=25) indicated an income of between $75,000 and $99,000, and 23.8 % (n=25) indicated an income of over $100,000.

2. Importance of Hand Drawing and Computer Assisted Drawing in Daily Design Activities and Effects of Demographic Characteristics

Table 1. Socio-demographic characteristics of participants

Category		Frequency (%)
Gender	Male	83 (79.0)
	Female	22 (21.0)
Age	25 ~ 34	19 (18.1)
	35 ~ 44	23 (21.9)
	45 ~ 54	46 (43.8)
	55 ~ 64	17 (16.2)
Education	BLA	72 (68.6)
	MLA	33 (31.4)
Place of employment	Small private	37 (35.2)
	Mid-size private	13 (12.4)
	Large-private	16 (15.2)
	Multi-disciplinary (M)	1 (1.0)
	Multi-disciplinary (L)	20 (19.0)
	Public practice	18 (17.1)
Number of years in practice	0 ~ 4	3 (2.9)
	5 ~ 9	17 (16.2)
	10 ~ 14	17 (16.2)
	15 ~ 19	12 (11.4)
	over 20	56 (53.3)
Income level	Less than $24,999	2 (1.9)
	$25,000 ~ 49,999	10 (9.5)
	$50,000 ~ 74,999	34 (32.4)
	$75,000 ~ 99,999	25 (25.7)
	Over $100,000	25 (23.8)
Position	Entry level	2 (1.9)
	Experienced	7 (6.7)
	Project manager	21 (20.0)
	Senior manager	23 (21.9)
	Principal	52 (49.5)

n=105

Respondents are asked to mark one of Likert-scale ratings provided (5-agree strongly; 4-agree; 3-neutral; 2-disagree; 1-disagree strongly) about importance of hand drawing and computer assisted drawing in daily routine design activities. Respondents agreed that both hand drawing and computer-assisted drawing are important part of their daily design activities. The mean of importance of computer assisted drawing (M=4.25, Std.D.=1.17) appears higher than

the mean of importance of hand drawing (M=3.55, Std.D.=1.37) in daily design activities of respondents. Figure 1 compares overall distribution of respondents' self-reported importance of hand drawing and computer assisted drawing, and it reveals that 45.7 % (n=48) of participant strongly agree with importance of computer assisted drawing while 10.5 % (n=11) strongly disagree. About 36 % (n=38) strongly agrees about the importance of hand drawing and 7.6 % (n=8) strongly disagrees.

Gender differences in self-reported importance of hand drawing and computer assisted drawing were analyzed through T-test. The results of T-test in Table 2 indicate that there is no difference in self-reported importance of hand drawing and computer assisted drawing between male and female groups in their routine design activities. The mean differences between female and male groups is 0.01 in importance of hand drawing and 0.08 in importance of computer assisted drawings. In both cases, female group shows higher mean values for both importance of hand drawing and computer assisted drawing than male groups, but the differences are not statistically significant at p=0.05.

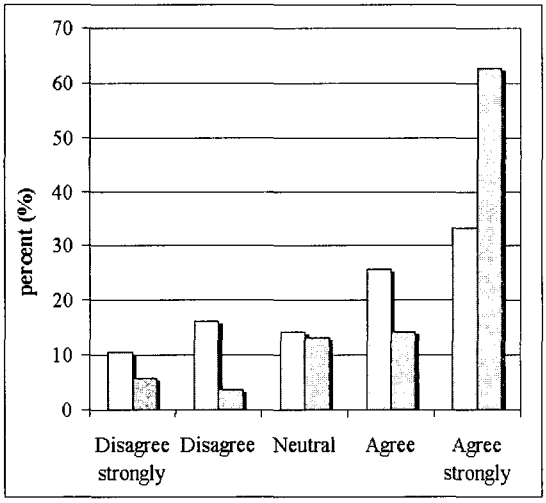

Figure 1. Distribution comparison between importance of hand drawing and computer assisted drawing.
Importance of hand drawing
Importance of computer assisted drawing

The correlation between the factors of age, position, experience with computer drawing, number of years in practice, education level and income level was analyzed in relationship to self-reported importance of hand drawing and computer assisted drawing in daily design activities. Table 3 summarizes the results of correlation analysis between demographic factors and self-reported importance of hand drawing and computer assisted drawing. The results indicate that there is no significant relationship between importance of hand drawing and computer assisted drawing (r=−0.12). Self-reported importance of hand drawing and computer assisted drawing seem dependent on each other. In specific, self-reported importance of hand drawing in participants' daily design activities is negatively correlated with place of employment (r=−0.34). Any other demographic variables of participants do not show any significant relationship with importance of hand drawing. Self-importance of computer assisted drawing is positively correlated with computer experience (r=0.45) and negatively cor-

Table 2. T-test for comparing mean differences of self-reported importance of hand drawing and computer assisted drawing between male and female groups

Perception	Gender	N	Mean	Std. D.	Mean Difference	F	p
Importance of hand drawing	Female	22	3.55	1.43	0.01	0.05	0.81
	Male	83	3.55	1.37			
Importance of computer assisted drawing	Female	22	4.18	1.25	0.08	0.02	0.86
	Male	83	4.28	1.15			

Table 3. Correlation analysis between demographic variables, importance of hand drawing and computer assisted drawing in daily design work[a]

	Age	Place of employment	Position	Computer experience	Years in practice	Education level	Income level	IHD[b]
Place of employment	−0.09							
Position	0.39**	−0.41**						
Computer experience	−0.46**	0.07	−0.26**					
Years in practice	0.68**	−0.04	0.45**	−0.42**				
Education level	0.35**	−0.01	0.14	−0.22*	0.13			
Income level	0.38**	−0.07	0.52**	−	0.54**	0.03		
IHD[b]	−0.12	−0.34**	0.16	−0.06	−0.03	−0.01	−0.05	
ICAD[c]	−0.17	0.15	−0.26**	0.45**	−0.16	−0.14	0.07	−0.12

[a]: n=105, *: $p < 0.05$, **: $p < 0.01$
[b]: IHD: Importance of Hand Drawing
[c]: ICAD: Importance of Computer Assisted Drawing

related with position ($r=-0.26$).

The correlation analysis reveals a few interesting aspects of the relationships between demographic characteristics of participants with self-reported importance of hand drawing and computer assisted drawing in daily design activities. Interestingly enough, participants in larger firms tend to report that hand drawing techniques are less important in their daily design activities. This is might be because the types of landscape architects' work in large firms are more document oriented rather than actual landscape design while work type in small firms are drawing oriented. Apparently computer assisted drawing was reported as to be less important as the positions of participants gets higher. Considering that the position is also negatively correlated with experience of computer ($r=-0.26$), the position itself might not be the main factor. An explanation of this correlation might be that participants at a higher position don't have enough computer experience and don't use computer often because of lack of knowledge and experience. Additional consideration must be given to when computer technology is available in the landscape architecture profession. Simply senior designers with higher position might not have the opportunity to learn computer assisted drawing skills, not because of their preference.

Another possible explanation has to deal with work type at higher position that demands less computer experience and uses. Together these factors lead participants at higher position report that computer assisted drawing does not play important role in their daily design activities.

3. Evaluation on Level of Skill in New Graduates for Hand Drawing and Computer Assisted Drawing

A set of questions was used to measure the opinions of respondents in the skills of hand drawing and computer assisted drawing in new graduates. Respondents were asked to select one of the Likert-scale ratings provided (5-agree strongly; 4- agree; 3-neutral; 2-disagree; 1-disagree strongly). The mean responses for hand drawing and computer- assisted drawing are 2.84 and 3.41 respectively. Figure 2 reveals more details of participants' opinion on skill level of new graduates on hand drawing and computer assisted drawing. Surprisingly 38.1 % (n=40) of participants show that hand drawing skills of

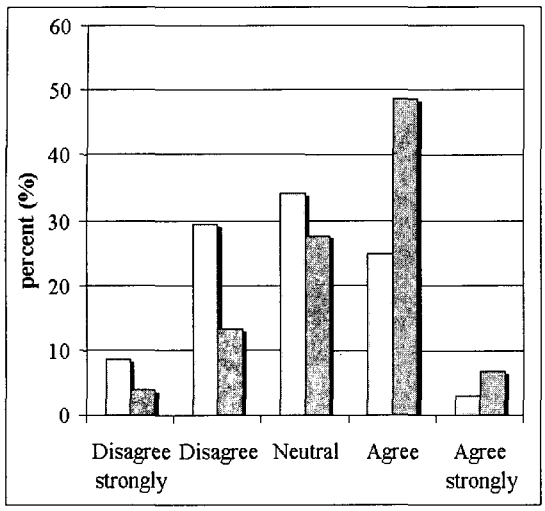

Figure 2. Distribution comparison between evaluated skill level of new graduates on hand drawing and computer assisted drawing.
Hand drawing skills
Computer assisted drawing skills

new graduate are adequate while only 27.7 % (n=29) agrees or strongly agrees that new graduates have adequate hand drawing skills. More than half of participants agree (48.6 %, n=51) or strongly agree (6.7 %, n=7) that computer assisted drawing skills of new graduates are adequate.

Gender differences in skill level of hand drawing and computer assisted drawing of new graduates were also analyzed through T-test. The results of T-test in Table 4 indicate that there is no significant difference in both skill levels between male and female groups. The mean differences between female and male groups is 0.09 in adequate level of hand drawing skills and 0.12 in computer assisted drawing skills of new graduates.

The results of the correlation analysis in Table 5 show interesting aspects of the relationship between demographic variables of participants and their opinions on skill adequacy on hand drawing and computer assisted drawing of graduates. Observed adequacy on hand drawing skills is negatively correlated with participants' position ($r=-0.19$), years in practice ($r=-0.19$) and their income level ($r=-0.20$). Age, place of employment, computer experience and education level of participants do not show statistically significant relationships with obser-

Table 4. T-test for comparing mean differences of level of skills of new graduates in hand drawing and computer assisted drawing between male and female groups

Perception	Gender	N	Mean	Std. D.	Mean Difference	F	p
Hand drawing skills of graduates	Female	22	2.91	0.92	0.09	1.65	0.20
	Male	83	2.82	1.01			
Computer assisted drawing skills of graduates	Female	22	4.18	0.94	0.12	0.04	0.83
	Male	83	4.28	0.94			

Table 5. Correlation analysis between demographic variables, hand drawing and computer assisted drawing skills of new graduates[a]

	Age	Place of employment	Position	Computer experience	Years in practice	Education level	Income level	IHD[b]
HDSG[c]	−0.17	0.06	−0.19*	−0.05	−0.19*	0.02	−0.20*	
CADSG[d]	0.19	−0.01	0.15	−0.37**	0.18	0.07	0.19	−0.06

[a]: n=105, *: $p<0.05$, **: $p<0.01$
[b]: IHD: Perceived Importance of Hand Drawing
[c]: HDSG: Hand Drawing Skills of Graduates
[d]: CADSG: Computer Assisted Drawing Skills of Graduates

ved hand drawing skills of graduates. Interestingly enough, only the computer experience of participants shows significant relationship with the observed computer assisted drawing skills of graduates. In other words, more computer experienced participants tend to think new graduates' computer drawing skills are not adequate. One of possible explanations could be participants who have enough experience and knowledge of computer assisted drawing in practice expect more skills from graduates, and computer skills of graduates do not meet their expectations. On the contrary, less computer experienced participants report that computer skills of graduates are adequate.

4. The Use of Hand Drawing and Computer Assisted Drawing in the Design Process and Documents

A question was used to determine the type of computer software landscape architects in professional practice were using on a regular basis. Respondents were asked to check as many responses as applied to them. 83 % of the respondents indicated that they used CAD software on a regular basis. Only 4 % indicated they used Sketchup, 54 % indicated they used photo-imaging software, 10 % used three-dimensional software, and 4 % used animation software. These results indicate that the vast majority of landscape architects in the Dallas / Fort Worth metropolitan areas are using computer assisted drawing software, and that over half are using photo-imaging software. Very few are using Sketchup, three-dimensional and animation software.

A question was used to determine what tasks in the design process landscape architects were using the computer to help them accomplish. 39 % of the respondents indicated that they used the computer in conceptual design, 62 % used the computer in design development, 53 % used the computer in schematic design, 81 % used the computer in working drawings, 67 % used the computer in final presentation drawings, and 54 % used the computer in firm qualification presentations. When comparing these results to the research of Tai (2003), it was found that more landscape architects in this study were using the computer in conceptual design and design development that were in the Tai study. In accounting for this difference in results, it could be the format of the survey. The Tai survey was a web based survey and this was a mail survey. One could assume that a web based survey would have responses that were more computer oriented, however this was not the case. Another explanation for the differences in the results may be that in the past two years, there have been advances in the use of the computer in the design process which leads to the use of the computer earlier in the design process.

The set of questions were used to assess the importance of hand drawing and computer assisted drawing in the production of certain types of graphic documents. Respondents were asked to select one of the Likert-scale ratings provided (5-extremely important; 4-important; 3-neutral; 2-not very important; 1-not important at all). In Figure 3, the

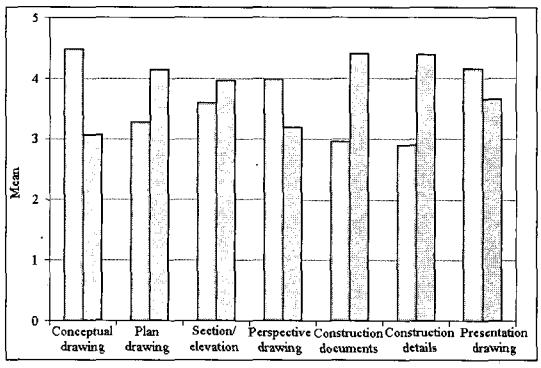

Figure 3. Comparison mean importance of hand drawing and computer assisted drawing in the production of certain types of graphic documents.
Hand drawing
Computer assisted drawing

mean response for the importance of hand drawing to produce conceptual drawings was 4.49, to produce construction documents was 2.95, to produce construction details was 2.89, to produce plan drawings was 3.39, to produce sections and elevations was 3.59, to produce perspective drawings was 3.98, to produce presentation drawings was 4.17. This indicates that hand drawing remains important to very important in the production of conceptual drawings, perspective drawings and presentation drawings. Hand drawing is not very important to neutral in the production of construction documents and construction details.

The mean response for the importance of computer assisted drawing to produce conceptual drawings was 3.07, to produce construction documents was 4.42, to produce construction details was 4.40, to produce plan drawings was 4.15, to produce sections and elevations was 3.97, to produce perspective drawings was 3.20, to produce presentation drawings was 3.65. This indicates that computer assisted drawing has become important to very important in the production of construction documents, construction details, plan drawings, and sections and elevations. Computer assisted drawing is least important in the production of conceptual drawings.

5. The Effect of the Use of Computers on Design

A final question was used to determine if the computer has affected the way landscape architects design. 52 % of the respondents indicated that the computer has affected the way they design. 48 % indicated that they way they design has not been affected by the computer. There was room provided in the survey for respondents to reply to this open-ended inquiry.

In summarizing the comments of the respondents, positive replies included that enhanced design option investigations are quicker and easier with the computer and provide greater accuracy. Computer assisted drawing makes it easy to work out geometry or grading more quickly. Visualization of geometry is made easier, respondents tended to use more geometric lines and forms. There is more professional presentation, the ability to share drawings and accurate project data with affiliated professionals, quick transmittal through e-mail, less storage costs and preservation of electronic drawings. There is the opportunity to explore more design alternatives in a more effective manner. Revisions are easy to accomplish and are much more cost effective. The ability to quickly explore plan and section relationships leads to better design decisions. The pace of designing is faster. The ability to edit, adjust and compare options helps find the best solutions more quickly, and the landscape architect can hone a design and rework to produce higher quality. Efficiency is increased by the use of the computer and the ability to re-use notes, details, and symbols.

Some of the respondents indicated that the computer was limiting. The computer slows design down and stops free flow thought during the design process. It inhibits the freedom to create and see the overall concepts. One of the negative impacts of the computer on design included that designers tended to be more precise with the computer, sometimes to a fault. There is a negative influence on conceptual "feelings" of scale and material selection. One honest respondent said the computer has made them lazy, and that when they were hand drawing they thought more about the design because it took longer and any mistakes were more costly.

Respondents indicated they were more willing to experiment with design because changing the design is easier in the computer. One comment was that they believed there is a stronger link between the brain and the hand than between the brain and the

computer screen. Learning to draw by hand well makes someone better on the computer and hand drawing gives you a better feel of the design. Once the design is done, the computer can help refine it.

There was consensus among the respondents that both hand drawing and computer drawing are needed to stay competitive in today's environment and that hand drawing and sketching is faster and better for one on one conceptualization with clients and groups and to explain and direct ideas to computer staff and technicians. Many of the respondents used a hybrid type of drawing, using the computer to develop wire-frame perspectives and then using traditional drawing methods to make the presentation drawings. The ability to provide a client with quick sketches and alternatives to a proposed design in a manner they can understand is important. Some believed you could generate more creative ideas with a pencil than with a computer. Hand drawn presentation graphics provide more 'splash' and are more awe inspiring and provide a higher comfort level than hard line, uniform colored computer drawings.

V. Discussion and Conclusions

The survey data support the findings from literature review that there are certain phases of the design process and types of drawing that are more frequently performed by hand rather than computer. Hand drawing is seen as an important method in conceptual design drawings, perspective drawings and presentation drawings. Computer drawings are seen as more important in plan drawings, construction documents and construction details. Sectional and elevation drawings are being produced both by hand and computer. Hand drawing remains the most frequently used method of drawing at the conceptual phase of the design process and the computer has become the most frequently used method of drawing in working drawings and design development drawings. A hybrid type of drawing has emerged in the production of presentation drawings. This hybrid drawing may take the form of a hand drawing being scanned and enhanced in Photoshop resulting in a final presentation drawing, or taking a computer rendered perspective and overlaying with trace to produce a hand rendered softer presentation perspective. Over half of the respondents indicated that their design has been affected by the use of computers. Their design has been affected in many ways, from geometric forms being used in computer design, to the opportunity to explore more design options more quickly.

When comparing this research to earlier research by Tai (2003), it was found that more landscape architects in this study are using the computer in conceptual design, design development and schematic design. When compared to the Tai study, fewer landscape architects in this study are using the computer to produce working drawings, final presentations and qualifications presentations. This may be explained by the differing survey methods. Tai used a web-based survey that may have biased respondents towards computer-oriented answers. It might also be explained in the population target that was surveyed. Tai's target population was executive members of the ASLA and this study was given to a broader general full membership of ASLA.

The types of software most prevalently being used by landscape architects are computer assisted drawing software and photo imaging software. There is little present use of three dimensional software, animation software and Sketchup by landscape architects. Some of the three dimensional and animation presentations may be produced by those other than landscape architects.

When looking at the correlation of factors that affect the use of hand drawing, the higher the position of the landscape architect is, the more im-

portant hand drawing becomes as part of their daily activity. This is also true of income. The higher the income level of a landscape architect, the more important hand drawing is. The longer a landscape architect has been in practice, the more important hand drawing is. The more experience one has with computer drawing, the less important hand drawing becomes. Other factors did not have a significant correlation. There is also a high correlation between income, age, number of years in practice, income level and position of landscape architect. This may explain the high correlation between position and the importance of hand drawing as part of a landscape architect's daily activity.

When looking at the correlation of factors that affect the use of computer drawing it was found that the older a landscape architect is, the less important computer drawing is in their daily activities. The more experience a landscape architect has with computer assisted drawing, the more important computer assisted drawing is to them in their daily activities. The longer a landscape architect has been in practice, the less important computer drawing is, and the higher the education level of a landscape architect, the less important computer drawing is in their daily activities.

The computer technology has affected the way landscape architects design and will continue to do so as computer-assisted drawing completes more tasks. Hand drawing will continue to have an important part in the communication of ideas in the conceptual phase of the design process. An emergence of a new hybrid method of drawing has taken place. This hybrid drawing is prevalent in the production of presentation drawings. It is important for landscape architects to become proficient in the use of computer assisted drawing in order to remain competitive and efficient when it comes to the production of working drawings, construction documents and construction details. As three-dimensional and animation software become more commonly used, it will also be important for landscape architects to use these tools. Thus, it is important to educate, both at the university level and through continuing education, landscape architects in both hand drawing and computer drawing methods and to focus the exercises on the way hand drawing and computer drawing are being used in professional practice.

Some of study limitations should be discussed. On of limitations has to deal with geographic location of the study site. The study results might not be evident in elsewhere US and Korea. As a matter of fact, it would be even interesting if a further study compares differences between these results and similar investigation surveyed from Korean practitioners. Also, this study did not take into account project characteristics. Some of project and design process may require certain types of computer assistances regardless preferences of designers on computer assisted drawing. It is also noteworthy that intercorrelations were found among personal characteristics of respondents. These variables might be condensed into reduced variable dimension through factor analysis. However, condensed personal variables would loose specificity of characteristics. Thus, it is very apparent additional investigation tools including more rigorous literature review on roles of drawings in our profession and face to face interview to clarify the study results.

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