5-2014

An Evaluation of Current Applications of 3D Visualization Software in Landscape Architecture

Jie Yan
Utah State University

AN EVALUATION OF CURRENT APPLICATIONS OF 3D VISUALIZATION SOFTWARE IN LANDSCAPE ARCHITECTURE

by

Jie Yan

A thesis submitted in partial fulfillment
of the requirements for the degree

of

MASTER OF LANDSCAPE ARCHITECTURE

Approved:

Shujuan Li, PhD Major Professor	Bo Yang, PhD Committee Member
Joanna Endter-Wada, PhD Committee Member	Mark R. McLellan, PhD Vice President for Research and Dean of the School of Graduate Studies

UTAH STATE UNIVERSITY
Logan, Utah

2014

ABSTRACT

An Evaluation of Current Applications of 3D Visualization

Software in Landscape Architecture

by

Jie Yan, Master of Landscape Architecture

Utah State University, 2014

Major Professor: Dr. Shujuan Li
Department: Landscape Architecture and Environmental Planning

With the rapid development and widespread use of 3D software, an increasing number of landscape architects are applying 3D technology to their projects in order to supplement their traditional 2D methods. 3D technology can create visualizations that simplify complex and abstract information for clients. This technology allows, and even insists, that landscape architects integrate other disciplines and the related information of those disciplines into their work. Because the information is available, landscape architects are held accountable for that information and are increasingly expected to use that information to inform and substantiate their work. Landscape architects are often expected to produce quantifiable substantiation that their designs will yield ecological, economic, and functional benefits. Some people argue that the high cost and time investment needed for the use of 3D software are significant deterrents for most designers and firms to use the software. However, little research has been conducted to investigate the extent to which landscape architects have adopted 3D software. In addition, even less is known about their opinions on the software's suitability for their professional needs.

The primary objective of this study is to identify current trends, opinions, and barriers to applying 3D visualization software in the field of landscape architecture. Data were gathered through online surveys of landscape architecture professionals who are members of the American Society of Landscape Architects and educators from universities with landscape architecture programs. Overall, the respondents appear to have made limited use of 3D software. The results of this study provide insights into the current state of 3D applications in the landscape architecture profession. However, respondents did express a desire to know more about 3D visualization tools in the future. These findings suggest that there is a need for more dialogue between landscape architecture practitioners and landscape architecture educators to help students effectively prepare for their future professional roles in the workplace. There are also some indications that new 3D software development is desired by landscape architecture professionals for particular benefits it can bring to their work, such as reducing time for various tasks, simplifying the software learning process, and rendering photorealistic images.

(80 pages)

PUBLIC ABSTRACT

An Evaluation of Current Applications of 3D Visualization
Software in Landscape Architecture

Jie Yan

The design process is important to all landscape architects. It helps generate ideas to solve problems in an efficient amount of time and insure that all stages of a project are completed. Generally, a design process includes project acquisition, inventory and site analysis, conflicts identification, public involvement, draft products, and final presentation. Among these elements, public involvement has been recognized as one of the most important elements in the landscape design process. It not only helps professionals get projects done smoothly, but it also helps with long-term client retention. Traditional two-dimensional communication methods using renderings, design plans, and maps have not been fully successful in their ability to engage and sufficiently inform clients and stakeholders. While professional planners are able to rely on their experience to help them visualize proposed landscapes, the average client is often overwhelmed by the relatively complex and abstract information, and unable to translate this information into landscape visions. Developments in the field of 3D graphics have dramatically extended possibilities to overcome this barrier by providing a tool that produces designs that are easy to comprehend and helps clients better visualize the end product that the designer has put forth. Some people argue that the high investment cost of 3D software such as ArcGIS, 3Dmax, etc., and its time-consuming process to master, is too great an obstacle for most designers and firms to use the software in their work with the average client or stakeholder. However, little research has been done to investigate the extent to which landscape architects have adopted the 3D software. We know even less about their opinions on the suitability of existing 3D software packages to meet their professional needs.

A nationwide survey about current use and future demand for 3D simulation software within the landscape profession was conducted for this thesis. Comprehensive online surveys were sent to two groups: (1) landscape architecture firms and freelance landscape architects; and (2) institutions with landscape architecture programs. In total, 3,434 firms and freelance architects were identified based on data from the American Society of Landscape Architecture. Names and contact information of ninety-one faculty members from institutions with landscape architecture programs were found on the Council of Educators in Landscape Architecture website.

The opportunities and challenges of 3D visualization technology and its potential applications in landscape and environmental planning have been examined based on the findings from survey results. The results are relevant to the future improvement and innovation of 3D visualization software in the landscape architecture profession and can assist landscape architecture educators with future curriculum development.

ACKNOWLEDGMENTS

I would like to thank all the people that provided support and encouragement throughout this process and its related endeavors. In particular, I would like to express my true gratitude to my major professor, Dr. Shujuan Li, for providing excellent guidance, advice, and mentorship. I would like to thank my committee members, Dr. Bo Yang for expanding my thinking in ways that I could not get from landscape architecture alone, and Dr. Joanna Endter-Wada for her invaluable insight and extra time she spent on editing my thesis.

I also give thanks to Dr. Thomas Schroeder, from the Department of English, for all of his help and encouragement.

In addition, special thanks to my friends Kate Spears and Tom Cluff for their help, and my family for providing support and encouragement in my choice to be a landscape architect.

In the end, I would like to thank all the landscape architecture professionals and professors across the country who helped with this study by responding to the survey.

Thank you!

Jie Yan

CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Problem Statement

With the rapid development and widespread use of 3D software, an increasing number of landscape architects are applying 3D technology to their projects in order to supplement their traditional 2D methods of landscape representation. This technology's unique capabilities can create visualizations that simplify complex and abstract information for clients. This technology allows, and even requires, that landscape architects integrate other disciplines and the related information of those disciplines into their work (Hanna, 1999). With the growth of environmental consciousness in the 1970s and with the transference of public agency data into digital formats, landscape architects are now held accountable for a wide variety of information and are increasingly expected to use that information to inform and substantiate their work (Hanna, 1999). Landscape architects are often expected to produce quantifiable support that their designs will yield ecological, economic, and functional benefits.

Some people argue that the high cost and time investment needed to implement the use of 3D software is a significant deterrent to its use for most designers and firms (Paar, 2006). However, little research has been performed to investigate the extent to which landscape architects have adopted 3D software. In addition, even less is known about their opinions on the software's suitability for meeting their professional needs.

Research Objectives

The overarching goal of this study is to evaluate the existing applications of 3D software in landscape architecture profession practice and landscape architecture programs in the United States. By administering a survey to landscape architecture professionals and educators, it is possible to identify current patterns in the use of 3D technologies, the activities and the tasks in which 3D technology is employed, and the 3D practical skills that help landscape architecture practitioners function effectively. This study contributes to the field of landscape architecture in three ways. First, this study will produce quantifiable data on the degree of 3D software programs use in the profession. Second, educators in the field will be able to incorporate insights from the study into curriculum design and course development in order to best educate students on the most useful and appropriate programs that are being employed. Third, 3D software developers will be able to use the information to improve existing software and create new programs better suited for landscape architecture.

The more specific objectives of this study are to:

- understand trends in current 3D software use in landscape architecture;
- identify 3D skills and knowledge needed for landscape architects;
- discover critical factors affecting 3D software use in landscape architecture;
- seek feedback on preparing students with 3D graphics for the workplace; and
- provide recommendations to improve 3D software programs for use in the landscape architecture profession.

Study Limitations

One limitation is that the study lies on the assumption that all landscape architecture practitioners and educators can get access to 3D software. However, even though they may have access due to the availability of free 3D software such as Google Sketchup, some landscape architects who specialize in small-scale projects such as yard design may not need 3D software for their projects. Additionally, landscape architects who are working for public agencies are not included in the sampling frame because of the lack of contact information and the limitation of time and cost.

Thesis Organization

The first chapter explores current problems with 3D software application in landscape architecture and introduces the research objectives. In the next chapter, a literature review on the applications of 3D software in landscape architecture and introductions to several widely used 3D software programs are given to help refine research questions by providing the context for the study and articulating the knowledge gap. The methodology section provides a description of the sampling frames and methods and describes the data collection approach. This chapter also includes background information in the form of a summary of current curricula of different landscape architecture programs. The results section describes the survey findings and trends. In the end, the conclusion, discusses the implications of the findings and lists recommendations for future studies.

CHAPTER II

LITERATURE REVIEW

The purpose of this literature review is to examine existing information relevant to this study. It provides the reader with background knowledge of 3D software and its applications in landscape architecture, associated methodologies, and gaps in research. The literature review also helps to define and narrow the problem addressed in this thesis. This literature review is divided into two sections that will describe: (1) applications of 3D landscape visualizations; and (2) the 3D tools that currently are used in landscape architecture.

Applications of 3D Landscape Visualization

Today, 3D visualization tools are becoming increasingly important in many fields of study. In geography, it is considered as an essential informational approach for purposes such as communicating existing conditions and alternative landscape scenarios for research, education, and consultation (Priestnall & Hampson, 2008). In landscape planning, 3D visualization can help build consensus on public issues by transforming large amounts of data into understandable images (Bishop & Lange, 2005). It can also serve as an engagement medium in public participatory decision-making processes (Stock et al., 2009; Wu, He., & Gong, 2010).

In the field of landscape architecture, 3D landscape visualization has a relatively shorter history than other forms of landscape representation (Ervin & Hasbrouck, 1999). Historically, landscape professions have not been thought to benefit from the use of 3D software (Hehl-Lange, 2001). The earliest effort to place 3D symbols in a landscape image was accomplished in 1969 by Harvard Spatial Analysis Laboratory. Not until 1985 did early pioneers adopt 3D computer tools in landscape architecture (Ervin & Hasbrouck, 1999).

The development of 3D software was accelerated by the booming growth of virtual reality technology in the digital gaming industry (Herwig & Paar, 2002). Shortly thereafter, virtual reality began to be used in spatial modeling. The technique of merging image processing with geometric modeling opened the door for real-time rendering of virtual models (Danahy, 2001). However, during this time, many forms of information, such as leaf texture in 3D models, were not able to be synthesized by computers and had to be sampled from the real world (Ervin & Hasbrouck, 1999).

Over the past 20 years, significant research has been conducted to explore the applications of 3D technology in visualization. A status report on computer use in landscape architecture in 1993 indicated that few professionals used GIS or other 3D software in the design process (Palmer & Buhmann, 1994). A survey about projects that used GIS and virtual reality technology from 1993 to 1998 showed a rapid increase in 1994 and steady increases until 1998, after which there was a sharp decrease until 2001 (Haklay, 2002). The study concluded that the decline was due to the integration of virtual reality technology into standard software, which reduced the justification for specialized research projects. According to that survey, using virtual reality and GIS as tools for research projects in the field of urban and regional planning made up 29% of the total use of 3D software (Haklay, 2002). Prior to 1993, only a limited number of government agencies required 3D landscape simulations as a standard procedure for landscape planning and management (Lange, 1994; Sheppard, 1989). The similarity between the actual landscape and the landscape representation had been questioned, due in part to the accuracy and validity of landscape representation (Daniel, 1992). Today, because of significant improvements in image quality and related computer technologies, there is an increased level of detail in 3D visualizations. From the research conducted by He, Yang, Shifley, and Thompson (2011), the increase in detail helps eliminate ambiguity and increase the validity of visualization results.

Despite this array of knowledge regarding the inception of 3D software use and its integration into the field of landscape architecture, there is a much more limited body of work dealing with user evaluations of landscape visualization. In 1997, a nationwide survey about the computer skills and training of landscape architecture professionals was conducted (Palmer, 1997). The survey found that two-thirds of the respondents' computer skills were self-taught, and a lack of standard training in landscape architecture was one of the biggest obstacles that hindered computer applications in landscape architecture (Palmer, 1997). Paar (2006) surveyed environmental planners, landscape practitioners and other related professionals in Germany in 2006. He concluded that 3D software has a positive future in landscape visualization in Germany. A criterion for evaluating the overall landscape visualization quality was designed by Sheppard and Cizek (2009). The criterion established six visualization quality categories: accuracy, representativeness, visual clarity, interest, legitimacy and access. However, in the United States, little research has been conducted since 1997 to evaluate the current conditions of 3D landscape visualization in communicating designed landscape futures to users. This gap is also apparent within the field of landscape architecture education where few researchers have explored the role of 3D computer technology on teaching and learning within the field of landscape architecture (Sheppard, 2001; Nielsen, Fleming, Kumarasuriyar, & Gard, 2010).

3D Visualization Tools

There are many 3D visualization tools available today. In landscape architecture, the most commonly used 3D software packages include Google Sketchup, ArcGIS, AutoCAD, 3D Studio Max, Maya, VuE, etc. While some software packages are very comprehensive and include 3D visualization and analysis functions (e.g., ArcGIS, AutoCAD), some are 3D-orientied, like Google SketchUp, and 3D Studio Max.

ArcGIS developed by the Environmental Systems Research Institute (ESRI) is a Geographic Information System (GIS) software package. There are four products within ArcGIS with some adding higher levels of functionality to the basic package. ArcReader is a free viewer for maps which can view and print all maps and data types generated by other ArcGIS Desktop products. It also has some simple tools to explore and query maps. ArcView provides extensive mapping, data use, and analysis capabilities, along with simple editing and geo-processing functions. ArcEditor includes advanced editing for shape files and geo-databases in addition to the full functionality of ArcView. ArcInfo is the upgraded version of both ArcView and ArcEditor but with advanced geo-processing. It also includes the core applications for ArcInfo Workstation.

ArcGIS is frequently used in landscape architecture and many other disciplines for its 3D capabilities. ArcGIS has three major components for 3D analysis and representation—3D Analyst in ArcToolbox, ArcScene, and ArcGlobe. ArcGIS 3D Analyst is a toolset for 3D data analysis. It allows users to view a surface from multiple viewpoints, query a surface, determine visible points from a chosen location on a surface, and create a realistic perspective image that drapes raster and vector data over a surface. ArcScene and ArcGlobe allow the managing and visualizing of extremely large sets of 3D geographic data from a local or global perspective. 3D landscape design is also possible in ArcGloble with large amount of 3D features in its symbol library.

Autodesk Maya and 3D Studio Max are currently the world's most popular integrated 3D modeling, animation, effects and rendering solutions. Autodesk Maya combines an industry-leading suite of 3D visual effects with computer graphics and character animation tools, and it facilitates creative vision for design projects. 3D Studio Max is a professional 3D animation rendering and modeling software package used mostly by game developers and design visualization specialists.

AutoCAD Map 3D is an ideal tool for professionals involved in mapping, planning, and infrastructure management projects. AutoCAD Map 3D provides a wide range of ways to convert GIS features to CAD objects and vice versa. Compared to ArcGIS, it is more interoperable in terms of collecting a variety of both geographical data and project related data. It also provides an opportunity to directly edit more types of user-defined entities. Since its initial release in 2004, AutoCAD Civil 3D has gained its reputation in landscape architecture from its intelligent objects and dynamic modeling.

Rather than relying on generic CAD entities, AutoCAD Civil 3D provides real-world objects that are related to other objects. For example, when an object is edited, the changes will be reflected automatically in all related objects. AutoCAD Plant 3D is relatively new to the AutoCAD family of programs. First released in 2009, AutoCAD Plant 3D had the unique ability to create material lists and bills, which update as the design evolves. This feature can help landscape architects with project budget calculation.

Vectorwork Landmark, developed by Nemetscheck, represents a means of 3D visualization of spatial information. It is built with the AutoCAD BIM system and creates its own menu and panel of tools, which can help increase productivity. Vectorwork is also Mac compatible, while AutoCAD did not have industry standard for Mac until 2012. The only AutoCAD feature that is missing in Vectorwork is modifying block attributes.

Vue, a specialized landscape 3D software program, allows 3D modeling of existent and non-existent landscapes with high realistic visualization, rendering both as still images or animations (Sheppard, 2001). Another 3D software similar to Vue is Bryce from DAZ 3D. Bryce, which was first released in 1996, is probably one of the best known 3D landscape software. However, it has struggled in recent years due to company takeovers. The uncertainty of its company transitions gave its competitor—Vue—enough time to overtake its 3D landscape rival.

Bryce and Vue have a lot in common. They probably share more features than any other 3D applications. Two main differences are on their prices and features. Historically, Bryce was more expensive than it currently is. The newly released Bryce 7 Pro is free to users at this time. E-On Software raised the prices of Vue 7 but offers occasional promotions to obtain the software at discounted prices. Comparing the current versions of these two software programs, Vue has the edge in terms of features. Some of these features have very significant improvements over what Bryce can offer, but Bryce still has advantages in terms of ergonomy and a nicer interface and scene preview. Vue improved its scene preview significantly in V7, adding anti-aliased lines for example, but it is still not comparable with Bryce in that respect (French, 2010).

SketchUp by Google is another commonly used 3D tool in landscape architecture. This free 3D software allows creating, viewing, and modifying 3D representations in a relatively quick and easy way. A professional version (SketchUp Pro) is available for advanced users. The free version has sufficient 3D visualization capabilities for small-scale projects. One effective function of SketchUp is that users do not have to depend on the much more complicated traditional graphic design software (e.g., CAD). It has the further advantage of being closely linked to both the GIS software from which users export the locations of changed land use, and the Google Earth tool that can be used to show the final visualizations. Google Earth often supplements SketchUp as its presentation platform, presenting and exchanging geo-information. It is easy to use and is available for download and use by anyone. Exporting files from SketchUp to Google Earth is easy because the buttons are standardized. Although visualizing 3D images in Google Earth needs a lot of computer capacity, the availability of the aerial photos, the large scale on which the user can present information, and the geo-referencing of the data are big advantages over professional 3D software (Maya, 3D Studio Max, etc.), which need a lot of processing RAM for large area calculations. Google Earth can be used live during a presentation if an Internet connection can be accessed. This makes it possible to access information and show it to audience immediately (Table 1).

Table 1.
A Comparison of Commonly Used 3D Software in Landscape Architecture

	Price	Educational version	Initial release*	Platforms	Main applications	Animation	Rendering	Wireframe
3D Studio Max	$3,495	One-year Free	1988	Win	Modeling, animation, lighting, rendering, video game creation, visual 3D effects, post-production video editing	Yes	Yes	Yes
AutoCAD Civil 3D	$6,825	One-year Free	2004	Win	Basic 3D modeling	Yes	Basic	Yes
AutoCAD Map 3D	$5,245	One-year Free	2005	Win	Basic 3D modeling	Yes	Basic	Yes
AutoCAD Plant 3D	$8,922	One-year Free	2009	Win	Basic 3D modeling	Yes	Basic	N/A
ArcGIS	$5,000-$40,000	One-year Free	1999	Win	Modeling, geo-processing	Yes	Basic	No
Bryce 3D	$19.95	Freeware	1996	Win, Max OS	Modeling, animation, lighting, rendering, visual 3D effects	Yes	Yes	Yes
Google SketchUp /Pro	Free/$495	Free	2000	Win, Max OS	Computer aided design	Yes	Yes	Yes
Maya	$3,495	One-year Free	2007	Win, Max OS, Linux	modeling, animation, lighting, rendering, video game creation Visual 3D effects, post-production video editing	Yes	Yes	Yes
Rhinoceros 3D	$995	$975 for school license	1998	Win, Max OS	Modeling, computer aided design	Yes	Yes	Yes
Vectorwork	$1,441-$2,895	Free	1999	Win, Max OS	Computer aided design	Yes	Yes	Yes
Vue	$1,495	$149	2005	Win, Max OS	Landscape modeling, animation and rendering	Yes	Yes	N/A

* Initial released date is based on the first commercial version released date.

Summary

This chapter reviews literature and information that is important to this particular study. This literature review provides background on the current state of applying 3D software tools in landscape architecture. It is also the groundwork for development of the research methodology in this study.

From a review of literature specific to landscape architecture, it is apparent that very little research has been done concerning current use of 3D visualization tools in landscape architecture, let alone the challenges and requirements facing 3D visualization software users. Further, no studies were found that researched possible gaps in teaching and practice between landscape architecture practice and landscape architecture education. The goal of this study is to gain a better understanding of the current use of 3D software and, in particular, to provide baseline descriptions of the current condition and the influential factors involved in the landscape architecture profession's use of these tools. Study results are intended to assist landscape architecture educators with curriculum and course development and may also influence future developments in 3D visualization software.

CHAPTER III

METHODOLOGY

This chapter describes the methods used in this study to achieve the proposed research objectives. This chapter has three sections: (1) survey design and selection of study groups; (2) data collection procedures; and (3) data analysis methods. The first section includes a description of the survey instrument as it relates to the research objectives. The first section also includes the reasons for choosing the instrument, organization of the survey and a description of the study groups. The second section includes the strategies used to distribute the instrument and collect the data. The last section describes the statistical tests used to obtain descriptive findings.

Survey Design and Sample Groups

For this study, an online survey was determined to be the best instrument for data collection. In general, self-completed surveys and face-to-face interviews are two of the most common ways used in social studies to gather information from people. Interviews often provide information that reflects interviewees' real thoughts because sometimes people are willing to tell interviewers things that they do not want to write down (Sommer & Sommer, 1991). However, considering the large sample groups and their geographic distributions all over the country, an online self-completion survey method was more appropriate and feasible than interviews in this study. According to Henderson, Morris, and Fitz-Gibbon (1978), advantages of self-completion surveys (also referred to as questionnaires) include "[permitting] a person a considerable amount of time to think about answers before responding" (p. 29). Self-completion surveys can be given to many people at the same time, providing better uniformity of measurements than interviews. In general, the data surveys provide can be more "easily analyzed than the data received from oral responses" (Henderson et al., 1978, p. 29). The feasibility of distributing and retrieving data to a geographically-dispersed populations and the ease of processing large amounts of data made online self-completion surveys more appropriate than interviews for this study.

In general, a successful survey design needs to meet three criteria. These three criteria ensure that only necessary questions are asked, questions are worded in an understandable manner and with clear terminology, and questions must be related to the research objectives of the study (Foddy, 1993). In this study, two lists of questions were carefully designed to serve as a means of clarifying how these criteria were met, including information on the following:

- the background of participants and their firms/institutions;
- the current incorporation of 3D software by landscape architecture firms and institutions;
- the familiarity of landscape architecture practitioners and educators with 3D software;
- the interest in future use of 3D software in landscape architecture; and
- desirable impact of 3D software on landscape architecture.

The self-completion surveys were developed separately for landscape architecture practitioners and educators. Both questionnaires had two different sections. While the first sections in both questionnaires were the same, the second sections differed.

Information collected in the first section of both questionnaires included demographic information, such as age, gender, and educational background, current job titles and responsibilities, and company/institution information. The second section for landscape architecture professionals examined their current applications of 3D software and their perceptions of its future use in performing their jobs. The questionnaire for landscape educators also covered questions related to the current use of 3D software, but put more weight on their learning and teaching experience (see Appendices A & B).

Survey questions were mostly close-ended but with space for participants to provide "other" open-ended answers, particularly in response to questions asking them for their evaluations or opinions. This approach provided for consistent investigation of particular topics with the participants, but also afforded flexibility to solicit further comment and deeper insight (Sommer & Sommer, 1991). This approach allowed respondents to express personal experience, therefore providing more reliable information. Furthermore, survey questions were structured so that related questions were grouped together. For instance, in the landscape architecture professional questionnaire, question B1and B2 were both related to using 3D software (Table 2). Grouping connected questions together helps simplify data processing and also helps respondents logically think through the form (Foddy, 1993).

Table2

Research Questions and Data Types

Research Construct	LA Professionals			LA Educators		
	Question #	Data type	Key words	Question #	Data type	Key words
Background	A1	Nominal	Gender	A4	Nominal	Gender
	A2	Nominal	Work experience	A6	Nominal	Work experience
	A3	Nominal	Education	A7	Nominal	Education
	A4, A5, A7,	Nominal	Respondent's employer	A1, A2, A5	Nominal	Respondent's employer
	A6	Nominal	Geographical area	A3	Nominal	Geographical area
	A8	Nominal	Operating system	A8	Nominal	Operating system
The current incorporation of 3D software	B1, B2	Nominal	Software use	B1	Nominal	Software teaching
	B6		Benefit	B2		Credit count
	B7		Challenge	B4		Course type
				B5, B6, B7		Student number
The familiarity with 3D software	B3, B4	Interval	Application			
The interest in 3D software	B5	Interval	Communication			
	B8	Nominal	Teaching	B3, B8, B9	Nominal	Teaching
Program improvements	B9	Interval	Improvement			

Both questionnaires were designed electronically through SurveyMonkey (http://www.surveymonkey.com). A brief explanation of the study and the goals of the survey were given to the participants in the email that invited their participation in the online survey. These procedures helped respondents better understand the overall study and what was expected from them (Dillman, 1978; Foddy, 1993). A link to the survey was sent with the email invitation. Two weeks after the initial email was sent, a reminder email was sent to potential survey participants. An additional reminder was sent out three days prior to the close of the survey. Anonymity of the respondents was guaranteed.

Two sample groups were included in this study:

- Landscape architects registered with the American Society of Landscape Architecture (ASLA)
- Faculty members from institutions registered with the Council of Educators in Landscape Architecture (CELA)

ASLA was chosen because of its unique position in the field of landscape architecture. As quoted from its website, ASLA is "the national professional association for landscape architects, representing 17,000 members." ASLA is the largest professional society in landscape architecture in the United States. Its mission is "to lead, to educate, and to participate in the careful stewardship, wise planning, and artful design of our cultural and natural environments. Members of the Society use the 'ASLA' suffix after their names to denote membership and their commitment to the highest ethical standards of the profession." Based on its stature and purpose, ASLA was selected as the sample group of landscape architecture professionals.

CELA was chosen to represent the landscape architecture educators. It was chosen because it includes all higher educational programs in landscape architecture in the United States. The history of CELA can be traced back to 1920, and during the past ninety-two years it has been contributing to the improvement of professional education in landscape architecture.

During the preliminary study, 4,789 firms and freelance landscape architects were identified based on their memberships with ASLA. However, contact information on the ASLA website was not complete; only 3,434 contact email addresses were found through independent research. Eighty-two educational institutions with landscape architecture programs were found on the CELA website. To ensure the reliability of the faculty survey, teachers who currently teach computer graphics in each institution were identified. Ninety-one email addresses were obtained from universities' websites or with the help of department heads from schools where contact information was not available on the websites.

Data Collection

Developing procedures for distributing research instruments and collecting data is important for the organization of raw data into a meaningful form. This gives a sense as to what the data are telling us (Sullivan, 2008). Establishing a procedure also helps to coordinate the distribution and collection of survey instruments amongst a population largely spread across the country and to attain a good response rate. One final reason that data collection procedures are established is so that uniformity can be maintained, resulting in more reliable information.

It is usually necessary to gain permission for collecting data to ensure that respondents have given their informed consent to participate in the research, and that the research itself does not pose potential harm to respondents. For this study, explicit permission was obtained by the researchers through Utah State University's Institutional Review Board (IRB) in May 2012 (see Appendix E).

Data collection occurred over a four-week period beginning on June 21st, 2012. The follow-up requests were sent out two weeks after, on July 5th. The online survey was closed on July 21st.

By the end of the data collection period, approximately 13% of the landscape architecture professionals surveyed had responded and 30% of the landscape architecture faculty surveys had been received. The relatively high non-response rate is possibly because some landscape architects who specialize in small-scale projects such as yard design may not need 3D software for their projects. In addition, due to the delay of information update on ASLA website, some contact information from non-existent firms may be still included.

Three sets of data were collected for this study. The first set of data is a form of preliminary data collected in Fall 2011 that provides the contact information of landscape architecture practitioners and educators. Due to the relative small sample of the educator group, a curricula review was conducted to look at the status of 3D courses being offered by landscape architecture programs as part of the preliminary data collection. These observational data can reduce non-response bias if respondents are unwilling or unable to provide data through the online survey. This review mainly focused on two categories:

"course delivery" and "course content." The "course delivery" was to study the characteristics of the structure or design of current curricula, mainly focusing on questions such as:

- What classes include instruction in 3D software?
- Is instruction in 3D software integrated into other courses or provided in an individual course?
- How many credits are these 3D classes?
- Are classes in 3D software required or elective?

The "course content" primarily focused on the breadth and depth of 3D substance in courses and addressed two main questions:

- How broad the 3D substance is taught in the courses? (e.g., "How many" and "what" 3D software programs are taught)
- To what degree the 3D substance is explored in the courses? (e.g., "targeted student groups" and "the depth of each 3D software")

The second set of data is the information gathered from the survey of landscape architecture practitioners. The third set of data is the information gathered from the survey of landscape architecture educators. The second and third sets of data could be downloaded from the "analyze results" tab of the SurveyMonkey.com website.

Data Analysis

After survey data were gathered via SurveyMonkey, the data were analyzed. Data analysis is vital because it uses the numbers and facts generated in the survey instrument to suggest a story about the results. In this study, data were analyzed through the use of frequency distributions to describe or indicate the relationship between two chosen variables. These frequencies display how many respondents have chosen the various responses for each question. From this information, landscape architecture professionals' and landscape architecture educators' perceptions of the importance of certain trends in the use of 3D graphic technologies can be inferred. In order to facilitate the analysis of the data, Excel and "Analysis Tool" from SurveyMonkey were used.

After all the data gathered from SurveyMonkey were reviewed, the materials were manually coded to ensure confidentiality, and preliminary analysis was generated from sorting raw data via Excel crosstabs (Table 2). The crosstabs were set up to determine the relationship between 1) the frequency of 3D software use and other variables, and 2) correlations between variables related to 3D software use, software teaching and other relevant factors. Based on the sorted data, different charts were created for categorical data interpretation. Current applications of 3D software and the overall patterns of change in the role of 3D software in landscape architecture practice and education were revealed by comparing and contrasting responses from the two sample groups (Table 3).

Table3

A Framework for Gap Analysis of Two Sample Groups

Research Question	LA professionals	LA educators	Variable	Data demonstration
	Related Question			
Current 3D software application in landscape architecture				
Objective				
• determine whether *work experience* affects 3D software use	B2 & A2	B1 & A6	Work experience	Histogram
• determine whether *operating system* affects 3D software use	B2 & A8	B1 & A8	Operating system	Pie chart
• determine whether *gender* affects 3D software use	B2 & A1	B1 & A4	Gender	Pie chart
• determine whether *education* affects 3D software use	B2 & A3	B1 & A7	Education	Histogram
• determine whether *geographical area* affects 3D software use	B2 & A6	B1 & A3	Geographical area	Scatter chart
• determine whether *respondent's employer (firm/institution)* affects 3D software use	B2 & A5	B1 & A2	Size	Histogram
	B2 & A4	B1 & A1	Years established	Histogram
Improvement/change should be considered for 3D software teaching				
Objective				
• determine whether professionals and educators differ in their perceptions of 3D software teaching	B8	B9	"Not necessary to offer" "Current is OK" "Teach more programs" "Teach with more depth" "Collaborate with other disciplines"	Table

CHAPTER IV

RESULTS

In total, 454 completed surveys were received from the 3,434 invitations that were sent out, with a total response rate of 13%. Of those responses, 427 were collected from the landscape architecture professional survey, with an approximately 13% response rate. The remaining 27 surveys were received from landscape architecture educators, with a 30% response rate (Table 4).

Table 4
Distribution and Return of Two Surveys

Category (sample group)	Survey number	Return sample	Response rate (%)
Professional	3,343	427	13
Educator	91	27	30

Although the response rates are relatively low, they are still acceptable and comparable with many online surveys at the present time. First the size of the population in the professional survey is large. All of landscape architecture firms are private, thus it was difficult to obtain up-to-date contact information. Second, the geographic distribution map shows that the surveys sent out are randomly distributed and the people who responded are also randomly distributed within the sample group in the premise of no unknown systematic bias being identified. A random sample still exists no matter how small the response when there is no self-selection, exclusion of particular sample groups and no selection of a specific area (Biersdorff, 2009). Possible reasons that people did not respond include: landscape architects who do not need 3D software on a daily basis may not have had the motivation to respond; and, the contact information on the ASLA website was not up to date. For example, some small companies may have gone out of business or have changed their contact information. As part of the preliminary data collection, observational data can help determine biases from respondents or interpret low response rates if respondents are unwilling or unable to provide data through surveys or interviews (Taylor-Powell & Steele, 1996).

Current 3D Software Use in Landscape Architecture Profession

No statistical tests were applied to the data collected from the demographic section. However, totals and percentages for each item in this section were calculated. These figures are provided to help identify current trends and issues in the application of 3D software tools in landscape architecture.

Frequency of 3D Software Use

In order to study the current trends and issues of 3D visualization software use in the profession of landscape architecture, the most important survey question was how frequently professionals use 3D software in their daily work. According to the results from data collection, few landscape firms and freelance landscape architects use 3D visualization software (Table 5). Only 30% of the respondents said they often or very often use 3D software during the landscape design process, and only 20% of the respondents considered themselves as experienced/expert 3D software users. Among those 3D software programs list in the survey, respondents indicated that Google

Sketchup, ArcGIS, AutoCAD Civil 3D, 3D Studio Max, and AutoCAD Map 3D were most utilized.

Table 5
Frequency of 3D Software Use in Landscape Architecture Profession

	Response Rate (%)	Response Count (total valid answers = 377)
Very often	11	41
Often	19	70
Sometimes	33	124
Rarely	20	77
Never	17	65

For the question of whether experienced 3D software users practice 3D computer programs more often than inexperienced users, Use Frequency and Levels of Experience are compared. Figure 1 shows that in expert/experienced groups, more than half of the respondents said they use 3D software often/very often. However, in novice or new users groups, fewer respondents said they used 3D software frequently. The results indicate that more experienced users would adopt 3D software more often than novice or new users. Even though some respondents did not consider themselves as experienced or experts in terms of proficiency and knowledge with 3D software, they reported high frequency of 3D software use in their work.

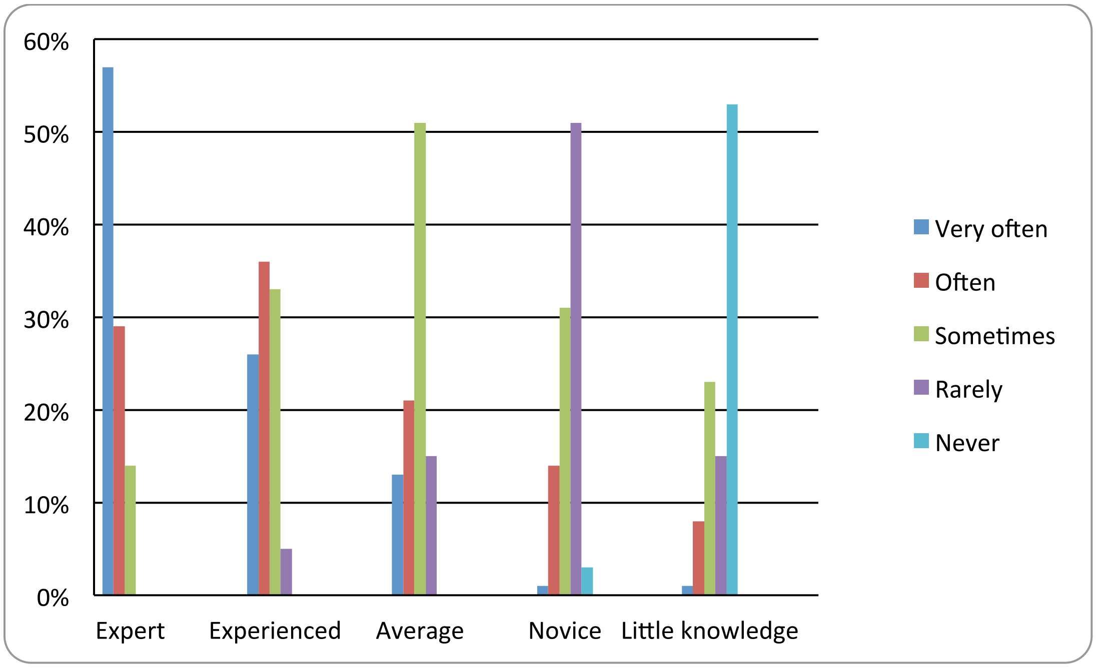


Figure 1. Frequency of 3D software use in terms of acquaintance of 3D software.

Gender

Of the 424 landscape architecture professional respondents, 305 (73%) were males and 114 (27%) were females. Five respondents chose not to report their genders. From the respondents, 31% of females and 29% of males indicated that they use 3D software often/very often in their daily work; 28% of females and 35% of males sometimes use 3D software; and 41% of females and 36% of males rarely or never use 3D software. On Figure 2, it is obvious that there was a fairly even distribution of 3D use between the genders.

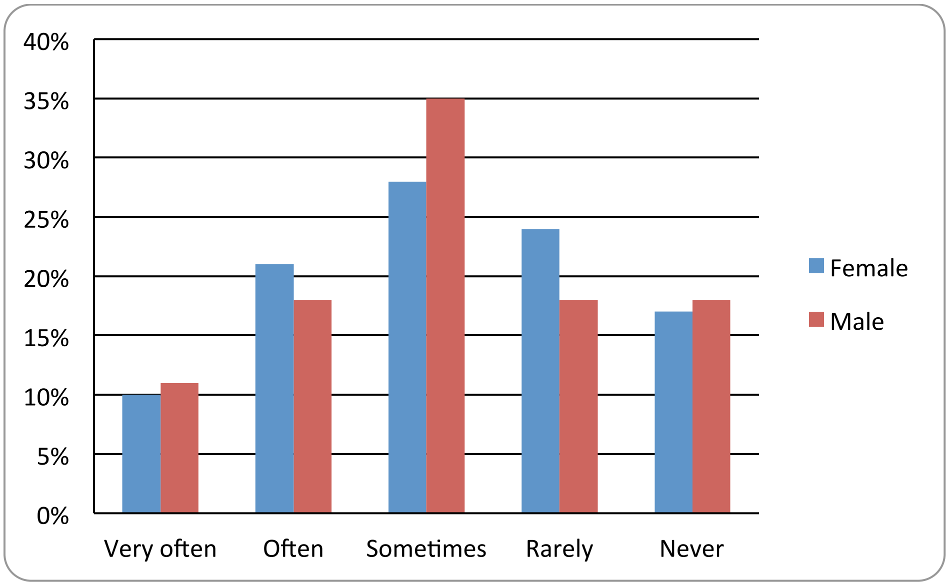


Figure 2. Frequency of 3D software use between gender groups.

Total Years of Experience

When asked about years of experience in landscape architecture, 84% (347) of the 413 professionals responded that they had more than ten years of work experience. In contrast, only 21 respondents have one to two years of work experience in landscape architecture (Table 6).

Table 6
Respondents' Experience in Landscape Architecture (n = 413)

1-2 years	3-5 years	5-10 years	Over 10 years
21	19	26	347

Based on the literature review, the history of 3D software application in landscape architecture is short. It was not until the 1990s that 3D technology had been introduced to the field of landscape architecture (Ervin, 2001). Considering this fact, one assumption could be that senior landscape architects would adopt 3D software less frequently than junior professionals due to their higher positions in the firms and they have less time to learn new software. However, comparing the years in the profession with the frequency of 3D software use, it was found that there is insufficient evidence to conclude that there is a difference in the use of 3D software among groups with varying years of work experience (Figure 3). While the results show that none of the respondents with one to two years of experience reported that they never use 3D software, it is still hard to draw any conclusion from it, considering the response group is relatively small.

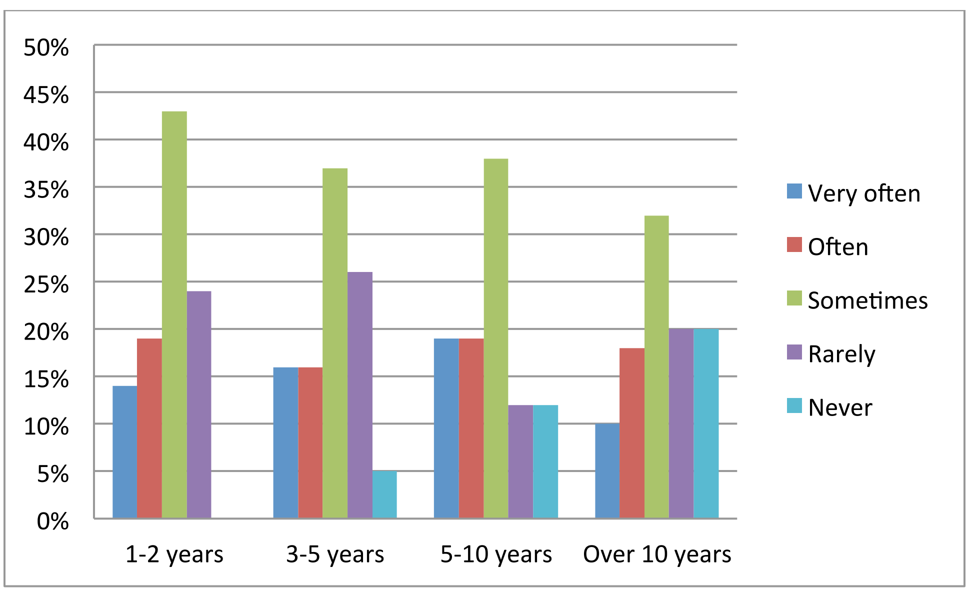


Figure3. Frequency of 3D software use related to work experience.

Education Level

The relationship between the respondents' levels of education and the frequency of their 3D software use in their professional work was examined. Among of all 419 participants who responded to this question, over 62% of them held bachelor's degrees and 35% held master's degrees (Figure 4). Within these two groups, the distribution of the frequency of 3D software use was fairly even. There is no evidence that the frequency of 3D software use is related to the education level that landscape architecture professionals received. In fact, two respondents who held doctoral degrees rarely used 3D software in their daily work. However, it is difficult to draw any conclusions because of other factors, such as the possibilities that these two doctoral degrees holders are specialized in an area where they don't need 3D software; 3D software hasn't been introduced to landscape architecture during the time they pursue their degrees, or they work with colleagues who have better 3D skills than them.

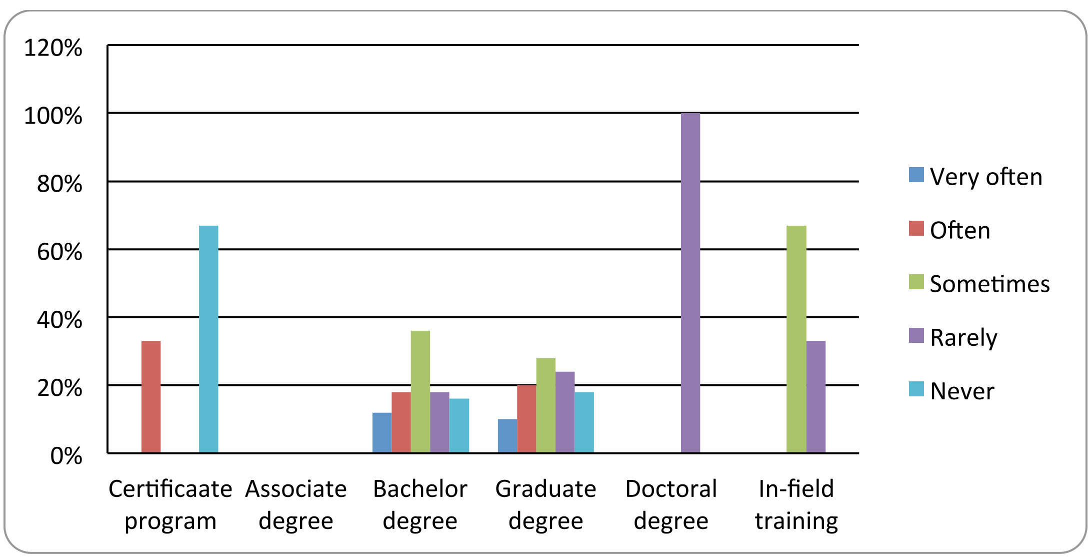


Figure 4. The relationship between frequency of 3D software use and users' education levels.

With regard to 3D software type, the most popular 3D software used by all educational levels is Google SketchUp. This is likely due to the ease of learning this software and the low cost of this program. Landscape architecture professionals with bachelor or graduate degrees generally adopted other 3D software programs in their work, with a relatively even distribution as shown in Table 7.

Table 7
Frequency Counts of 3D Software Programs Used by Respondents with Different Education Levels

	Certificate program	Associate degree	Bachelor's degree	Master's degree	Doctoral degree	On-job training	Total
3D Studio Max	0	0	27	14	0	0	41
AutoCAD Civil 3D	0	0	61	28	0	0	89
AutoCAD Map 3D	0	0	28	13	0	0	41
AutoCAD Plant 3D	0	0	4	2	0	0	6
ArcGIS	0	0	43	25	0	0	68
Bryce 3D	0	0	1	0	0	0	1
Google SketchUp	*1*	0	*184*	*111*	*2*	*3*	*301*
Maya	0	0	2	3	0	0	5
Rhinoceros 3D	0	0	12	9	0	0	21
Vectorwork	0	0	22	12	0	0	34
Vue	0	0	6	2	0	0	8

Firm Establishment

When asked about their firms, over 53% of the respondents indicated that their firms have been established for more than 20 years and 23% were working for firms that were between 11 to 20 years old. Only 44 new firms were reported to have less than 5 years of firm history. With a crosstab query on this variable, all the other groups show around 35% of “rarely or never use of 3D software” except the group of firms with only 1 to 5 years of establishment show a higher percentage (42%). However, due to the number of firms in this group is small, there is no evidence to confirm that the use of 3D software in the landscape architecture profession is correlated with the years of firm establishment (Figure 5).

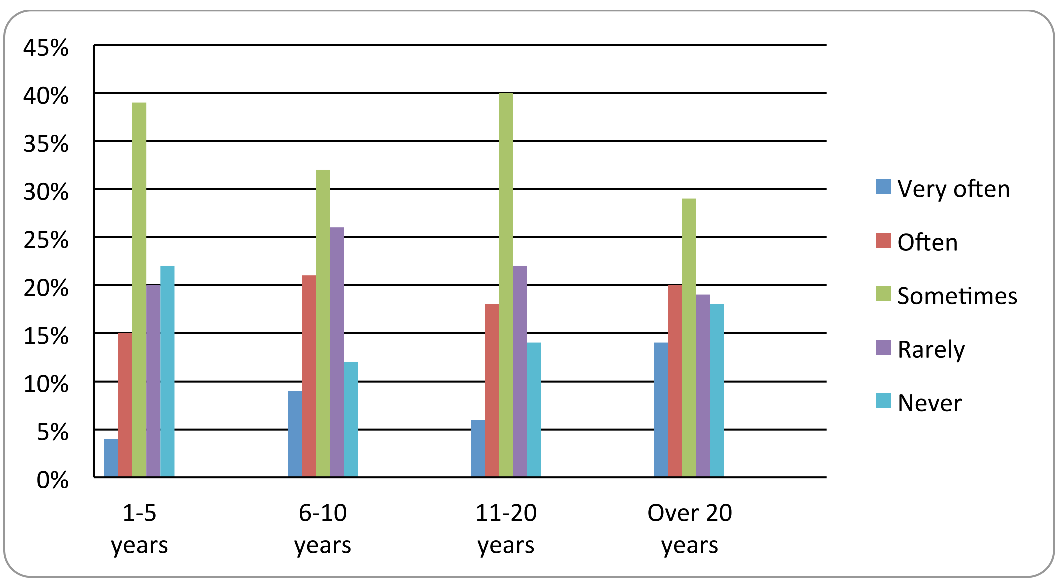


Figure5. Frequency of 3D software use related to the years of firm established.

Geographic Distribution

Geographic distribution is a very important factor which affects the validity of this research. The map below shows the geographic distribution of all respondents who stated they were currently using 3D software. Comparing the geographic distribution of landscape architecture firms included in this survey with responses received to the survey shows similar patterns, especially in terms of being equally spread across the country, which increases confidence in the survey's reliability (Figure 6).

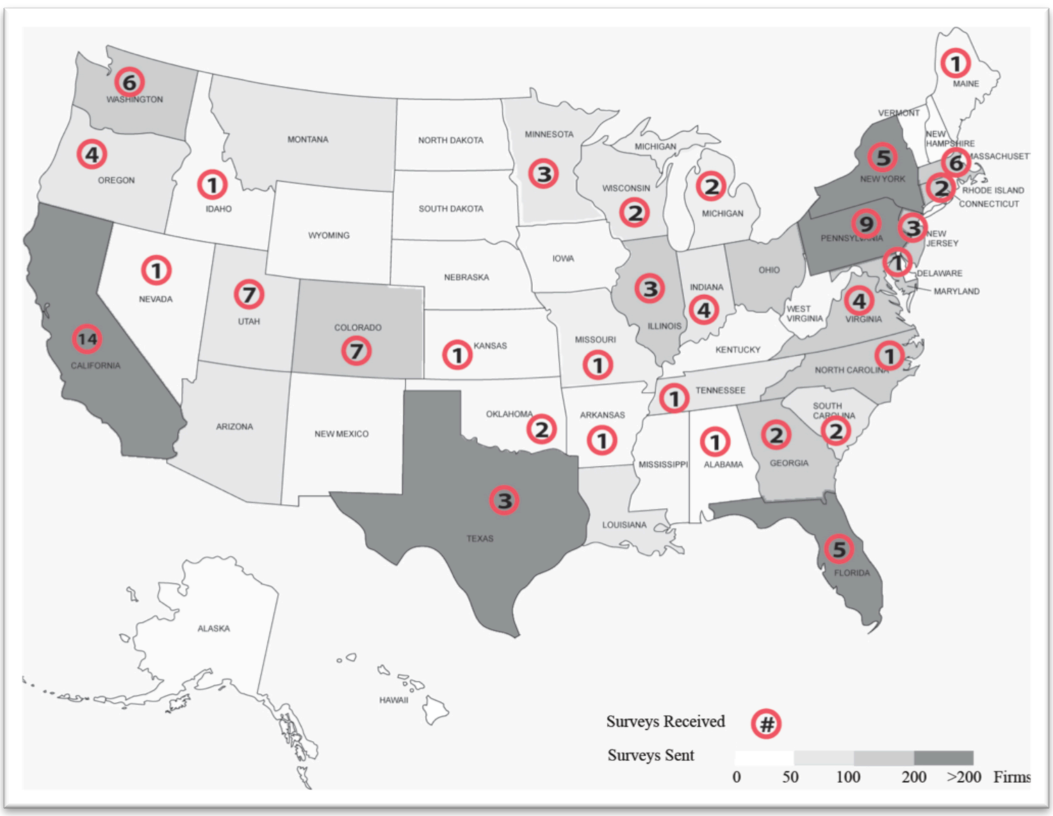


Figure 6. Geographic distribution of 3D software users.

Targeted Groups

Communication is always recognized as one of the most important parts in the landscape design process. A process of communication happens primarily between the designers and the clients. Communication is also critical when a design is documented for real construction (Nielsen et al., 2010).

In the survey of landscape architecture professionals, participants were asked to rate the effectiveness of 3D visualization software as a communicative medium. The majority of the respondents agreed that 3D software is an effective tool to improve communication with all targeted groups. The general public (55.2%), concerned groups (42.5%) and policy makers (37.9%) have identified 3D software to be particularly effective (Figure 7). In general, these groups are considered to have limited knowledge of design (Paar, 2006).

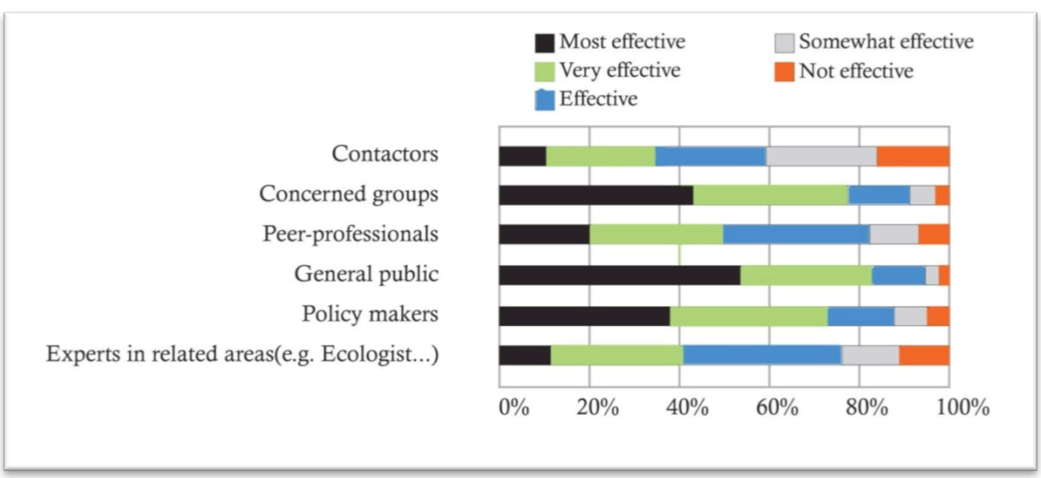


Figure 7. Key addressee for using 3D software to improve effectiveness of communication.

3D Software Use in Design Process

According to Lange (2001), 3D visualization should be an essential part of the design process. A question was asked regarding how 3D visualization software was applied in the main phases of the landscape design process. From figure 8 below, there is a fairly even distribution of its use in each step of the design process, with the largest utilization in the final output. Other phases such as public involvement, planning alternatives, and preliminary draft were reported to be occasions when 3D software is utilized. These findings have suggested that 3D software is used most often with regard to communicative tasks in the design process. All these communicative tasks target groups with limited knowledge in landscape architecture, such as clients, stakeholders, and policy makers. Clear and comprehensible project presentations will help these groups better understand landscape architecture projects (Sheppard & Meitner, 2004).

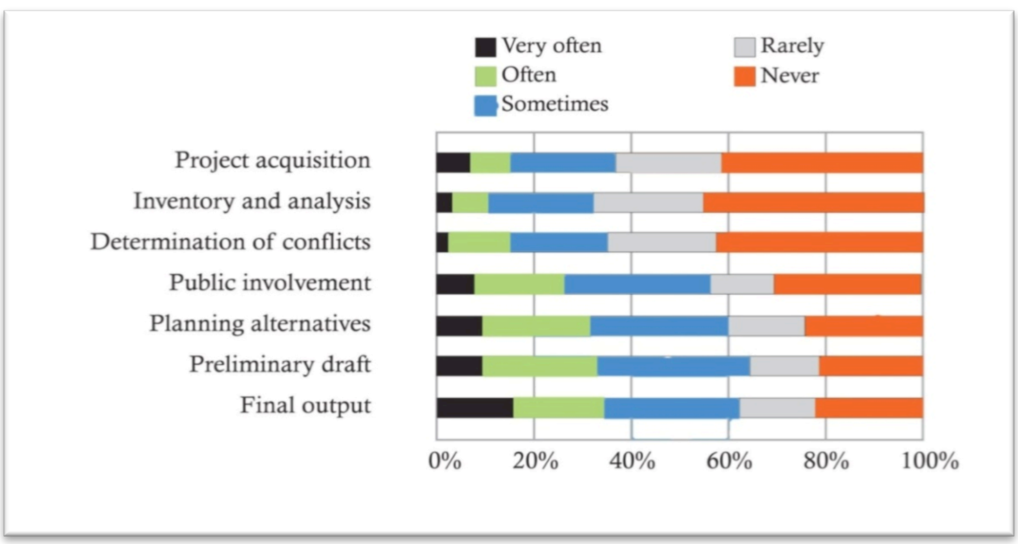


Figure 8. Frequency of 3D software use in each design phase.

Benefits and Challenges

Even though most of the respondents' knowledge of 3D software in landscape simulation is limited, they believe that the use of 3D software will benefit the landscape architecture profession (Figure 9). To be specific, 89% of respondents believe that the visual aid provided by 3D visualization will improve communication between landscape architects and their clients, and thus increase client satisfaction. Client satisfaction has been recognized as one of the most important elements in landscape and environmental planning process. A good professional-client relationship will not only help landscape architecture professionals get projects done smoothly but can also help with long-term client retention. Traditional 2D graphic methods which use renderings, design plans, and maps have not been fully successful in their ability to engage and sufficiently inform clients and stakeholders (Kheir, 2001). While professional landscape architects are able to rely on their experience to help them visualize landscape designs, the average client is overwhelmed by the relatively complex and abstract information and is unable to translate this information into landscape visions. Developments in the field of 3D graphics have dramatically extended possibilities to overcome this barrier by providing a tool in which clients can easily comprehend and visualize the design that has been put forth.

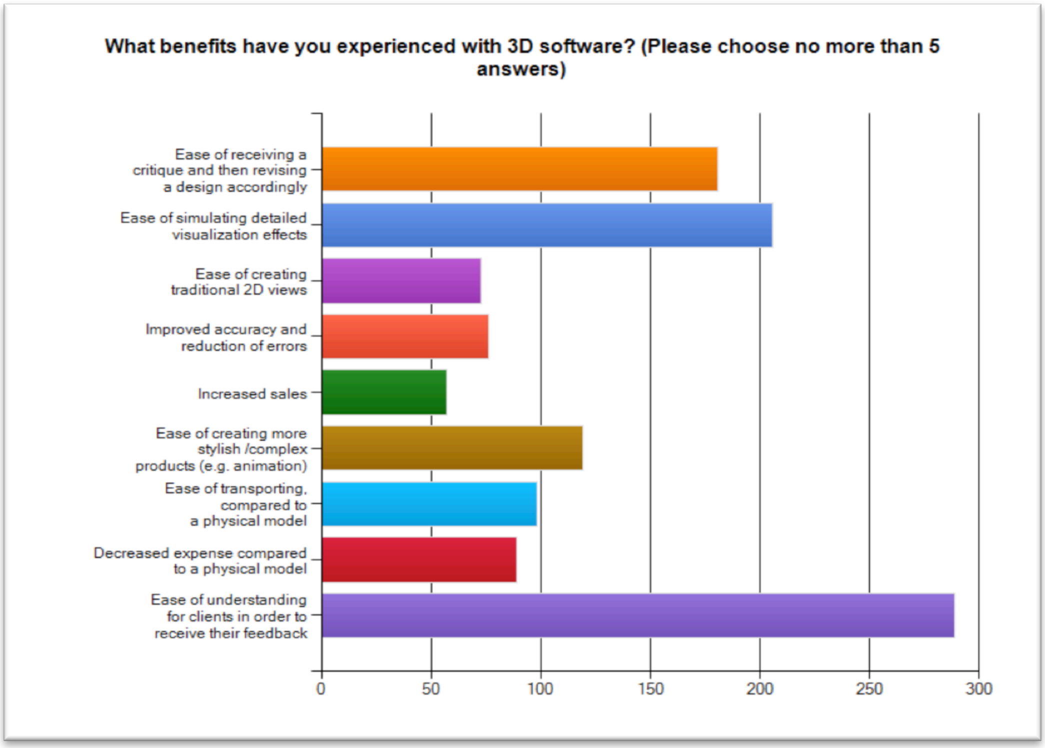


Figure 9. Benefits from using 3D software in landscape architecture (*n* = 324).

In addition, 3D simulations allow representation of the effects of a project on the landscape scenery, and can enable comparisons of various alternatives. Problems/design errors that are not able to be identified in a two-dimensional representation can be more easily seen in a 3D model representation. With 3D models, the feasibility analysis and performance evaluation of a design can be performed. At the same time, receiving critiques and then revising a design accordingly become much easier with the use of 3D software tools.

Challenges reported in using 3D software include time-consumption (79.3%) and a steep learning curve (68.3%). If these two challenges were overcome, landscape architecture practitioners would prefer to increase the rendering quality in the design process, more lights with more complex parameters, richer materials with intricate reflection, and graphic presentations of alternatives in real-time (Figure 10).

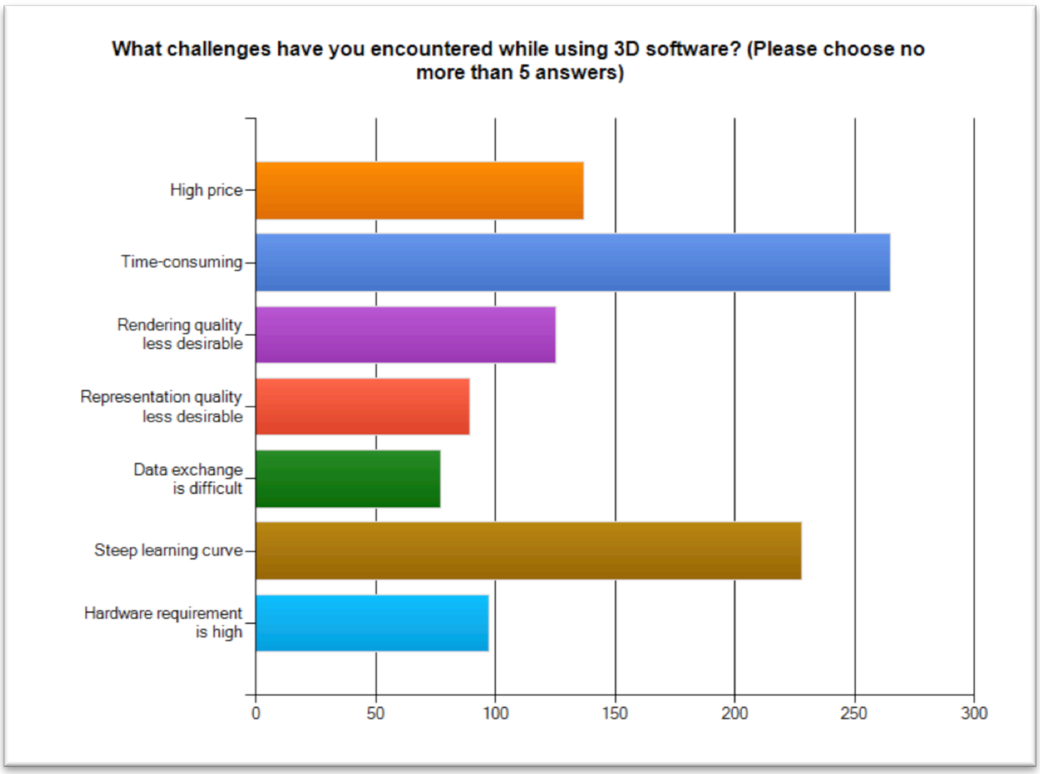


Figure 10. Challenges with available 3D software in landscape architecture (*n* = 334).

The problem, however, is that without the capabilities of presenting high-quality results quickly, landscape architects have little choice but to omit design details in creating the visualizations, particularly in the early phases of design. Furthermore, if a project is small, the budget may not allow using 3D technology to enhance the design. These problems have often prevented landscape architects from using 3D visualization in the design process. The difficult in learning 3D software is another reason that deters landscape architects from using 3D software. One of the respondents commented “I would be interested in using 3D software, but time for learning and money to invest is currently scarce. I am busy enough without it at the moment."

Current 3D Software Use in Landscape Architecture Education

One of the primary objectives of this research is to seek feedback on preparing landscape architecture students for the future workplace. In order to achieve this objective, a survey of landscape architecture educators was conducted. The objectives were to identify specific problems that are important to 3D software teaching and to disseminate such findings throughout the community of academics as well as landscape architecture practitioners. It is expected that by making academic aware of the problems important to practitioners, they will be encouraged to rethink their current curriculum and begin to investigate issues important to their students. This may also lead to different types of research (e.g. internship, research projects, and case studies) and to new data sources and funding opportunities.

Perhaps the most important use of this section of the study is to provide a considered assessment of current teaching of 3D software in landscape architecture programs, especially on the breathe and depth of 3D materials in the curriculum. The information from this study can help landscape architecture educators quantify and prioritize key features of 3D teaching thereby improving curriculum design.

In this section of the study, 7 of the 67 schools being surveyed were not included because 5 schools did not include information of curriculum and the other 2 had announced the date of closing their landscape architecture programs. The results are presented in Table 8.

Table 8

Results of Curriculum Catalog Review

3D course offering					
One	Two	Three	More than three		
40%	44%	10%	1%		
Credit hours					
One	Two	Three	More than three		
7%	16%	57%	20%		
Department that offers 3D courses					
Landscape architecture			Other department		
83%			17%		
University level					
Undergraduate					Graduate
78					59
Freshman	Sophomore	Junior	Senior	Unclear	
6%	10%	14%	14%	56%	
Course Type					
Required			Elective		
N/A			N/A		

Out of the 67 schools, 24 of them (or 36%) currently offer two 3D courses and twenty (30%) of them offer one 3D course. Other schools offer three (10%) or more than three different 3D courses (1%). With regards to credit hours, more than half of the 3D courses are three credits (57%), and 20% is offered as more than three-credit classes and 16% are two-credit classes. Only six 3D courses out of the total courses being offered are one-credit (7%). Graduate students have a significantly greater preference to register for 3D courses than undergraduates. With regard to undergraduates only, no difference is noted among the grade levels.

Reviewing the curriculum from each of the schools with landscape architecture programs reveals subtle, yet very valuable, information for current 3D teaching. It is interesting to note that most of the courses covering 3D software are not described specifically as individual courses, but integrated as "advanced computer graphics" or "advanced design communication." However, 23 out of 67 landscape architecture programs (34%) separate their ArcGIS courses from other computer program courses. This has major pedagogical implications, not only for course content but also for course delivery. Are 3D software programs more effectively presented in specific courses or integrated into the curriculum through changes in content and methodology in the landscape architecture profession? Is the knowledge of 3D software helpful for students' future professional roles? Is ArcGIS being considered as 3D software or a research method to foster true collaboration in multi-disciplinary teams?

Another question was examined as to whether landscape architecture departments collaborated with other departments to teach 3D courses or not. Eight out of 67 programs indicated that they work with other departments for 3D teaching. The other departments are mostly Architecture, Geography, and Graphic Design.

Demographic Information

Of all the 26 faculty respondents, 15 were male and 11 were female. One respondent declined to identify his/her gender. With regards to teaching experience, 13 respondents had more than 10 years of teaching experience; four had 6 to 10 years of experience; five had 3 to 5 years; and the remaining four had only one or two years of experience.

Among them, 15 landscape architecture educators hold master's degrees and nine hold doctoral degrees. Two faculty members only hold bachelor's degrees. When asked about their current job title, seven of them indicated they are professors; nine are associate professors; six are assistant professors, and three are lecturers. Only one adjunct instructor was included. When it came to the size of institutions, the number of faculty members and years of establishment for the institution were used for evaluation. According to the responses collected, 22 out of 26 landscape architecture programs have been established more than 10 years (Table 9).

Table 9
Summary of Demographic Information on Faculty Respondents

Gender				
Male			Female	
15			11	
Teaching experience				
0-2 years	3-5 years	6-10 years	Over 10 years	
4	5	4	13	
Education				
Doctor's degree	Master's degree		Bachelor's degree	
9	15		2	
Job title				
Professor	Associate Professor	Assistant Professor	Lecturer	Adjunct Professor
7	9	6	3	1
Landscape architecture program established				
1-2 years	3-5 years	6-10 years	Over 10 years	
0	1	3	22	

Geographic information was examined in this survey, the same as it was in the survey of landscape architecture professionals. Detailed information is shown in Figure 11.

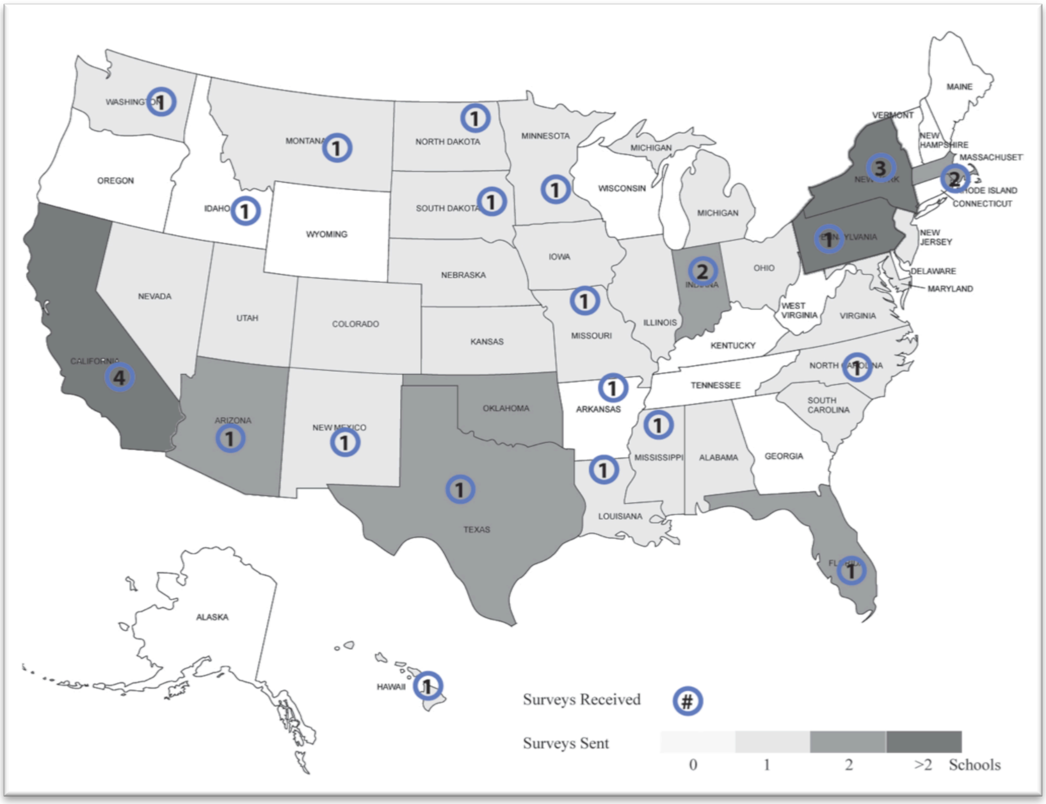


Figure 11. Geographic information on university programs that offer 3D computer courses.

Course Offering

In this survey, questions regarding current 3D course offerings were included. Of the 25 participants that responded to this question, sixteen respondents (64%) reported that their institutions offered more than one computer graphics courses that cover 3D software programs. On average, more than half of the participants indicated that courses that include 3D computer graphics components were 3-credit (Figure 12), and 75% of the courses are required in the curriculum (Figure 13). Among these respondents, twenty-one out of twenty-five participants (84%) have not considered increasing course credit hours

(Figure 14). The top five programs being taught were: ArcGIS, Google Sketchup, Rhinoceros 3D, AutoCAD Civil 3D, and 3D Studio Max.

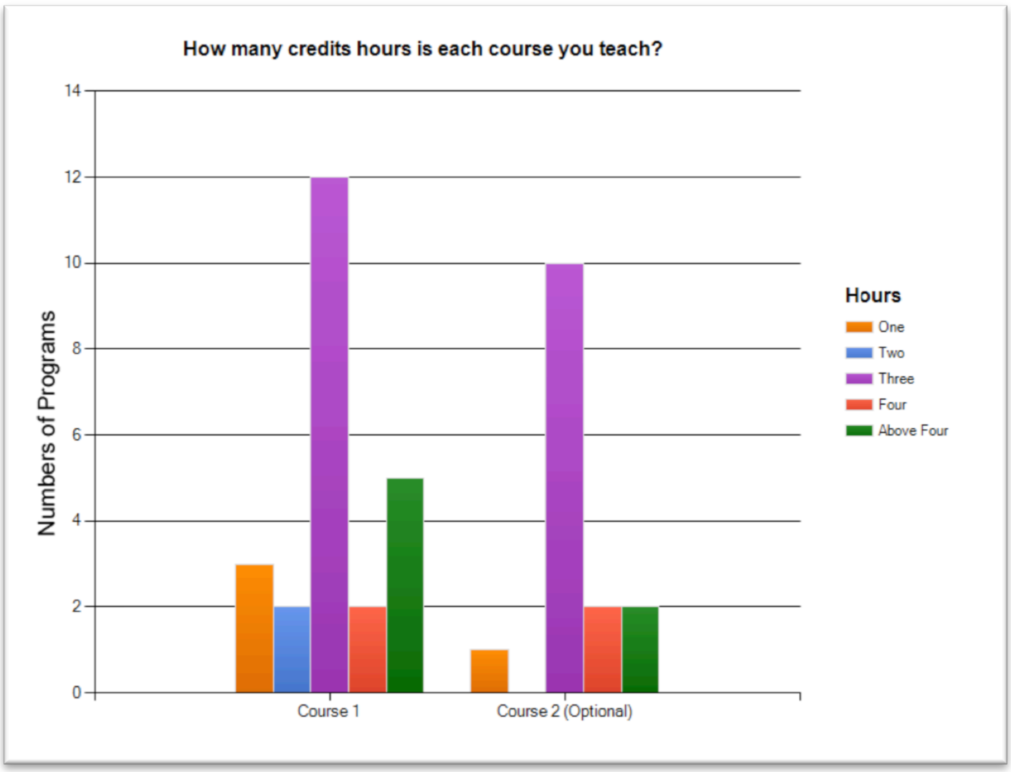


Figure 12. Credit hours distribution.

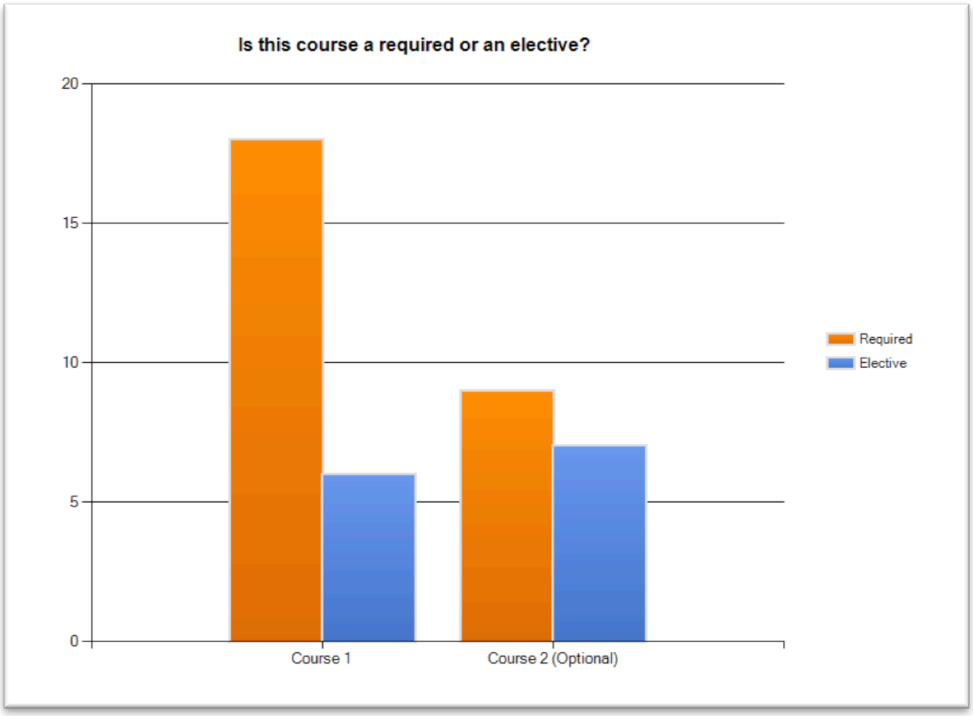


Figure 13. Requirements on 3D graphic courses.

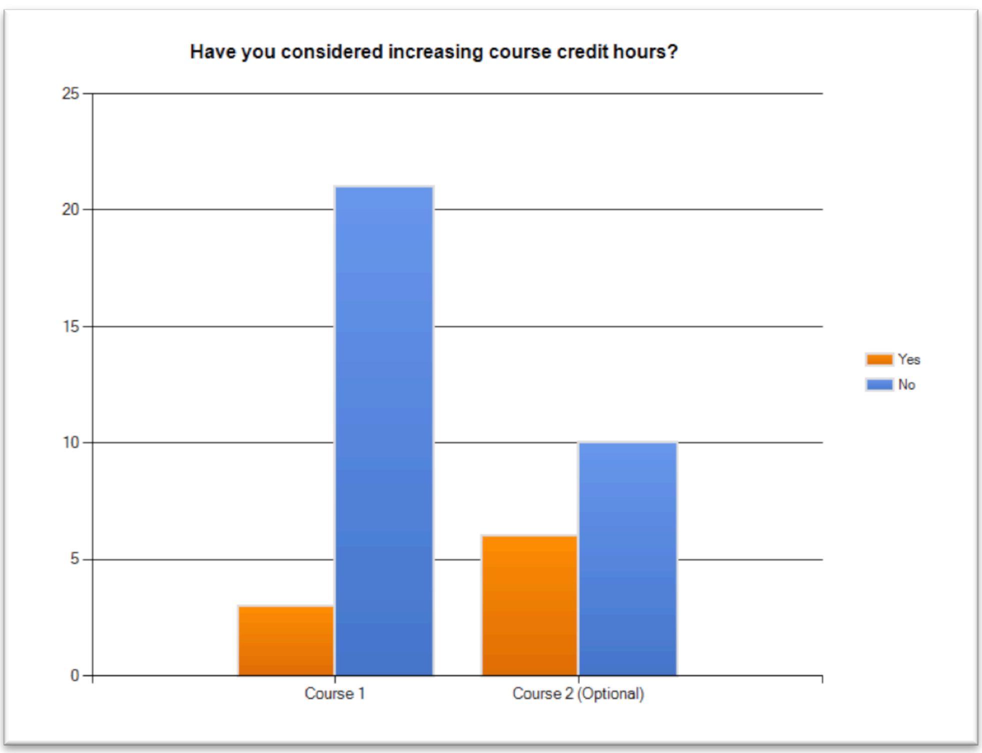


Figure14. Educators' perceptions on increasing credit hours of 3D software courses.

Distance education and on-line course questions were included in the survey. Only one out of 27 respondents teaches on-line 3D courses. 68% of those who do not currently teach online courses indicated that they would do so in the future.

Student population

Questions were asked about student populations taking classes in 3D computer graphics. Of the 25 landscape architecture educators responded, the size of the classes ranged between 11 and 20, in both courses (Figure 15).

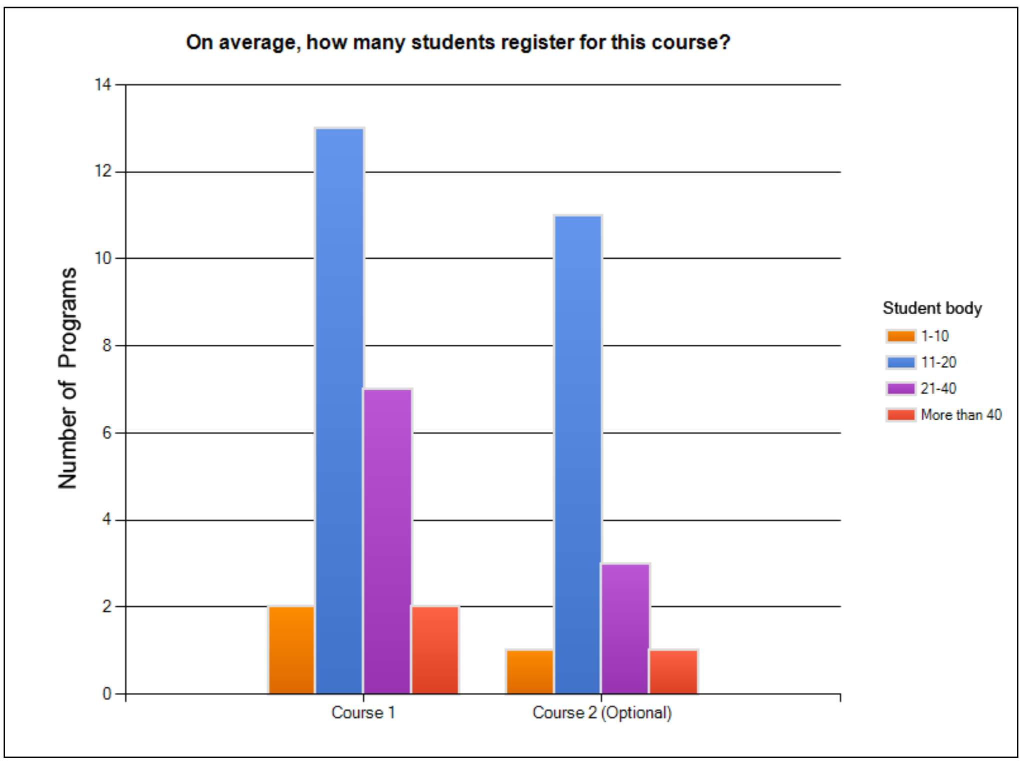


Figure 15. Student enrollments.

Survey questions on to which university level of 3D computer graphics courses are delivered are examined. Figure 16 indicated that course 1, which is usually required, is most often offered to sophomores and senior students. Course 2, which is either elective or required, is delivered to juniors and graduate students (Figure 16).

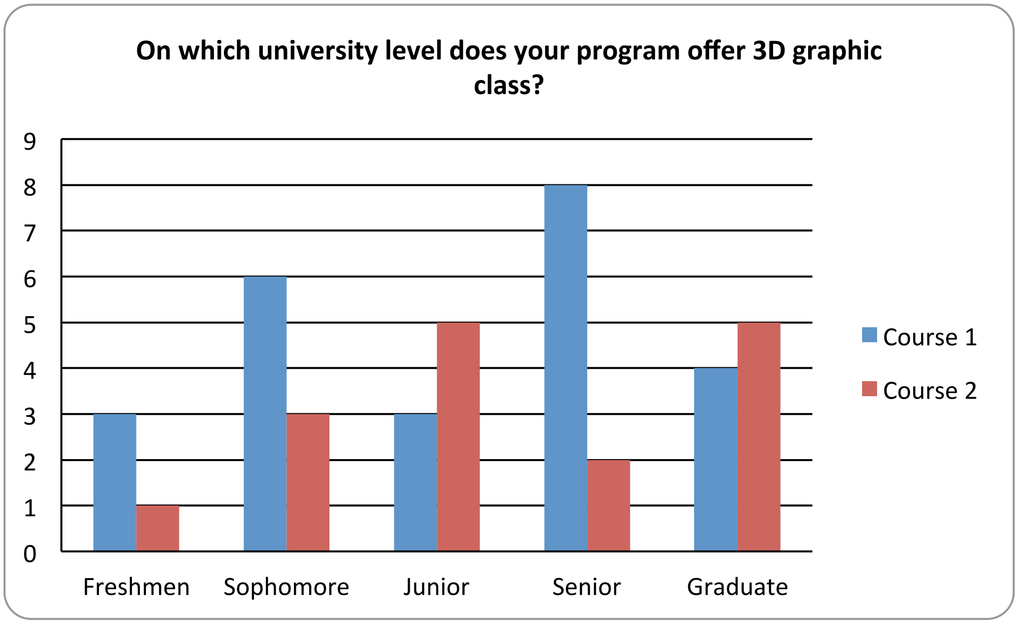


Figure 16. The relationship between 3D course delivery and university levels.

Gap Analysis of Landscape Architecture Education

This information was cross-referenced with different types of 3D computer programs that were covered in the courses (Table 10). This table shows that Google Sketchup and ArcGIS are the two most widely taught 3D computer programs at every university level. Most 3D software courses are offered to upper-level students—juniors, seniors and graduate students. Most upper-level 3D computer programs are offered only to graduate students, such as Maya, AutoCAD Plant 3D, and Vue. No Bryce 3D was taught in any grade levels.

Table 10
3D Software Programs Taught at Different Grade Levels

(n = 26)	Freshmen	Sophomore	Junior	Senior	Graduate
Google Sketchup	2	8	5	6	3
Maya	1				2
Rhinoceros 3D		2	1	3	3
Vectorwork		1		1	2
Vue		1	1		2
Bryce 3D					
3D Studio Max	1	2		3	3
AutoCAD Civil 3D		1	3	2	5
AutoCAD Map 3D			1	2	4
AutoCAD Plant 3D			1		2
ArcGIS	2	3	1	3	1

Table 11
Comparison of 3D Software Use in Landscape Architecture Practice and Education

	LA professional (n = 341)	LA educator (n = 24)
3D Studio Max	22%	58%
AutoCAD Civil 3D	43%	59%
AutoCAD Map 3D	23%	36%
AutoCAD Plant 3D	4%	23%
ArcGIS	38%	***91%***
Bryce 3D	1%	0%
Google Sketchup	***93%***	86%
Maya	4%	33%
Rhinoceros 3D	13%	61%
Vectorwork	19%	23%
Vue	5%	25%

Table 11 shows practitioners and educators have considerable agreement on the importance of these 3D software programs. However, there is a slight curriculum gap between what is being taught in landscape architecture degree programs and what practitioners use. As seen in the findings from both surveys, Google Sketchup, ArcGIS, AutoCAD Civil 3D, and 3D Studio Max were the most widely used 3D software programs. However, several important differences are noticed. First, although almost all of the schools teach ArcGIS, only 38% of the firms implement this software in their work. The same situation pertains to Rhinoceros 3D. Possible reasons for this situation, based on the literature review, are that the price of ArcGIS is between $5,000 and $40,000, which makes it much more expensive than other 3D software. Further, this software is not necessary when it comes to small projects in which geo-referenced imagery is not needed. Another interesting observation is that practitioners use Bryce 3D but none of the schools' offered class that covers this software.

Teaching Improvement

As indicated earlier, questions were asked in both questionnaires on what improvements should be considered for 3D software teaching. Table 12 below shows a side-by-side comparison of responses to the same question contained in these two questionnaires.

Table 12
Opinions on the Improvement of 3D Software Teaching

	LA professional (*n* = 317)	LA educators (*n* = 21)
The removal of all 3D computer graphics courses	2%	0%
An increase in the number of software programs taught	28%	14%
An emphasis on a few select software programs, focusing on depth over breath	63%	76%
An increased collaboration with other departments that offer 3D graphics courses (Art, Planning, Geography, etc.)	46%	57%
No change	6%	14%

In Table 12, the same five statements were chosen as prior improvements needed to be considered for both groups. Tasks that received low importance scores from practitioners also received low importance scores from educators. Both groups agreed that “an emphasis on a few select 3D software programs, focusing on depth over breadth” was the most urgent change that should be considered. Furthermore, both groups agreed that increasing collaboration with other departments that offer classes in 3D computer software was the second most important improvement on 3D teaching.

From the write-in comments, the most noted concerns on teaching 3D software were the need to maintain 2D practices such as sketching; the focus on more professional practice; less emphasis on production ability development and more emphasis on the design thinking behind decisions; and more interface with other software platforms. Some respondents wrote comments such as these: “Too many graduates are coming out of school with great graphics and 3D skills, not professional practice skills and the reality check of whether their designs are attainable." "While not at all opposed to 3D modeling as a presentation tool, I am of the opinion that deign professional MUST learn to draw, both in 2D and 3D, by hand. It is critical to the creative process!"

The consensus among the respondents seemed to be that design is human-centered. It is a unique presentation of human creativities that cannot be replaced by digital technologies. Many landscape architects are trained to view their designs as the expression of their creative thinking and works of art. Innovation and artistic quality are very important to their designs. However, the tendency of developing more and more pre-set models or templates in 3D software could lead to having more and more "similar" design projects. Some landscape architects concern these designs lacking of artistic qualities. Another concern is that 3D software generates models that may look as if the design is finalized and there is little chance to change the design; thus make the client feel less involved.

Future Demands of 3D Software

When it comes to the replies from landscape architecture professionals regarding what is important for future development of 3D software, over 50% of them cited mostly: a simplified learning process, lower investment cost, a more realistic representations of plants, larger texture libraries, and better rendering quality. Increasing efficiency of navigation/orientation tools, providing easy internet presentability and improving interactivity with client/general public were also considered as important, with an average of 30% of the respondents expressing a strong agreement (Figure 17).

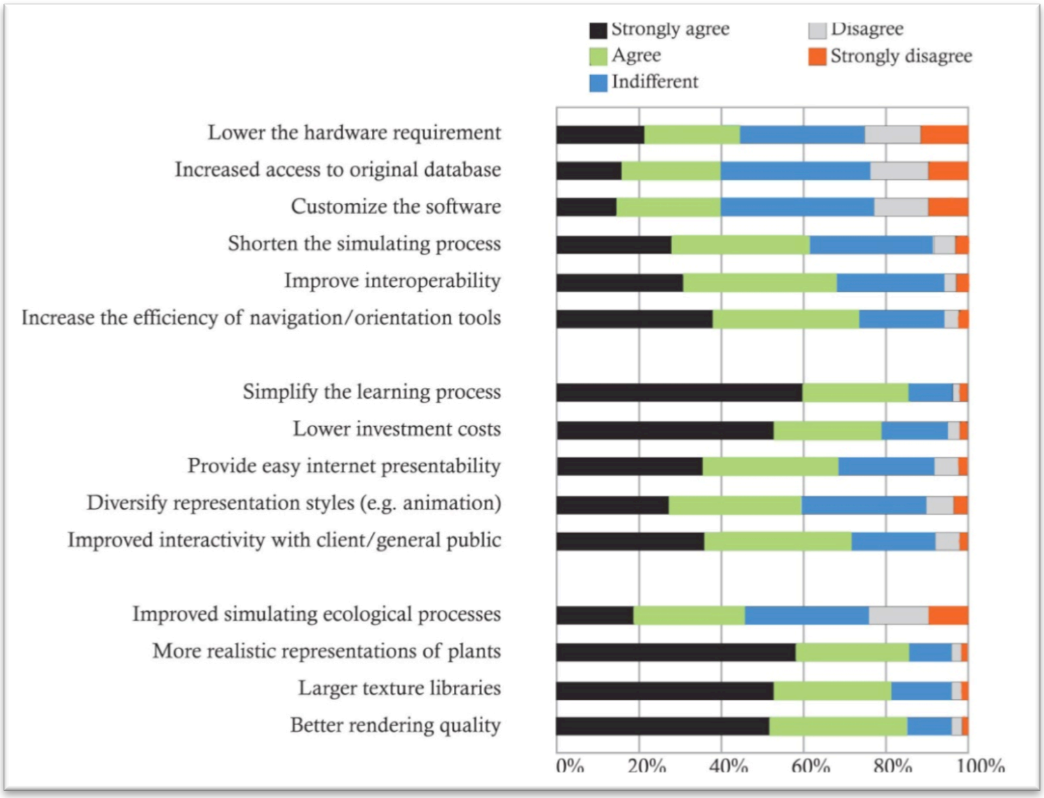


Figure 17. Demand for future development of 3D software.

CHAPTER V

CONCLUSIONS

This chapter summarizes the major findings of the study and then explains the implications of this study in terms of the landscape architecture profession and education. This chapter is divided into two sections. A brief summary of the study purpose, objectives, and research methodology will be given in the first section. The first section also provides a discussion of significant findings and implications as they relate to landscape architecture practitioners. A brief summary of the findings from landscape architecture educators is given in the second section. The gap analysis between landscape architecture practitioners and educators and the needs for future improvement of landscape architectural education as revealed in this thesis' findings are also included. In the end, the discussion on future 3D software development is included.

Trends and Issues of 3D Software Use in Landscape Architecture Profession

The information found in this thesis is descriptive. From the questions asked in the landscape architecture professional survey, this paper drew the following conclusions. First, in the United States the landscape architecture profession exhibits limited use of 3D visualization software. Only 30% of the respondents use 3D software on a daily basis. Within this group of people, 93% of them currently use Google Sketchup. The second most widely used software program is ArcGIS, 38% of the total.

Before data collection, a hypothesis was that there would be differences in the use of 3D software in terms of gender, years of work experience, knowledge level, firm size, location, etc. After examining the data, it was found that there is insufficient evidence to conclude that there are obvious differences related to these variables. Most results show even distributions on the frequency of 3D software application.

When it comes to the design process, 3D software appears to be used mostly in client and public involvement, design alternatives, preliminary draft and final output. However, considering the highest percentage (32%) of 3D use is less than one third of the process, it is confirmed again that the current use of 3D software is limited.

Even though, at present, use of 3D software is limited, landscape architecture professionals do express a desire to know more about 3D visualization in landscape architecture in the future. A majority of respondents think that they can benefit from the use of 3D software in communicating with clients and the general public, creating detailed landscape representation, and easily receiving feedback and revising the model accordingly compared to traditional physical models. Other advantages such as animation and ease of transporting are also notable.

However, several constraints on the future growth of 3D visualization software application have also been identified. Findings from this study suggest that 79% of the respondents are dissatisfied with the longer time that they spend on generating 3D models than 2D methods. The high price of the 3D software, the difficulty of learning the software, and low desirable rendering quality are other challenges that impede the application of 3D visualization tools in the landscape architecture profession.

Trends and Issues of 3D Software Use in Landscape Architectural Education

From the questions asked in the survey of landscape architectural educators, the following conclusions can be drawn. First, from the preliminary curricula review of each landscape architecture program in the United States, analysis of these data can be useful in better understanding the current situation of 3D teaching, as well as designing a curriculum to achieve future needs of the landscape architecture profession. Each curriculum designer, however, must determine the level of 3D skills needed to achieve a landscape architecture program's objectives and the unique capabilities of the institution and its faculty. In this case, some items that are considered as a lower priority may be important to other constituencies and may need to be considered for inclusion in the curriculum.

Secondly, almost all the schools that have landscape architecture programs have adopted 3D software in their curricula. Two thirds of the institutions offer two or more computer graphic courses that cover 3D software. Most of the courses are offered as 3-credit courses and 87 % of landscape architecture educators do not consider increasing course credits. With all the 3D software programs covered in the courses, the top five taught in landscape architecture are: ArcGIS, Google Sketchup, Rhinoceros 3D, AutoCAD Civil 3D, and 3D Studio Max. With regard to student population, most courses are offered to sophomores and senior students. Graduate students have more options on the selection of what 3D computer programs they want to learn. Most course enrollments are among 11 to 20 students. Considering the difficulties of 3D software teaching, maintaining small size of the class can help providing students the opportunity for more in-class active involvement; the opportunity to receive more immediate feedback on their learning; and the opportunity to learn group cooperation and problem solving. These benefits will favor students to achieve their academic goals in landscape architecture.

Gap Analysis and Implications for Education

There is a gap in landscape architectural practice and education. Although most popular 3D software packages utilized in the landscape architecture profession have been taught in school, Bryce 3D is a program that is not. Some new programs have been widely used in this profession such as AutoCAD Map 3D; however they are lagging behind in being taught at school.

Possible reasons for this lag are discussed here. Since most of the faculty respondents have worked as educators in the field of landscape architecture for over ten years, we could assume that courses they taught were well developed. Developing a new course needs substantive amount of work. Further, as software teaching cannot only be lectures, it has to be in lab classrooms with instructor-guided software practices. Faculty members will have to commit themselves to ongoing training in order to keep pace with the rapid software changes. If they teach in schools with constant budget cuts, they may have to pursue funding to support their teaching endeavors. Another possible reason is that there is no consensus on what 3D visualization software should be taught, according to the curricula review of landscape architecture programs. It varies by teachers and university. If the teacher is an expert on certain 3D software, he/she would possibly teach this 3D software in lieu of others.

Regarding opinions on 3D software teaching in landscape architecture, there is a small difference in landscape architecture professionals as compared to educators. Both groups agree on the importance of providing in-depth teaching on core 3D software programs and collaborating with other departments that offer 3D computer graphic courses. However, a debate on what are the core 3D software programs exists.

Opportunities for Future 3D Software Development

The findings of the survey reveal high potentials of 3D visualization software development. The most common demands cited were lowering time in software processing, simplifying learning process, and providing photo-quality realistic rendering. Other aspects that survey respondents expressed a desire for improvement includes compatibility with GIS, more and better symbols and improvement of accuracy.

Since the number of landscape architects is relatively smaller compared to civil engineers and architects, there is not a lot of 3D software designed for landscape architects (Pihlak & Barrett, 2000). Landscape architects need to initiate the dialogue with software developers and maintain an on-going communication in order to create positive results. If professionals could include educators into this conversation towards the common goal of improving software for needs of current and future landscape architects, more productive results would be seen.

REFERENCES

Biersdorff, K. K. (2009). *How many is enough? The quest for an acceptable survey response rate.* Retrieved from http://kkbiersdorff.wordpress.com/2009/09/16/how-many-is-enough

Bishop, I. D., & Lange, E. (2005). *Visualization in landscape and environmental planning*, *technology and applications*. London, UK: Taylor and Francis.

Danahy, J. W. (2001). Technology for dynamic viewing and peripheral vision in landscape visualization. *Landscape and Urban Planning, 54*(14)*,* 125–137.

Daniel, T. C. (1992). Data visualization for decision support in environmental management. *Landscape and Urban Planning, 21*(4)*,* 261–263.

Dillman, D. (1978). *Mail and telephone surveys: The total design method*. New York, NY: Wiley.

Ervin, S. M. (2001). Digital landscape modeling and visualization: A research agenda. *Landscape and Urban Planning, 54*(1−4)*,* 49–62.

Ervin, S. M., & Hasbrouck, H. (1999). 30 years of computing in landscape architecture. *Landscape Architecture, 89*(11)*,* 54–56.

Foddy, W. (1993). *Constructing questions for interviews and questionnaires.* Hong Kong: Cambridge University Press.

French, O. (2010). *Bryce and Vue feature comparison.* Retrieved from http://www.virtual-lands-3d.com/bryce-vs-vue.html

Haklay, M. E. (2002). Virtual reality and geographical information systems: Analysis and trends. In P. Fisher & D. Unwin (Eds.), *Virtual reality and geography* (pp. 47–57). London, UK: Taylor and Francis.

Hanna, K. C. (1999). *GIS for landscape architects*. Redlands, CA: ESRI Press.

He, H. S., Yang, J., Shifley, S. R., & Thompson, F. R. (2011). Challenges of forest landscape modeling-simulating large landscapes and validating results. *Landscape and Urban Planning, 100*(4), 400–402.

Hehl-Lange, S. (2001). Structural elements of the visual landscape and their ecological functions. *Landscape and Urban Planning, 54*(1–4), 105–113.

Henderson, M., Morris, L. L., & Fitz-Gibbon, C. T. (1978). *CSE program evaluation kit.* Thousand Oaks, CA: SAGE.

Herwig, A., & Paar, P. (2002). Game engines: Tools for landscape visualization and planning? In E. Buhmann, U. Nothelfer, & M. Pietsch (Eds.), *Trends in GIS and virtualization in environmental planning and design* (pp. 162–171). Heidelberg, Germany: Anhalt University of Applied Sciences.

Kheir, A. (2001). Visualization tools and methods for participatory planning and design. *Journal of Urban Technology, 8*(2), 1–37.

Lange, E. (1994). Integration of computerized visual simulation and visual assessment in environmental planning. *Landscape and Urban Planning, 30*(1–2)*,* 99–112.

Lange, E. (2001). The limits of realism: Perceptions of virtual landscapes. *Landscape and Urban Planning, 54*(1–4), 163–182.

Nielsen, D., Fleming, M. J., Kumarasuriyar, A. C., & Gard, S. (2010, March). *Digital design communication: Measuring learner technological prowess and self-efficacy in problem resolution.* Paper presented in INTED 2010 International Technology, Education and Development Conference, Valencia, Spain.

Paar, P. (2006). Landscape visualizations: Applications and requirements of 3D visualization software for environmental planning. *Computer, Environment and Urban Systems, 30*(6)*,* 815–839.

Palmer, J. F. (1997). The 1996 status report on computing skills and training in landscape architecture. *Newsletter of the ASLA Open Committee on Computing, 9*(2), 2–5.

Palmer, J. F., & Buhmann, E. (1994). A status report on computers. *Landscape Architecture, 84*(7), 54–55.

Pihlak, M., & Barrett, S. (2000, October). *Design computing for the real world*. Paper presented at ASLA Annual Meeting, St. Louis, MO.

Priestnall, G., & Hampson, D. (2008). Landscape visualizations: Science and art. In M. Dodge, M. McDerby, & M. Turner (Eds.), *Geographic visualization: Concepts, tools and applications* (pp. 241–258). Chichester, UK: Wiley.

Sheppard, S. R. J. (1989). *Visual simulation: A user's guide for architects, engineers, and planner.* New York, NY: Van Nostrand Reinhold.

Sheppard, S. R. J. (2001). Guidance for crystal ball gazers: Developing a code of ethics for landscape visualization. *Landscape and Urban Planning, 54*(1–4), 183–199.

Sheppard, S. R. J., & Cizek, P. (2009). The ethics of Google Earth: Crossing thresholds from spatial data to landscape visualization. *Journal of Environmental Management, 90*(6)*,* 2102–2127.

Sheppard, S. R. J., & Meitner, M. (2004). Using multi-criteria analysis and visualization for sustainable forest management planning with stakeholder groups. *Forest Ecology Management, 207*(1–2), 171–187.

Sommer, B., & Sommer, R. (1991). *A practical guide to behavioral research: Tools and techniques* (3rd ed.). New York, NY: Oxford University Press.

Stock, C., Bishop, I. D., O'Connor, A. N., Chen, T., Pettit, C. J., & Aurambout, J. P. (2009). SIEVE: Collaborative decision-making in an immersive online environment. *Cartography and Geographic Information Science, 35*(2)*,* 133–144.

Sullivan, M. (2008). *Algebra and trigonometry.* Upper Saddle River, NJ: Pearson Press.

Taylor-Powell, E., & Steele, S. (1996). *Collecting evaluation data: Direct observation*. Madison, WI: University of Wisconsin Cooperative Extension. Retrieved from http://learningsotre.uwex.edu/pdf/G3658-5.pdf

Wu, H., He, W., & Gong, J. (2010). A virtual globe-based 3D visualization and interactive framework for public participation in urban planning processes. *Computer, Environment and Urban Systems, 34*(4)*,* 291–298.

APPENDICES

Appendix A: Survey Instrument for Landscape Architecture Professionals

Survey for Landscape Architecture Professionals Exit this survey

Part A: PROFESSIONAL BACKGROUND

Please answer the following general questions about yourself and your firm.

What is your gender?

- Female
- Male

How long have you been working as a landscape architect?

- 1-2 years
- 3-5 years
- 6-10 years
- Over 10years

What is the highest level of school you have completed or the highest degree you have received?

- Certificaate program
- Associate degree
- Bachelor degree
- Graduate degree
- Doctoral degree
- I have in-field training experience required for my job

8%

Next

Survey for Landscape Architecture Professionals Exit this survey

How long has your firm been established?

- 1-5 years
- 6-10 years
- 11-20 years
- Over 20 years

Which state is your firm located in?

State: -- select state --

ZIP:

17%

Prev Next

Survey for Landscape Architecture Professionals

Exit this survey

How long has your firm been established?

- ◯ 1-5 years
- ◯ 6-10 years
- ◯ 11-20 years
- ◯ Over 20 years

which state is your firm located in?

State: -- select state --

ZIP:

17%

Prev Next

Survey for Landscape Architecture Professionals

Exit this survey

What types of services does your firm provide? (Please check all that apply)

- ☐ Commercial
- ☐ Residential
- ☐ Transportation
- ☐ Industrial
- ☐ Institutional
- ☐ Environmental restoration/revitalization
- ☐ Historic preservation
- ☐ Consultancy
- ☐ Urban/Regional planning
- ☐ Recreational design
- ☐ Tourism planning

Other (please specify)

Which operating system is your firm currently using? (Check all that apply)

- ☐ Windows
- ☐ MacOS
- ☐ Lunus/Unit
- ☐ Other

25%

Prev Next

Survey for Landscape Architecture Professionals

Exit this survey

How would you rate yourself in terms of proficiency and knowledge with 3D software that you are using?

○ Expert ○ Experienced ○ Average ○ Novice ○ Little knowledge

Please rate how frequently you use 3D tools during the design and planning process.

	Very Often	Often	Sometimes	Rarely	Never
Project acquisition	○	○	○	○	○
Inventory and analysis	○	○	○	○	○
Determination of conflicts	○	○	○	○	○
Public involvement	○	○	○	○	○
Planning alternatives	○	○	○	○	○
Preliminary draft	○	○	○	○	○
Final output	○	○	○	○	○

42%

Prev Next

Powered by SurveyMonkey
Check out our sample surveys and create your own now!

Survey for Landscape Architecture Professionals

Exit this survey

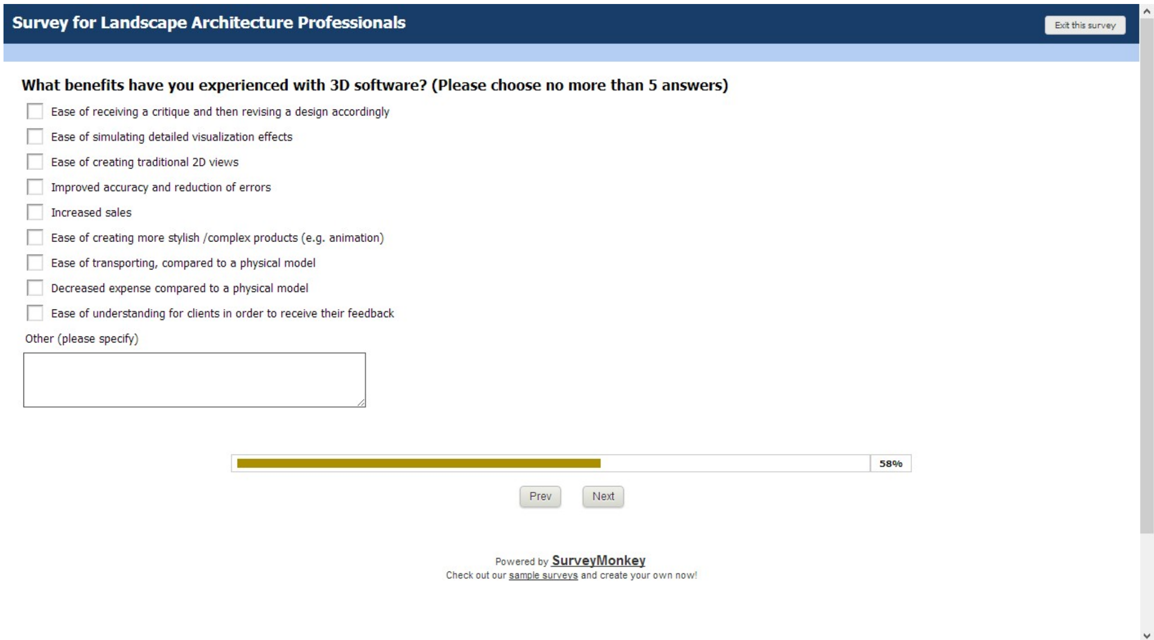
With which of the following groups do you find 3D software to be an effective tool to communicate design ideas? (Please rate the level of effectiveness)

	Most effective				Less effective
Contractors	○	○	○	○	○
Concerned groups	○	○	○	○	○
Peer-Professionals	○	○	○	○	○
General public	○	○	○	○	○
Policy makers	○	○	○	○	○
Experts in related areas (e.g. Ecologist...)	○	○	○	○	○

50%

Prev Next

Powered by SurveyMonkey
Check out our sample surveys and create your own now!



Survey for Landscape Architecture Professionals

Exit this survey

What benefits have you experienced with 3D software? (Please choose no more than 5 answers)

- [ ] Ease of receiving a critique and then revising a design accordingly
- [ ] Ease of simulating detailed visualization effects
- [ ] Ease of creating traditional 2D views
- [ ] Improved accuracy and reduction of errors
- [ ] Increased sales
- [ ] Ease of creating more stylish /complex products (e.g. animation)
- [ ] Ease of transporting, compared to a physical model
- [ ] Decreased expense compared to a physical model
- [ ] Ease of understanding for clients in order to receive their feedback

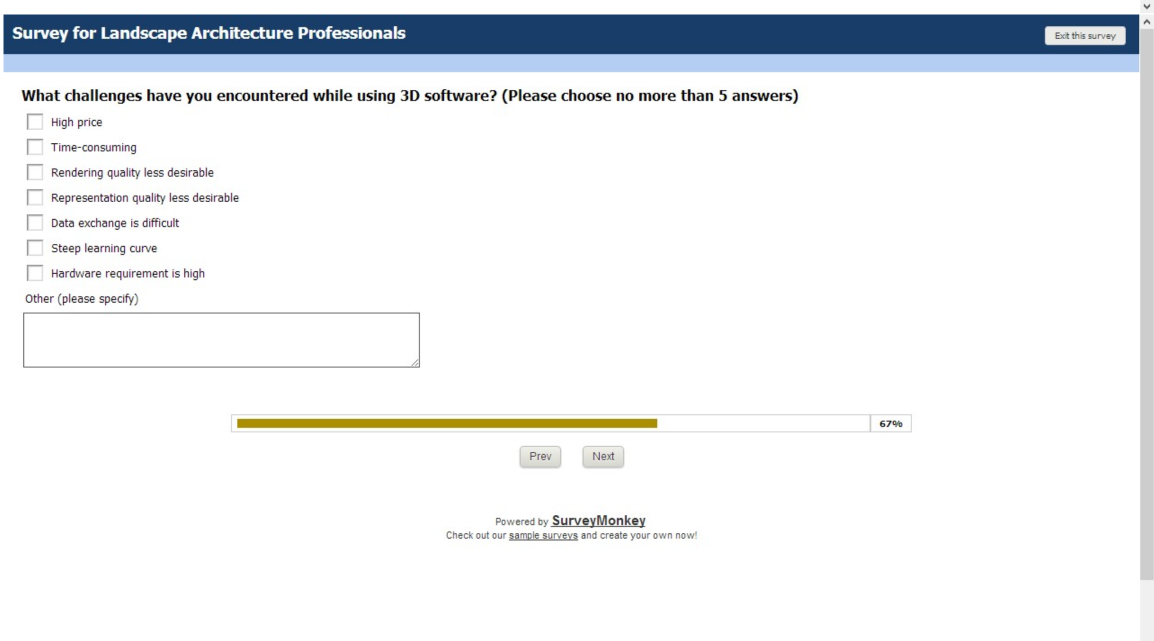
Other (please specify)

58%

Prev Next

Powered by SurveyMonkey

Check out our sample surveys and create your own now!



Survey for Landscape Architecture Professionals

Exit this survey

What challenges have you encountered while using 3D software? (Please choose no more than 5 answers)

- [ ] High price
- [ ] Time-consuming
- [ ] Rendering quality less desirable
- [ ] Representation quality less desirable
- [ ] Data exchange is difficult
- [ ] Steep learning curve
- [ ] Hardware requirement is high

Other (please specify)

67%

Prev Next

Powered by SurveyMonkey

Check out our sample surveys and create your own now!

Survey for Landscape Architecture Professionals Exit this survey

What improvement/change do you think should be considered for 3D software program teaching?

- ☐ The removal of all 3D computer graphics courses
- ☐ An increase in the number of software programs taught
- ☐ An emphasis on a few select software programs, focusing on depth over breath
- ☐ An increased collaboration with other departments that offer 3D graphics courses (Art, Planning, Geography, etc.)
- ☐ No changes

Other (please specify)

75%

Prev Next

Powered by **SurveyMonkey**
Check out our sample surveys and create your own now!

Survey for Landscape Architecture Professionals Exit this survey

What do you think is important for future development of 3D software? (Please rate your level of agreement with the following statements.)

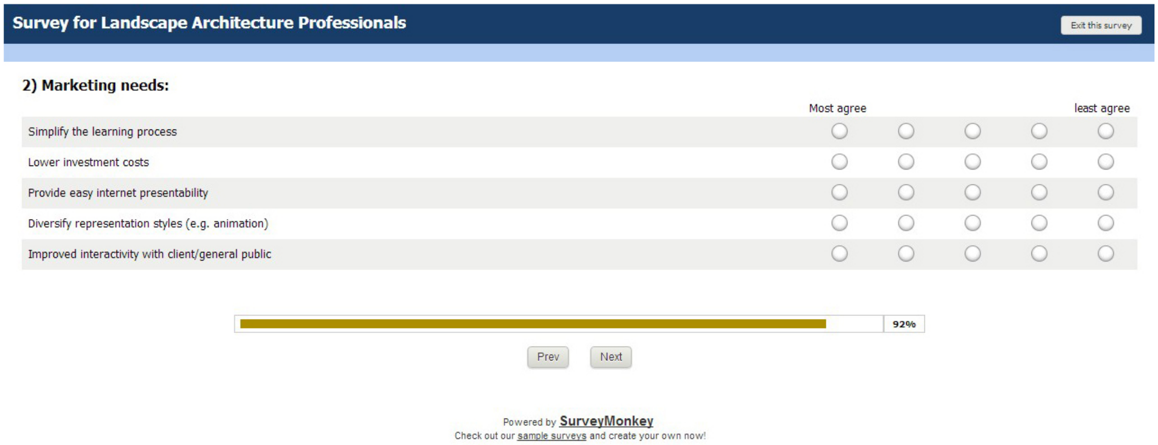
1) Software enhancement:

	Most agree				least agree
Lower the hardware requirement	○	○	○	○	○
Increased access to original database	○	○	○	○	○
Customize the software	○	○	○	○	○
Shorten the simulating process	○	○	○	○	○
Improve interoperability	○	○	○	○	○
Increase the efficiency of navigation/orientation tools	○	○	○	○	○

83%

Prev Next

Powered by **SurveyMonkey**
Check out our sample surveys and create your own now!



Survey for Landscape Architecture Professionals Exit this survey

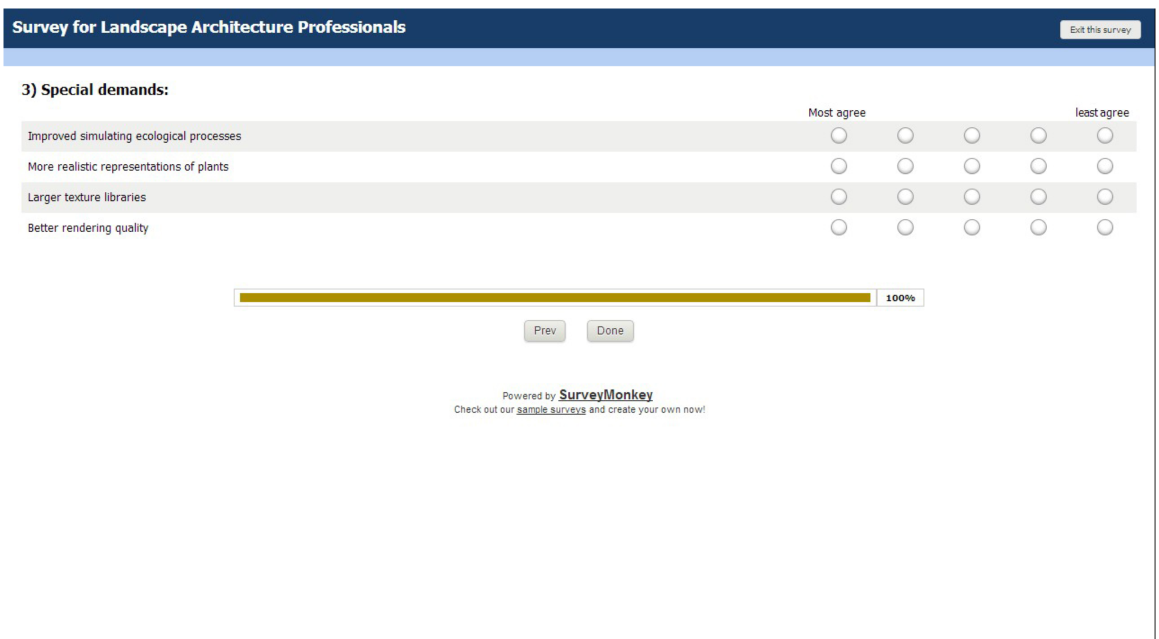
2) Marketing needs:

	Most agree				least agree
Simplify the learning process	○	○	○	○	○
Lower investment costs	○	○	○	○	○
Provide easy internet presentability	○	○	○	○	○
Diversify representation styles (e.g. animation)	○	○	○	○	○
Improved interactivity with client/general public	○	○	○	○	○

92%

Prev Next

Powered by SurveyMonkey
Check out our sample surveys and create your own now!



Survey for Landscape Architecture Professionals Exit this survey

3) Special demands:

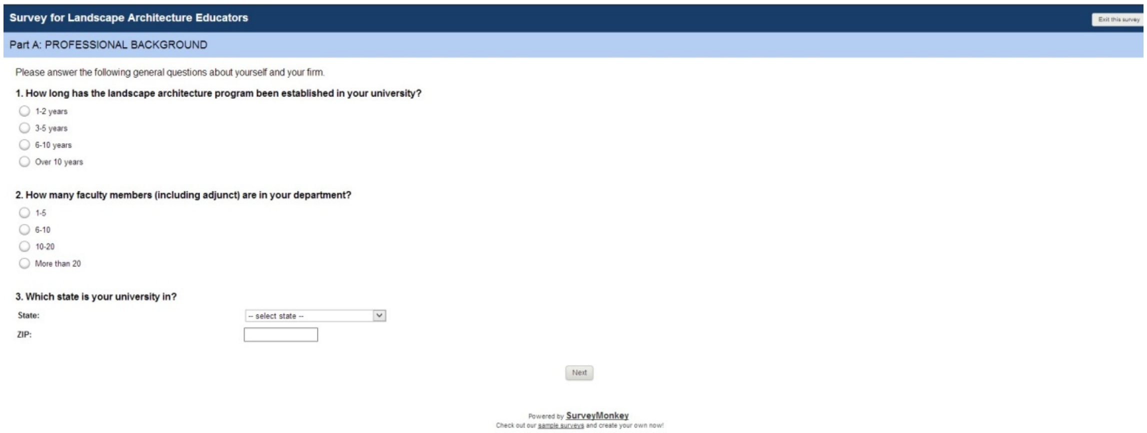
	Most agree				least agree
Improved simulating ecological processes	○	○	○	○	○
More realistic representations of plants	○	○	○	○	○
Larger texture libraries	○	○	○	○	○
Better rendering quality	○	○	○	○	○

100%

Prev Done

Powered by SurveyMonkey
Check out our sample surveys and create your own now!

Appendix B: Survey Instrument for Landscape Architecture Educators



Survey for Landscape Architecture Educators

Exit this survey

Part A: PROFESSIONAL BACKGROUND

Please answer the following general questions about yourself and your firm.

1. How long has the landscape architecture program been established in your university?

- 1-2 years
- 3-5 years
- 6-10 years
- Over 10 years

2. How many faculty members (including adjunct) are in your department?

- 1-5
- 6-10
- 10-20
- More than 20

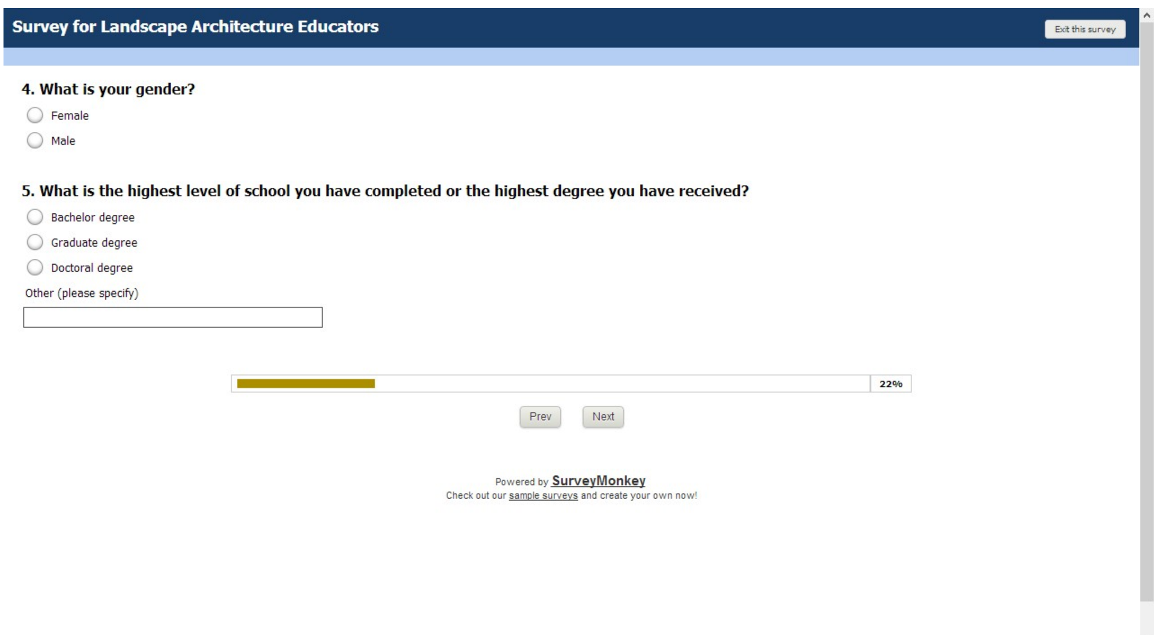
3. Which state is your university in?

State: -- select state --

ZIP:

Next

Powered by SurveyMonkey
Check out our sample surveys and create your own now!



Survey for Landscape Architecture Educators

Exit this survey

4. What is your gender?

- Female
- Male

5. What is the highest level of school you have completed or the highest degree you have received?

- Bachelor degree
- Graduate degree
- Doctoral degree

Other (please specify)

22%

Prev Next

Powered by SurveyMonkey
Check out our sample surveys and create your own now!

Survey for Landscape Architecture Educators

Exit this survey

6. What is your current job title?

- ◯ Professor
- ◯ Associate Professor
- ◯ Assistant Professor
- ◯ Lecturer
- ◯ Adjunct Instructor

Other (please specify)

7. How long have you worked as an educator in Landscape Architecture?

- ◯ 1-2 years
- ◯ 3-5 years
- ◯ 6-10 years
- ◯ Over 10 years

33%

Prev Next

Survey for Landscape Architecture Educators

Exit this survey

8. Which operating system is your department currently using? (Check all that apply)

- ☐ Windows
- ☐ MacOS
- ☐ Lunus/Unit
- ☐ Other

44%

Prev Next

Powered by SurveyMonkey
Check out our sample surveys and create your own now!

Survey for Landscape Architecture Educators

Exit this survey

Part B: 3D TOOLS IN LANDSCAPE ARCHITECTURE EDUCATION

Many landscape architecture programs offer 3D computer graphics courses. We would like to know how you teach 3D programs in landscape architecture.

9. What 3D software do you currently cover in 3D computer graphics courses? (Please also specify the year you began teaching the software you cover in your courses.)

	Yes/No	Year started
3D Studio Max		
AutoCAD Civil 3D		
AutoCAD Map 3D		
AutoCAD Plant 3D		
ArcGIS		
Bryce 3D		
Google Sketchup		
Maya		
Rhinoceros 3D		
Vectorwork		
Vue		

Other (please specify)

56%

Prev Next

Survey for Landscape Architecture Educators

Exit this survey

10. How many credit hours is each course you teach?

	One	Two	Three	Four	Above Four
Course 1					
Course 2 (Optional)					

11. Have you considered increasing course credit hours?

	Yes	No
Course 1		
Course 2 (Optional)		

12. Is this a required or an elective course ?

	Required	Elective
Course 1		
Course 2 (Optional)		

67%

Prev Next

Survey for Landscape Architecture Educators

Exit this survey

13. On average, how many students register for this course?

	1-10	11-20	21-40	More than 40
Course 1	○	○	○	○
Course 2 (Optional)	○	○	○	○

14. Which university level is the majority of the students in each course?

	Freshmen	Sophomore	Junior	Senior	Graduate
Course 1	○	○	○	○	○
Course 2 (Optional)	○	○	○	○	○

78%

Prev Next

Survey for Landscape Architecture Educators

Exit this survey

15. Do you offer 3D computer graphics courses online?

- ○ Yes
- ○ No

16. If not, would you or your department consider offering online 3D computer graphics courses in the future?

- ○ Yes
- ○ No

89%

Prev Next

Survey for Landscape Architecture Educators Exit this survey

17. What improvement/change do you think should be considered for 3D software program teaching? (Check all that apply)

- [ ] The removal of all 3D computer graphics courses
- [ ] An increase in the number of software programs taught
- [ ] An emphasis on a few select software programs, focusing on depth over breath
- [ ] An increased collaboration with other departments that offer 3D graphics courses (Art, Planning, Geography, etc.)
- [ ] No changes

Other (please specify)

100%

Prev Done

Appendix C: Sample Contact Email to Landscape Architecture Professionals

To: [Email]
From: "j.yan@aggiemail.usu.edu via surveymonkey.com" <member@surveymonkey.com> Verify

Subject: Survey for Landscape Architecture Professionals
Body: Dear [FirstName] [LastName],

The Department of Landscape Architecture and Environmental Planning at Utah State University is conducting a study on the education of landscape architecture digital graphics, specifically 3D software programs. The study is funded by the Utah Agricultural Experiment Station. We are surveying firms registered with ASLA. Enclosed is a questionnaire, which should take approximately 5 minutes to complete.

The information you provide will be kept strictly confidential. My thesis advisor, Dr. Shujuan Li, and I will be the only people who will see the questionnaires. No information will be made available to others that will allow identification of individual faculty members or institutions.

Your participation is voluntary. You may withdraw your participation at any time. There are no risks in participating in this survey. Although individually you will not benefit from this survey, your participation will benefit landscape architecture curriculum development and the profession's growth in emerging technologies.

You may ask questions concerning this survey at any time. We can be contacted by phone at (435) 797-0960 or by email at shujuan.li@usu.edu. Please contact us with any concerns you may have regarding the study.

To complete your survey today, click http://www.surveymonkey.com/s.aspx .If that does not work, please copy and paste the entire web address into the address field of your browser.
https://www.surveymonkey.com/s/laepprofessional

We would like to thank you for your time and feedback.

Please note:If you are NOT in charge of this please forward this email to appropriate people at your firm. If you do not wish to receive further emails from us, please click the link below http://www.surveymonkey.com/optout.aspx

Sincerely,
Jess Yan
MLA Candidate
j.yan@aggiemail.usu.edu, (435) 740-4946

Shujuan Li, Ph.D
Assistant Professor
shujuan.li@usu.edu, (435) 797-0960

Dept. of Landscape Architecture and Environmental Planning
Utah State University
4005 Old Main Hill
Logan, UT 84322-4005
http://laep.usu.edu

Appendix D: Sample Contact Email to Landscape Architecture Educators

To: [Email]
From: "j.yan@aggiemail.usu.edu via surveymonkey.com" <member@surveymonkey.com> Verify

Subject: Survey for Landscape Architecture Educators
Body: Dear [FirstName] [LastName],

The Department of Landscape Architecture and Environmental Planning at Utah State University is conducting a study on the education of landscape architecture digital graphics, specifically 3D software programs. The study is funded by the Utah Agricultural Experiment Station. We are surveying faculty members who teach digital graphics courses in landscape architecture programs. Enclosed is a questionnaire, which has been approved by IRB and should take you approximately 5 minutes to complete.

The information you provide will be kept strictly confidential. My thesis advisor, Dr. Shujuan Li, and I will be the only people who will see the questionnaires. No information will be made available to others that will allow identification of individual faculty members or institutions.

Your participation is voluntary. You may withdraw your participation at any time. There are no risks in participating in this survey. Although individually you will not benefit from this survey, your participation will benefit landscape architecture curriculum development and the profession's growth in emerging technologies.

You may ask questions concerning this survey at any time. We can be contacted by phone at(435) 797-0960 or by email at shujuan.li@usu.edu. Please contact us with any concerns you may have regarding the study.

To complete your survey today, click http://www.surveymonkey.com/s.aspx . If that does not work, please copy and paste the entire web address into the address field of your browser.
https://www.surveymonkey.com/s/laepeducator

We would like to thank you for your time and feedback.

Please note: If you are NOT teaching 3D computer graphic class please forward this email to appropriate teachers. If you do not wish to receive further emails from us, please click the link below http://www.surveymonkey.com/optout.aspx

Sincerely,
Jess Yan
MLA Candidate
j.yan@aggiemail.usu.edu, (435) 740-4946

Shujuan Li, Ph.D
Assistant Professor
shujuan.li@usu.edu, (435) 797-0960

Dept. of Landscape Architecture and Environmental Planning
Utah State University
4005 Old Main Hill
Logan, UT 84322-4005
http://laep.usu.edu

Appendix E: IRB Approval Letter

Institutional Review Board

USU Assurance: FWA#00003308

Exemption #2

Certificate of Exemption

FROM:	Richard D. Gordin, Acting IRB Chair True M. Rubal, IRB Administrator
To:	Shujuan Li, Jie Yan
Date:	April 13, 2012
Protocol #:	4405
Title:	An Evaluation Of Current Applications Of 3d Visulization Software In Landscape Architecture

The Institutional Review Board has determined that the above-referenced study is exempt from review under federal guidelines 45 CFR Part 46.101(b) category #2:

> Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (a) information obtained is recorded in such a manner that human subjects can be identified, directly or through the identifiers linked to the subjects: and (b) any disclosure of human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

This exemption is valid for three years from the date of this correspondence, after which the study will be closed. If the research will extend beyond three years, it is your responsibility as the Principal Investigator to notify the IRB before the study's expiration date and submit a new application to continue the research. Research activities that continue beyond the expiration date without new certification of exempt status will be in violation of those federal guidelines which permit the exempt status.

As part of the IRB's quality assurance procedures, this research may be randomly selected for continuing review during the three year period of exemption. If so, you will receive a request for completion of a Protocol Status Report during the month of the anniversary date of this certification.

In all cases, it is your responsibility to notify the IRB prior to making any changes to the study by submitting an Amendment/Modification request. This will document whether or not the study still meets the requirements for exempt status under federal regulations.

Upon receipt of this memo, you may begin your research. If you have questions, please call the IRB office at (435) 797-1821 or email to irb@usu.edu.

The IRB wishes you success with your research.

4460 Old Main Hill Logan, UT 84322-4460 PH: (435) 797-1821 Fax: (435) 797-3769 WEB: irb.usu.edu EMAIL: irb@usu.edu