Computer Aided Drafting Skills: An Investigation of Interior Design Entry level Expectations as Compared Between Industry & Academia

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Abstract

This study surveyed expectations of entry-level CAD skills and compared the results between interior design faculty and practitioners. Descriptive statistics indicate high levels of agreement on the importance of most knowledge areas and technical CAD skills. Despite this practitioners indicated that the CAD preparedness of recent entry-level employees was insufficient. Findings indicate that the majority of all skills surveyed were ranked 4 to 5 out of 5 with 5 being essential for entry-level practice. Without levels of priority, it is difficult for faculty to build curriculum that addresses the most essential components of CAD training needed to raise practitioner satisfaction levels. This study recommends additional research to rank CAD skills against each other to clarify levels of importance.

Keywords: interior design, computer aided design, CAD, entry-level, education

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Introduction

Why is This Important?

The ability to create construction drawings is recognized by the industry as a required entry-level skill for Interior Design. The Council for Interior Design Accreditation (CIDA) states that entry-level Interior Designers must be able to “produce competent contract documents including coordinated drawings, [and] schedules” (Council for Interior Design Accreditation, 2009, pp14). The U.S. Bureau of Labor Statistics (BLS) recognizes in the Occupational Outlook Handbook for 2009-2010 that designs are typically created with computer-aided design (CAD) software because it is more efficient than creating drawings by hand (Bureau of Labor Statistics, 2010). CAD is the tool that allows interior designers to communicate their designs to clients, contractors, and trades people. A marketable interior design graduate must be able to produce construction drawings using the industry-recognized process in order to be successful in the field (Council for Interior Design Accreditation, 2009).

Design Problem

As defined by the National Council for Interior Design Qualification (NCIDQ) “Interior Design includes a scope of services performed by a professional design practitioner, qualified by means of education, experience and examination, to protect and enhance the health, life safety and welfare of the public” (National Council for Interior Design Qualification, Inc., 2004). This includes “Preparation of construction documents to adhere to regional building and fire codes, municipal codes, and any other jurisdictional statutes, regulations and guidelines applicable to the interior space” (National Council for Interior Design Qualification, Inc., 2004).

The majority of research into entry-level qualifications specific to Interior Design was performed in the 1980s. The outcome was that employers expected students to have design skills but were willing to teach them the technical computer skills (Meyers, 1982; Iris & Baker, 1989). These results have formed much of the basis for the pedagogy of Interior Design curriculum. The problem is that technology today looks nothing like the technology of two decades ago.

Both CIDA and NCDIQ call for education programs to stay abreast of the technology requirements of the industry and to adjust instruction accordingly. However, they do not specifically require computer-drafting skills, a number of hours of CAD, or prescribe a course of study detailing what is currently required by the industry (Council for Interior Design Accreditation, 2009). Based on CIDA's professional standards, an Interior Design program could be accredited and still not be equipping its graduates with sufficient CAD skills. Most studies agree that CIDA accredited programs typically provide CAD instruction that exceeds the CIDA's standards (Zane, 1993). The question that has not been answered is whether the level of CAD instruction students are receiving meets or exceeds industry needs. This study will investigate how effectively the CIDA accredited programs are meeting industry CAD training needs and where the disconnect between academia and industry regarding this question exists.

Beneficiaries

This study will benefit interior design students, faculty and institutions that provide a four-year CIDA accredited Interior Design program of study by demonstrating where four-year Interior Design programs need to better prepare their students in order to successfully equip them for competent entry-level interior design practice. The study will also benefit the interior design industry. CAD training is costly and time consuming for employers to provide. While an employee is training, he is not producing and the company is not making money. Interior design graduates who are better prepared to go into the workforce will cost their employers less to train and will make them more money by being more productive immediately.

Contribution to Design

The mission of any undergraduate program is to prepare their students with industry specific skills that will allow them to excel in the workplace. For example, part of the mission statement for the undergraduate Interior Design program at the University of Central Oklahoma is to help students excel in: “Rendering, executing, and producing design” (University of Central Oklahoma, 2010). A study that clarifies what it means to be able to produce accurate construction drawings in the Interior Design industry will allow institutions of higher education to grow in their ability to prepare graduates who are both competent and ready to work in the field. The field of Interior Design is expected to grow at well above average rate of 19% between 2008 and 2018 (U.S. Bureau of Labor Statistics, 2010). The Interior Design field needs and will continue to need new designers that are not only design savvy but technically competent in CAD.

Literature Review

History of Computer Aided Design

The history of Computer Aided Design (CAD) began in the mid 1950’s. The first commercial numerical control system, developed by Dr. Patrick J. Hanratty, led to a system called Sketchpad, which was the first true CAD system. (Bozdoc, 2003). Sketchpad was developed in 1960 at MIT by doctoral candidate Ivan Sutherland (Bissell, 1990). It ran on a mainframe computer that required over 1000 square feet of space. This computer, which was very advanced for its time, featured 320 kilobytes (kb) of main memory, an eight megabyte (mb) magnetic storage device, a seven inch monitor, a light pen and a button box (CADAZZ, 2004). By comparison, today's machines required a minimum of two gigabytes (gb) of memory and storage devices are optical rather than magnetic and range in the hundreds of gigabytes, even terabytes (CADAZZ, 2004).

Sketchpad's significance in the history of CAD can be traced to how it enabled the user to interact with the CAD system. It allowed the user to draw directly on the screen, constrain line intersections to specific angles, store master versions of objects that could be copied, and reused or edited with changes propagating through the instances. Drawings were stored and could be easily duplicated and printed in large formats. Sketchpad proved for the first time that computers could automate drafting tasks more reliably and accurately than manual methods. Sketchpad also proved that computers could be used for more than just repetitive tasks and could interact with users for creative tasks (CADAZZ, 2004).

While the initial breakthrough in CAD occurred in 1960, it would be several decades before CAD would become mainstream in the interior design or architecture design process. In the 1960s, computers required enormous amounts of space and were extremely expensive. As a result only aircraft and automotive companies were the first to implement CAD systems (CADAZZ, 2004).

During the time of the mainframe computer, multiple CAD systems were developed that would influence the evolution of the CAD software we see today. In 1962 SLS Environetics developed Mac-Man, a system designed to draft interior layouts for office spaces. The only other major attempt to develop a commercially available CAD system cost $500,000 and was not widely sold. Over the next decade, the automotive and aviation industries researched and adopted CAD on UNIX based mainframe computers. UNIX was an early single user based operating system that today has expanded into a wide range of operating systems that use the same base architecture including Linux and Apple's MAC OS X. Instead of running CAD programs directly, using switches and other means, the UNIX operating system loaded software automatically (OS Data, 1998). By the end of 1979, the typical CAD system was a 16 bit minicomputer, which cost $125,000 (Bozdoc, 2003). It is important to note that CAD systems prior to 1980 were sold as turnkey hardware/software packages. The proprietary hardware was designed to run specific CAD programs and could not be simply uninstalled or replaced like the software we have today (CADAZZ, 2004).

Personal Computer Effect on CAD

With a new decade came a host of technological advances including the first personal computer (PC). The first PC, created by IBM, came at the relatively low cost of $3,000 (Bozdoc, 2003). Other notable advances in technology include the first mouse device, the first laptop computer, the first color video card, and double-sided floppy disks. Finally, technology was powerful enough at a low enough cost in a small enough box to make CAD feasible at a commercial level.

One of the first companies to see this opportunity was a venture called Marin Software Partners (MSP). They bought several startup pieces of software they saw potential in and began to develop them. Their goal was to develop software that required little customization for the consumer to use it and little technology support after it was installed (Walker, 1994). One of the software pieces they chose to develop was initially named MicroCAD. Although this small software piece was one of several and not the main market focus of MSP, this software would take the design world by storm.

In December of 1981, MSP headed to the Las Vegas COMDEX trade show with MicroCAD. The response was overwhelming. MSP returned from the show keenly aware of the market opportunity that MicroCAD could fill (Walker, 1994). They refined the program and renamed it AutoCAD; they also renamed the company Autodesk. Four years later in 1985, Bentley Systems, Inc. launched Microstation, the first major competitor to AutoCAD. The CAD market quickly took off and by 1990, a host of CAD software systems were available for the PC platform (Bozdoc, 2003).

CAD Integration into Practice

Interior design firms that had been unable to buy into CAD prior to the PC were quick to embrace the PC CAD trend. Between 1985 and 1989, surveys of the top 100 interior design giants indicated that CAD usage increased from 7% of firms to 92% of firms (McLain-Kark, 1986; Loebelson, 1989) Creating construction drawings with CAD was faster, more efficient, and allowed changes to be made more quickly and easily compared to hand drafting. CAD software also allowed the drafter to be far more precise, reducing the likelihood of errors. By 1990, multiple studies and articles indicated that CAD had become a permanent and important part of the design process (Clemons & McCullough, 1989; Brandon, 1987). While surveys of the top 100 interior design firms reflect the purchasing power of the most financially able firms, a study completed in 1995 of 259 interior design firms, evenly distributed across large (those with more than 50 employees) and small firms (those with five employees or less), indicated a 71% CAD usage rate (Waxman & Zang, 1995). This was a significant increase from results documented by a study done five years earlier that found only 20% of construction documents were being done using CAD (Bollinger,1990).

CAD Integration into Education

Interior design education programs also quickly incorporated CAD instruction into their curriculums. A study of interior design programs accredited by the Foundation for Interior Design Education Research (FIDER), indicated that by 1993, 91% of interior design programs were providing regular CAD instruction as part of their degree programs (Curry, Shroyer, & Gentry, 1993). Despite this high percentage, the extent of the integration was unclear. While the cost of computers and CAD software was much less expensive than it was in the 1970's, the funding required to set up an entire student computer lab was still prohibitive to many colleges and universities. By the end of the 1990s, the question of how universities could economically integrate CAD into the curriculum was still very much a concern (Case & Matthews, 1999).

One frequent method of integration was to teach CAD as a separate skills course. This was in contrast to the practice of integrating software use into studio courses in which students used CAD as a means to complete assignments rather than focusing on CAD as the goal of instruction (Clemons & Mclain-Kark, 1991). Offering CAD as a separate skills allowed institutions to maintain a single student computer lab rather than multiple computer labs. As a result, initial purchase, upgrade and maintenance costs were decreased because computers and the support infrastructure were not needed in every classroom. This method has been criticized because it does not encourage or allow students to fully integrate CAD into the development of their own design process (Gross, 1994). It is estimated that 300-500 hours of CAD use are required beyond basic skills training to make a designer a competent user (Sanders, 1996). Without the ability to work with CAD during studio hours, students must find time outside class to continue their CAD education on their own.

A more recent solution to the CAD integration predicament has been the student laptop requirement. Many schools now require students accepted into interior design programs to purchase a laptop to use at school. When students own and maintain the computer hardware and software it eliminates those costs for the institution. It also allows the institution to use existing infrastructure and space that would not have supported full-size desktop computers and the associated electrical and air conditioning loads on the building. As a result, CAD can be easily integrated into studio courses by simply requiring students to bring their laptops. In addition, the liability of ownership and theft is shifted from the institution to the student, further reducing the overhead cost for the institution (Case & Matthews, 1999).

CAD Preparedness of Students

This high level of computer integration into interior design curriculum would seem to indicate that students are being well trained and are comfortable using computers and CAD software. Multiple studies make similar conclusions based on integration percentages. A study done in 1992 surveyed educators of FIDER-accredited interior design programs and concluded that since 73.9% of programs required levels of CAD understanding above those prescribed by FIDER, students were adequately prepared in CAD (Curry, 1992). A study examining the use of CAD in the interior design industry in 1995 inferred that since 96% of educators reported that students used CAD at least partially to complete most assignments, students were well prepared to use CAD in the field (Waxman & Zang, 1995). This implied preparedness based on percentage comparisons is weak because the surveys did not test perceptions or specific CAD skills. In addition they did not define what CAD skills are required to meet their definition of preparedness. Most did not even offer a definition of preparedness. These claims of CAD preparedness are challenged by other studies that gauged student perceptions about CAD and computer use (Lee & Hagerty, 1996; Nawrocki, 2001; Meneely & Danko, 2007; Case & Matthews, 1999).

Several recent studies have documented the CAD preparedness perceptions and industry entry-level expectations of interior design students. In 1996, a study compared the perception of entry-level interior design skills, including CAD skills, of interior design students and practitioners. The study documented a significant difference between student and practitioner expectations regarding the type of work students would be doing upon graduation. This difference existed in both lower division and upper division students, although to a slightly lesser degree in upper division students (Lee & Hagerty, 1996). In 2007, a study researching the effect of digital media on the creative process documented student attitudes toward CAD and discovered that 40% of interior design students did not have a clear understanding of how CAD could be integrated into the design process. Student reasons for using CAD ranged from “everyone is doing it now” to “because the job market requires it” (Meneely & Danko, 2007). This was in stark comparison to student understanding of the role of sketching and hand drawing in interior design. Students had a clear grasp of both the reasons for sketching and their personal weaknesses that could help them improve their hand drawing skills. The ability to recognize where they were weak in order to facilitate improvement later was missing entirely from student statements about CAD use (Meneely & Danko, 2007). A third study done in 1999 traced the development of the laptop integration program into the curriculum at one interior design program. Each graduating class was surveyed about how prepared they felt to use CAD in their third year studio class. Even after three years of computer integration, students were not comfortable using the software and felt less than adequately prepared to use CAD (Case & Matthews, 1999). In 2001, a study measuring the level of CAD instruction that interior design professionals had received from their institutions indicated that practitioners recommended more CAD training and at an advanced level above what they had received. The general consensus was that one or two computer classes were insufficient to fully train interior design students in the CAD and technical skills required for entry-level employment (Nawrocki, 2001).

Recent Literature

The most current and relevant study to this literature review is an unpublished thesis study completed in 2004, which documented the entry-level CAD expectations of interior design practitioners (Key, 2004). The sample included 206 members from the American Society of Interior Designers (ASID) and the International Interior Design Association (IIDA). The goals of the survey were:

> (1) to determine the demographic characteristics of interior design firms regarding scope of design work, size of firm, and education level; (2) to determine which CAD programs interior designers use; (3) to determine the current use of computer-aided design among professional members of the American Society of Interior Designers (ASID), and professional members of the International Interior

> Design Association (IIDA); (4) to determine the level of computer-aided design competency required for entry-level employment; (5) to determine if firm size impacts gross volume; (6) to determine if firm size and scope of work impact CAD use. (Key, 2004,pp.7).

The need for an occupational evaluation was supported by studies that indicated a correlation between professional and educational standards must be in place in order for graduates of interior design programs to be prepared for entry-level practice (Curry, 1992). The need for periodic occupational evaluations is also supported by the Council for Interior Design Accreditation (CIDA [formerly FIDER]) professional standards. The CIDA standards require accredited programs to prepare students to produce construction drawings. However the appropriate method for the production of drawings is left for the institution to ascertain. The purpose of this is to allow curriculum flexibility (CIDA standards will be examined in more depth further in the literature review). Key's (2004) study aimed to address the need for institutions to understand what entry-level CAD skills were required in the workplace. The study determined what kind of software practitioners were using, how long they had been using it, and the general level of CAD training practitioners expected. One of the major findings of Key's (2004) study was that employers expected the maximum level of CAD training.

There are two weaknesses with Key's (2004) study that render it ineffective at informing institutions of the entry-level CAD requirements: first, the answers available for the question about how much CAD training was necessary was limited, and the second the stated definition of "maximum level" CAD training was also too limited and lacked precision and clarity. The survey question that asked practitioners how much CAD training they required of entry-level applicants had three available choices: no experience, minimal experience (defined as the applicant having taken a workshop on CAD), and maximum experience. The Maximum Level of CAD Training was defined by the survey as “one or more semesters that include 2D and 3D capability” (Key, 2004 p.12). Based on previous studies, most institutions are meeting the “Maximum Level of CAD Training” as defined by the Key (2004) survey by providing one or more semesters of CAD training (Curry, 1992; Waxman & Zang, 1995). Yet studies done from 1996-2007 clearly indicate that practitioners do not feel that interior design students are prepared for entry-level CAD use (Meneely & Danko, 2007; Nawrocki, 2001).

The definition provided by the Key (2004) study is ineffectual at describing what interior design practitioners expect students to learn during the “one or more” semesters of CAD training. No studies were found during the literature review phase to answer this question for the interior design industry. In addition, the Key (2004) survey did not ask if practitioners were satisfied with the level of CAD training entry-level applicants possessed. It is unclear if the majority of practitioners answered “maximum training” because the other answers were clearly not sufficient or because they were aware that most interior design graduates receive one or more semesters of CAD training and they were satisfied with the CAD training of entry-level employees. Without this information it is impossible for interior design programs to adjust their curriculum to meet industry requirements. Further study is clearly needed to define what CAD skills are valued and required for entry-level practice by interior design practitioners.

Occupational Analyses & Standards

Institutional based research only provides part of the picture. Both the National Council for Interior Design Qualification (NCIDQ) and CIDA periodically survey the interior design industry to keep their respective tests and standards in line with current industry needs to aid in answering questions like the ones mentioned in the study done by Key (2004). The NCIDQ and CIDA survey results are also used to establish standards for interior design professional qualification and accreditation for interior design programs. The most recent practice analysis performed by NCIDQ was done in 2008. NCIDQ bases their practice analyses on a previously developed master list of pertinent interior design knowledge, skills and abilities (KSAs). Practicing interior design professionals then rank the KSAs using three separate scales: importance, frequency, and performance. The importance scale asks, “How important is the task to overall job performance?” Respondents rank the KSAs from one, being not very important, to five, being extremely important. The frequency scale asks, “How often do you perform this activity?” Respondents rank the frequency from one to four, with one being seldom, and four being daily. The performance scale asks, “When is one required to independently perform this task?” Respondents rank the KSAs from one to three, with one being never, two being after the first two years, and three being within the first two years. The scales are considered highly reliable and are tested using Chronbach’s coefficient alpha (NCIDQ, 2008). The results are analyzed and compiled in a table that ranks the KSAs by weight which is determined by an equation that takes all three scales into account. (See Appendix A for the complete KSA list and methodology.) Essentially, the more important, more often, and earlier a KSA is required, the higher the weight. The weights calculated for the KSAs range from .98 to .00 (NCIDQ, 2008). Out of the top ten ranked KSAs, eight (80%) require competent CAD drawing skills. Out of the top 20 ranked KSAs, 14 (70%) require competent CAD drawing skills. The remaining six require the ability to read drawings or are skills necessary to gather information used to draw in CAD, both of which typically require a background in CAD. While the ranked KSA list clearly defines which tasks are the highest priority and most necessary for entry-level interior designers to possess, the question that remains is: How? What specific CAD skills are necessary for an entry-level interior designer to perform the activities reflected in the top 20 KSA's effectively and accurately? The practice analysis performed by the NCIDQ does not answer this question.

CIDA performs their own research in order to assemble meaningful accreditation standards that programs must be at least partially compliant with in order to receive accreditation. A standards committee comprised of interior design educators, practitioners, members of the public, and designers from related fields including environmental designers develop CIDA's professional standards and perform an annual review to ensure the standards remain valid and up to date. When changes are suggested, the revisions are circulated among CIDA "constituencies" including accredited programs, CIDA volunteers, interior design professional organizations, industry members, and other undefined "interested individuals" (CIDA, 2009).

The introduction to the CIDA professional standards states that technology plays an important role in determining what skills are necessary and required of interior designers. It also states that a sound interior design curriculum must maintain a balance between the cultural and historical perspectives and practical skills necessary to practice interior design. There are 16 standards in total. Compliance with the standards is measured by student learning and program expectations and is judged by a panel of experts based on their field expertise and accreditation precedent (CIDA, 2009). Student learning expectations are measured by evaluating student work based on three levels: awareness, understanding, and ability. Awareness is defined as student familiarity with required material. Understanding is defined as a thorough comprehension of required concepts. Ability is defined as competent entry-level skills clearly demonstrated in student work (CIDA, 2009).

From the very first standard, CIDA standards are focused on ensuring that accredited programs are preparing graduates for entry-level interior design practice. The discussion of prior research, including the NCIDQ practice analysis, has clearly demonstrated that competent CAD skills are an essential entry-level requirement. Based on this understanding, it would be expected that CIDA professional standards would strongly address this requirement. However, this is not found to be the case. It seems that CAD skills would be addressed under CIDA Professional Standard six: communication. Student learning expectation "E" under Standard six requires that students are able to "produce competent contract drawings including coordinated drawings, schedules, and specifications appropriate to project size and scope and sufficiently extensive to show how design solutions and interior construction are related" (CIDA, 2009,p.14).

CAD skills are not addressed at all under Section III, Core and Technical Knowledge. The only CAD related ability listed under Section III is found in Standard 13: Interior Construction and Building Systems: student learning expectation "G" states that students must be able to read and interpret construction drawings and documents

(CIDA, 2009). CAD is referred to specifically in only one place in the standards. It is found in the list of common examples of student work that would be acceptable to the accreditation committee for review. A disclaimer states that the items on the list are suggestions and not required.

In this respect, the CIDA standards fail to address a key competency necessary to entry-level interior design practice. Fortunately, the CIDA accreditation process has a second component: the expertise of the accreditation committee. This committee is aware that CAD skills are required of entry-level interior designers. Assuming that the accreditation committee requires CAD skills based on their own professional expertise, they theoretically act as a fail-safe against programs becoming accredited without adequately preparing graduates with entry-level employment skills. Despite this theoretical safe guard, the same studies discussed in reference to the Key (2004) survey are relevant. As recently as 2007, surveys of practitioners and students are still indicating that more CAD training at a higher level is still necessary to prepare students for entry-level interior design practice (Meneely & Danko, 2007; Nawrocki, 2001). However no studies have been done to define what specific skills CAD skills need to be taught to adequately prepare students for entry-level practice. It is not sufficient nor does it provide enough information for interior design programs to evaluate their curriculum to simply define the necessary CAD training as “maximum level” or “one to two semesters” of CAD training. It is not even sufficient to give a range of hours such as was provided in the Sanders (1996) study. Interior design programs need a clearly defined list of CAD skills critical to entry-level interior design practice.

During the last 30 years, CAD has grown from a fledgling industry only recently adopted by the design industry to a highly technical, evolved, core component of how designers communicate with clients, consultants, and each other. Interior design education programs have worked hard at integrating CAD into their curriculum and keeping pace with industry demands of entry-level designers. Multiple studies over the decades have documented both the growth of the CAD industry in the field of interior design as well as the growing lists of skills and abilities now required to practice interior design. As the interior design industry continues to evolve, its entry-level requirements will also evolve. Interior design degree programs must continually evaluate industry demands to ensure their programs are meeting employer needs. While occupational analyses such as the practice analysis done by the NCIDQ assist institutions in identifying appropriate entry-level skill sets, independent studies of student and practitioner perceptions of CAD indicate that further study is necessary to discover what specific CAD abilities students must possess in order to be prepared for the entry-level employment KSAs. This study aims to aid in filling that communication gap so that interior design education programs have a more clearly defined definition of the practical CAD skills required to meet entry-level interior design employment requirements.

Methodology

Research Problem

Previous research indicated that CAD skills are a core competency required for entry-level interior design practice (Waxman & Zang, 1995; Brandon, 1987; NCIDQ, 2008). Previous research has also indicated that practitioners expect interior design programs to provide the maximum amount of CAD training for students (Key, 2004).

Additional studies, however, indicate that recent interior design graduates do not have sufficient CAD skills nor do they have a clear understanding of what they will be expected to do in an entry-level interior design position (Case & Matthews, 1999; Meneely & Danko, 2007; Lee & Hagerty, 1996). Both NCIDQ and CIDA call for communication between practitioners and educators to keep educational programs abreast of current industry requirements. While research and documentation from both sides agree this is important, studies also indicate that somewhere there is a communication gap. This study is designed to help define precisely where the communication gap exists for CAD skill expectations by providing a detailed definition of what both interior design practitioners and interior design faculty perceive to be the most important CAD skills for entry-level interior design employment.

Research Questions

The research questions this study is designed to test are as follows:

1. Are there statistically significant differences between the software used by interior design practitioners and the software taught by interior design?
2. Are there statistically significant differences between the interior design practitioner and interior design faculty expectations of CAD use in an entry-level interior design position?
3. Are there statistically significant differences between specific technical entry-level CAD skills expected by interior design practitioners and interior design faculty?

Research Design

The approach for this study is designed to be mixed method. First descriptive statistics were used to quantify and compare population groups; second, discussion of the data was used to qualify and explain the findings. Since a wide range of interior design education and practice levels exist, it was necessary to define a subdivision of the overall interior design industry and education communities for sampling purposes. It was also necessary to keep the definitions of the population samples equal between industry and faculty to ensure valid comparison. Both definitions are designed to limit the population to the most measurably professional and regulated group in their respective categories using nationally recognized occupational definitions.

Population Definitions

For the purposes of this study the definition of an “interior design practitioner” is an NCIDQ-certified interior design professional. NCIDQ certification was selected as the basis for qualification because it is the nationally accepted measure of professional competency for interior design. Individual state regulations and definitions of interior design practice vary from no regulation at all to strict title and practice acts requiring registration to use the title “Interior Designer” and practice interior design in the state. However all states who regulate interior design practice recognize NCIDQ certification. “[The NCIDQ] is the only exam that measures competency in the full body of interior design knowledge” (American Society of Interior Designers, 2010, “The NCIDQ Examination,” para. 2). It is important to note that the NCIDQ exam does not test nor require CAD skills. However, as discussed in the literature review, the majority of interior design firms use CAD to produce construction drawings. Qualification for the

NCIDQ test requires between 3,520 and 7,040 full time hours of interior design work immediately supervised by an NCIDQ-certified interior designer (the required amount varies depending on qualification path) (NCIDQ, 2010); therefore it is assumed that NCIDQ-certified interior designers are knowledgeable enough to determine which CAD skills are most important for entry-level practice based on their own professional experience (NCIDQ, 2008).

The definition of "interior design faculty" is a faculty member of a CIDA-accredited interior design program. CIDA program accreditation is the nationally accepted measure of quality for professional-level interior design education. CIDA accreditation is endorsed and overseen by the Council for Higher Education Accreditation (CHEA) which is the largest institutional higher education membership organization in the United States (Council for Higher Education Accreditation, 2006; CIDA, 2009). The CIDA's professional standards are designed to ensure that all accredited programs prepare their graduates to meet entry-level professional interior design practice requirements. Program requirements, in addition to the strong recommendation that faculty in CIDA-accredited programs be NCIDQ-certified, makes faculty at CIDA accredited programs a comparable population to the NCIDQ certified practicing industry population.

Sampling Method

Once the target population was defined, the method for sampling the population also needed to be determined. Since there is such a wide range of interior design education and practice levels, it was necessary to ensure that the sample came from the intended population. This made it impossible to simply randomly sample the entire interior design industry and education populations and maintain the validity of the population definitions described above. In addition, no data was found during the literature review phase to determine whether location or a variety of other factors such as interior design employment concentration had an effect on interior design entry-level CAD skill expectations. The majority of relevant studies used local populations for study and had very small sample sizes. To address these variables, a method was designed to select which states to sample. The 50 states were ranked by interior design employment concentration, which is defined as the number of interior design jobs per 1,000 jobs in a state, as reported by the May 2009 (the most recent) State Cross Industry Estimates from the U.S. Bureau of Labor Statistics (BLS) (U.S. Bureau of Labor Statistics, 2010). Then the top ten and bottom ten states from the ranked list were selected for a total of 20 states. Collecting data from states on both ends of the interior design employment concentration spectrum will limit how much any single regional area might skew results.

The ten states with the highest levels of interior design employment concentration as listed in descending order from most to least concentrated are: Colorado, Maryland, Florida, Georgia, Maine, New York, Vermont, Texas, Minnesota, and Virginia. The ten states with the lowest levels of interior design employment concentration as listed in descending order from most to least concentrated are: Iowa, Hawaii, North Dakota, Montana, South Dakota, Oklahoma, Arkansas, Wyoming, Alaska, and West Virginia.

To ensure a valid comparison between populations by keeping the same assumptions intact for the faculty population, the list of twenty states was compared to the list of states containing CIDA-accredited interior design programs. Of the above states, Maryland, Maine, Vermont, Hawaii, Montana, Wyoming, and Alaska did not have

CIDA-accredited interior design programs and were removed from the sample population. This left a total of 13 states to sample for this study, and they are: Arkansas, Colorado, Florida, Georgia, Iowa, Minnesota, North Dakota, New York, Oklahoma, South Dakota, Texas, Virginia, and West Virginia. This list provides a wide cross section that includes states that are large and small in size, highly populated and sparsely populated, from diverse regions of the country, and with and without major metropolitan areas. Since no prior research exists to indicate what kind of effect any of these variables may have on interior design CAD expectations, sampling from a range of states with known diverse characteristics will help to limit how much the data can skew toward any single variable.

Sample Description

In the final 13 states selected for sampling there are 54 CIDA-accredited programs. All 54 programs each had 10 or fewer faculty members teaching courses that either taught or required CAD. The intent of the study was to survey the entire selected subpopulation for interior design faculty. Email addresses for faculty members at the 54 programs were collected from the respective school websites or directly from the school program chairperson when faculty contact information was not publically available. A total of 256 faculty emails were collected as the available population; the survey instrument was sent to all 256.

The industry population was sampled from the NCIDQ Q Search database. The Q Search database is a public listing of all NCIDQ-certified interior designers who elect to share their contact information in a public, searchable profile on the NCIDQ website. Each of the 13 states was entered into the Q Search database and the email addresses of all of the designers were collected. There were a total of 823 practitioners in the sample population and the survey instrument was sent to all 823 email addresses.

The Survey Instrument

The survey instrument consisted of two separate surveys with 25 questions each. The surveys were self-administered questionnaires. The first survey was designed for interior design practitioners; the second survey was designed for interior design faculty. The questions on the surveys covered identical topics but the wording was changed slightly to keep them audience-appropriate. The wording changes were superficial and did not affect the content of questions. For example, the question about how often software is upgraded is phrased as “How often does your institution upgrade your software package” for faculty and as “How often does your firm upgrade your software package” for practitioners. The questions are designed to be directly comparable between faculty and practitioners to allow for clear comparison.

The surveys were sent out by email invitation using an online survey company. Each invitation used a unique survey link good for a single use. Participants could save the survey and return to it later but could not submit responses more than one time. The survey link was preceded by email text providing a description of the study, the informed consent information, and directions for participation.

The survey questions were divided into four sections. The first section contained five questions about software brands and versions used. The second section contained ten questions about CAD expectations as they pertain to entry-level interior design employment. The third section was further divided into seven sub-categories that grouped technical CAD skills. The seven subcategories were: Drafting Mindset, Expected

Knowledge, General CAD Abilities, CAD Workspace Habits, CAD Communication Skills, CAD Accuracy Skills and Advanced CAD Skills. Each category consisted of a set of technical CAD skills that were rated by level of importance from 1 to 5, with 5 being most important, to determine the significance of specific technical CAD skills. The fourth section contained three questions about demographics and an open comment field.

Question content was determined by reviewing the top 20 NCIDQ KSAs described in the literature study. The KSAs (Knowledge, Skills and Abilities) were compared with basic CAD skill lists from CAD training materials. The CAD skills that were needed to achieve the top 20 KSAs were included in the rating scale section of the survey. The entry-level perception questions were designed to expand definitions of previous studies by asking similar, but more specific questions. The perception questions were also formatted to gauge the number of training hours employers and faculty expected to provide, and also what they expected their industry counterpart to provide.

The specific CAD questions are designed to define what CAD training for the interior design graduate means and to fill in the missing information left by previous studies. The study done by Key (2004) indicated that practitioners expected the maximum level of CAD training. Maximum level was defined as one or two semesters and no higher training option was available in the survey. No definition of what interior design students should learn in that one or two semesters has been previously offered. Another previous study indicate that one or two semesters of CAD training is insufficient to bring student up to a minimum competency level (Nawrocki, 2001). However that study does not indicate what specific CAD skill students are lacking.

Human Subject Review

An application for IRB Review of Research Involving Humans was approved by the Institutional Review Board at the University of Central Oklahoma. The research was survey based and there were no known risks to the participants. The surveys were kept completely anonymous and all data was stored on a secure server provided by the online survey service. The survey responses were destroyed at the end of the research project and only aggregate data were reported. See Appendix B for complete details.

Pilot Study

Prior to sending out the survey to practitioners and faculty, a pilot study was performed to ensure content coverage and validity. Three participants from each population group participated in the pilot study. Each participant was provided with an explanation of the study, the survey link and was asked to provide comments on wording and content. Comments were integrated into the final study resulting in some minor wording changes and corrections to survey formatting errors.

Survey Procedure

The survey was formatted and distributed via email using the online Zip Survey service. The email addresses were compiled into two lists, one for faculty and one for practitioners. These lists were then pasted into the survey launch software. The informed consent and information text was sent along with the link to the survey (See Appendices C and D for recruitment/consent documents). A unique key was generated for each email address in the survey and was automatically added into the email by the survey software. A link place holder in the information text ensured that the link showed up in the same place for each participant in the correct place in the email. The survey was left open for a total of 20 days. A reminder email was sent out after 10 days. A total of 121 practitioners responded for a response rate of 15%. A total of 37 faculty members responded for a response rate of 14%.

Data Analysis Procedure

Data from the surveys was collected once the survey was closed. The data from each question was separated into individual variables for statistical analysis with the SPSS statistics software. The means of the responses were compared to discover if there were any statistically significant differences and correlations between faculty and practitioner answers at the .05 level of probability. The descriptive data and percentages were also compared and discussed in qualitative form to gain insight into the expectations of both population groups and provide a more complete comparison between faculty and practitioner expectations.

Study Limitations

While the study was designed to gauge entry-level CAD skill perceptions as accurately as possible, some limitations exist. First, although the study was sent to a wide audience range, it is likely that only those who were most interested in the topic responded. This could skew the data slightly. In addition, not all of the states surveyed were represented in both the faculty and practitioner sample populations. Second, the study aimed specifically at 2D CAD drafting skills. Although prior research and this study indicate that 2D drafting is the main method of construction document creation, a trend is growing toward Building Information Modeling (BIM) over 2D drafting. BIM software is listed in question one of both the practitioner and faculty surveys. BIM specific skills are not addressed in the technical knowledge section of the survey and some of the specific drawing skills do not apply to BIM. With 14% of practitioners already using and 15% of faculty already teaching BIM software, as reported by this study, additional research will be necessary to track which BIM specific skills are critical to entry-level interior design practice. Last, faculty and practitioner responses were not collected from all states and not all participants answered every question. A total of six states were represented by either faculty only or practitioners only. The data reported reflects the number of responses for a given question which may not equal the total number of participants for a group.

Results and Discussion

The data from the survey instruments was collected, analyzed and compared using SPSS and qualitative discussion. Survey questions were designed for direct comparison between the practitioner and faculty survey instruments. The means of each question response data were compared using the t-test to discover statistically significant differences between practitioner and faculty expectations and the Chi-Square test was used on each the data from each question set to discover statistically significant correlations between practitioner and faculty expectations.

Software Brands and Versions

The first five questions surveyed participants about which software package they primarily use or teach, which version, how often they upgrade and what standard they use or require their students to use. This study confirmed findings by previous studies done by Nawrocki (2001) and Key (2004) that found AutoCAD to be the primary software package for both interior design practitioners and faculty. In this study, 75% of practitioners report using AutoCAD. Similar percentages for AutoCAD use indicate that

70% of faculty from CIDA-accredited programs are training students to use software relevant to entry-level interior design practice.

Revit, a BIM software package, was the second most frequent It is interesting to note to that the percent of faculty (28%) teaching Revit is double the percentage of practitioners (14%) using it and is statistically significant at the .05 level as indicated by the negative Pearson correlation. This could indicate that CIDA-accredited programs are embracing the trend toward Building Information Modeling (BIM), although level of training would still need to be determined.

Looking at software usage in greater depth, more variation between practitioners and faculty emerges. Faculty members at CIDA-accredited programs are much more likely to be using the most recent version of AutoCAD than practitioners. Seventy-nine percent of faculty reported using the 2010 or 2011 AutoCAD release compared to only 38% of practitioners. Practitioners reported that they typically upgrade every two to four years as opposed to faculty upgrade tendencies which were reported as each new release, typically every year. The findings of this study are consistent with results reported by McConnell & Waxman (1999) and Patil (2006), both of which indicated that interior design education programs tend to be more proactive in upgrading software. Despite this trend toward upgrading, it is important to separate upgrade frequency from curriculum content. Previous studies have suggested that education is leading the interior design industry in CAD use based on the tendency of interior design education programs to upgrade their software more often than their industry counterparts. Newer software keeps education programs on the cutting edge of technology but does not necessarily indicate that students receive updated CAD training nor does it provide an indicator of the level of

CAD training. Entry-level CAD training requirements will be discussed in more depth in the Technical CAD Skills section.

Differences between practitioner and faculty software upgrade schedules are not surprising. Not only does previous research support this trend but economic and pragmatic motives also help explain the differences. First, educational software licensing programs are available at both the individual and institutional levels and offer a typical minimum discount of around 80% for a perpetual institutional or individual license that does not expire (Autodesk, 2010). In addition, many software options are offered free of charge for individual educators and students; Autodesk offers free three-year non-perpetual licenses to students and faculty through their student community website of both AutoCAD and Revit. ArchiCAD also offers a free educational version to students, as does Microstation (Bentley, 2010; Graphisoft, 2010).

Software licenses are not only much more expensive for practitioners, but multiple software pieces must typically be upgraded at once due to compatibility issues. Results reported in the “Other” answer section of the question concerning upgrade frequencies indicated that practitioner upgrade schedules are linked to third party software releases. A variety of plug-ins, or software add-ons typically provided by a company other than the manufacturer of the initial product (a third party), usually must be upgraded at the same time as the main product. Since plug-ins are typically third party products they will have a different release and update schedule. The “other” responses also indicated that practitioners may be more affected by CAD productivity concerns than faculty. Each new release has a learning curve and takes time to configure. Practitioners may be more likely to evaluate software based on its ability to increase production efficiency rather than simply upgrade because it is available. The cost of software upgrades is simply higher for practitioners both in terms of money and productivity which leads to longer upgrade intervals when compared to faculty upgrade intervals.

Entry-level CAD Expectations

The second section of the survey addressed general entry-level CAD drafting requirements and concerns. Questions were phrased to discover when during the design process entry-level interior designers were expected to use CAD, how many hours of annual training an employer expected to provide, and which CAD standards were used. It also addressed problem solving skills needed for CAD drafting as an entry-level interior designer and the role of entry-level interior designers in the construction document production process. The industry survey also addressed the overall practitioner perception of the CAD preparedness of entry-level interior designers.

The first question in this section asked respondents to indicate when in the design process CAD was used (practitioners) or when it was included in instruction (faculty). Multiple answers could be selected. The phases of design are defined by the NCIDQ practice analysis Master List of Tasks (see Appendix A for complete task lists for each phase of design). As indicated in Table 1, the comparison between practitioners and faculty yielded similar percentages.

Table 1

CAD Usage by Design Phase Frequencies

	Practitioners		Faculty	
Design Phase	n	Percent	n	Percent
Programming	51	12.3	5	6.5
Preliminary Design	94	22.7	18	23.6
Design Development	106	25.6	27	35.5
Construction Documents	102	24.6	23	30.2
Contract Administration	61	14.7	3	3.9
Total	414	100.0	76	100.0

Both practitioner and faculty reported that CAD was used most heavily during the Design Development stage. Design Development occurs after the research done during the Programming and Preliminary phases is applied in order to develop detailed plans for an interior design project. As illustrated in Figure 1, CAD usage increases as a project moves through the sequential design phases, peaks during Design Development, remains high but begins to taper during the Construction Document phase and decreases substantially by the time a project gets to the Contract Administration phase.

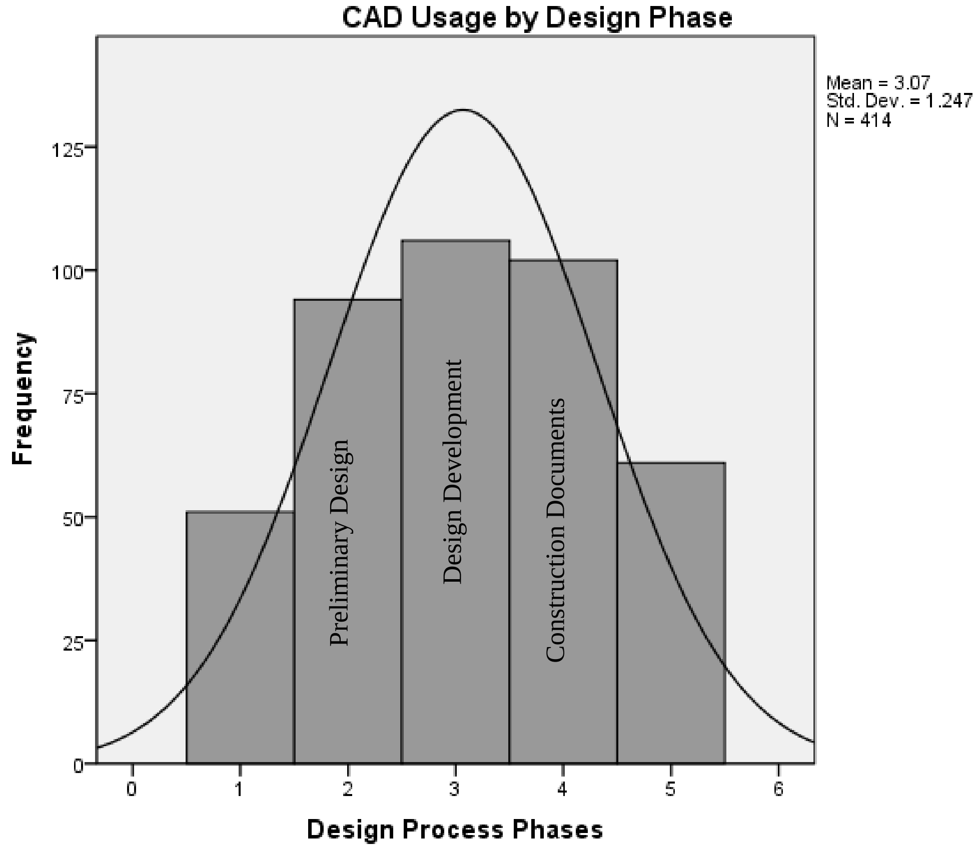

Figure 1.

Frequency graph illustrating the level of CAD usage over during the sequence of design phases

While both practitioners and faculty data for CAD use follow a similar curve, differences do occur. For example, nearly twice as many practitioners used CAD during the Programming phase of design while a larger percentage of faculty reported higher use in the Design Development phase than practitioners. None of these differences were found to be statistically significant at the .05 level.

In addition to when CAD is being used in a firm, it was also important to understand what type of standards are in place to manage CAD use. Similar percentages of practitioners (32%) and faculty (36%) reported that they use the United States National CAD Standard (NCS) which is a comprehensive CAD standards document developed by the National Institute of Building Sciences (National Institute of Building Sciences, 2010). Nearly identical percentages were also reported for the use of a custom CAD standard. In addition, practitioners indicated that they frequently used client specific CAD standards which varied by project. Eleven percent of practitioners and 21% of faculty used no CAD standard at all. While no statistically significant differences were found between the data, it is worth noting that over 20% of faculty reported that they do not require students to use any CAD standards – an alarming statistic. Practitioners who do not use standards tend to be sole proprietors. When not working as a member of a design team, CAD standards become less crucial because there is only one person who works in the drawings. While that may be the case for a small percentage of practitioners, 97% require a CAD standard and interior design students need to be prepared.

Looking at CAD use from a broad perspective indicates that CAD is clearly being used and taught during all phases of design and both practitioners and faculty are using CAD standards, although differences exist in reported use of CAD standards. Next, to examine CAD use at the individual level, several questions were asked about general entry-level CAD use. Topics included the number of hours per day entry-level interior designers reported spending using CAD software, how many hours of training were typically offered, problem solving skill expectations and the role of the entry-level interior designer in drawing production.

Both practitioners and faculty were surveyed about whether employers were expected to provide additional on the job training for entry-level interior designers in order from them to perform basic entry-level tasks. Based on survey responses, practitioners and faculty agree that firms hiring entry-level interior designers are not expected to provide additional on the job training to prepare the new employee. Practitioners and faculty also agree that entry-level interior designers are expected to perform problem solving design functions as opposed to simply drafting from sketches of a senior designer's concepts. No statistically significant differences were found for these results. From this data we can infer that both practitioners and faculty expect entry-level interior designers to be prepared to apply problem solving skills and be able to draft at the entry-level upon graduation. Entry-level drafting will be defined in the Technical CAD Skills section of this chapter.

While entry-level interior designers are expected to be prepared, employers do expect to provide some continuing education for their employees. The majority of firms (74%) provide less than five hours annually; only 10% of firms provide more than ten annual hours of company provided CAD training. As would be anticipated, faculty expect to provide more training over the course of the four year interior design degree program. Survey results indicate that the majority of CIDA accredited programs provide between 0 and 10 hours of CAD training with nearly half of programs providing between six and ten semester/quarter hours. This indicates that CAD training may have increased since the studies in the literature review were done. Previous studies found that CIDA accredited programs were typically offering one to two CAD courses or three to six semester/quarter hours per program (Key, 2004; Nawrocki, 2001). Since several faculty indicated in the comments section that their programs are now including BIM software in addition to AutoCAD, it is possible that the increase of three credit hours over data reported by prior research may reflect the addition of new material to the curriculum rather than a change in the level or amount of 2D CAD training. Additional research would be needed to answer this question.

As shown in Table 2, practitioners and faculty agree entry-level interior designers are important or essential to the production of construction drawings. Essential was defined as entry-level interior designers performing the majority of the drafting; Important was defined as entry-level interior designers performing at least 50% of the drafting; Unimportant was defined as entry-level interior designers performing less than 25% of the drafting. None of the faculty expected entry-level interior designers to be unimportant to the production process. Interestingly, 10% of practitioners reported that entry-level interior designers do not play an important role in drafting construction drawings. The comments field for the question helps clarify potential reasons for these results. Multiple practitioners reported that someone else does their CAD for them; either an architect at the firm does the CAD for them, or they contract out that service when they need it. In light of these comments, an important qualification of the data for this question may need to be made. It is unclear whether 10% of practitioners feel that entry-level interior designers are not important to the construction document production process overall, or if the data simply reflect that some do not use entry-level interior designers for drafting because they either do all of their own CAD work (sole practitioners) or they do not use CAD at all and contract out to a consultant on the occasions they need it. Of the firms that do in-house interior design drafting, entry-level interior designers perform at least 50% of the drafting for nearly half of the sampled practitioners. Thirty-five percent of practitioners reported that entry-level interior designers perform the majority of drafting needed to create construction documents. Clearly, practitioners and faculty agree that entry-level interior designers need to be well prepared to draft in CAD.

Table 2

Importance Level of Entry-Level Interior Designers to Construction Document Production

	Practitioners		Faculty	
	n	Percent	n	Percent
Essential	41	35	13	36
Important	53	46	20	61
Unimportant	12	10		
Other	10	9		
Total	116	100.0	33	100.0

While practitioners and faculty agree that entry-level interior designers need to be well prepared, the question is: Are they prepared? Two questions were asked to gauge the practitioner and faculty perceptions of overall CAD preparedness and a third question was asked of practitioners to quantify the losses they sustained as a result of poor CAD drafting. The relevancy of this question is supported by the data reporting that entry-level interior designers perform at least 50% of the drafting during construction document production at the majority of firms and perform the majority of drafting at 30% of firms.

If practitioners are sustaining losses due to poor drafting, and most of the drafting is done by entry-level interior designers then it is reasonable to infer that there is a strong correlation between the two.

Table 3 presents a comparison between entry-level drafting importance in construction drawing production and error frequency. The data indicated that as the importance of entry-level drafters increases, so does the likelihood of errors. While this may seem like an obvious statement since those with the least amount of experience are logically the most likely to make errors, it is important to realize the potential for impact this has on interior design curriculum. Eighty-one percent of practitioners reported that entry-level interior designers perform at least 50% of the drafting required to produce construction documents. The highest levels of drafting error costing firms money or delaying projects correlates strongly with entry-level interior design drafters. There are two ways to solve this problem: stop using entry-level interior designers for drafting or raise the CAD drafting training level of interior design students to better prepare them for a key component of entry-level practice.

Table 3

Importance Level of Entry-Level Drafting Compared on Drafting Error Frequency

		Error Frequency					
Importance Scale		None	1-5	6-10	11-15	16 +	Total
Essential	n	12	20	2	2	5	41
	%	29%	49%	5%	5%	12%	41%
Important	n	18	26	3	0	1	48
	%	38%	54%	6%	0%	2%	48%
Unimportant	n	9	1	0	1	1	12
	%	75%	8%	0%	8%	8%	12%
Total	n	39	47	5	3	7	101
	%	39%	47%	5%	3%	7%	100%

Note: The highest percentage of practitioners with no errors is associated with those who do not use entry-level drafters. As you move up the none column from unimportant to essential, the percentages drop indicating that as the importance of entry-level drafters increases so does the likelihood of errors.

In order to complete the analysis of practitioner perception of entry-level CAD preparedness, one final question was asked only of practitioners: “How would you rate your perception of the CAD preparedness of entry-level interior designers hired by your firm in the last 5 years?” In light of the data presented in Tables 2 & 3, it is not surprising that the majority (56%) of practitioners reported that entry-level interior designers typically had only a basic knowledge of CAD and there were issues with technical ability and/or level of knowledge. In addition, 9% of practitioners reported that most entry-level interior designs were unprepared and lacked the CAD skills necessary for entry-level practice. Only 34% of practitioners felt that the majority of entry-level interior designers were both technically competent and knowledgeable enough for entry-level practice. These results confirm that better coordination between faculty and practitioners is necessary to determine what specific skills need to be addressed to raise entry-level interior designers' technical skills and knowledge base to proficient levels.

Technical CAD Skills

Up to this point, the focus for this study has been on quantifying why sufficient CAD training is so crucial for interior design students. However, the "How?" question has yet to be addressed. Without a comparison between faculty and practitioner expectations examined at the most rudimentary levels it is impossible to expect coordination between interior design industry and academia. This comparison will provide a practical and measurable definition of what specific CAD skills are necessary for entry-level interior design practice.

The CAD skill question set was divided into seven sections that grouped skill sets by type. Each skill was evaluated using an interval scale from 1 to 5 with 1 representing "Not Very Important" and 5 representing "Extremely Important". The means of each response set were then compared to discover statistically significant differences between practitioner and faculty responses. Any significant differences and correlations are discussed and a t-test by skill is reported for each section.

Drafting mindset. The first set of skill specific questions addressed mindsets and CAD specific problem solving approaches. Topic included efficiency (hours spent in CAD per drawing produced), accuracy, problem solving, ability to follow CAD standards, ability to estimate how long a task will take, whether a drafter advances CAD skills on their own time, ability to work without direct supervision for the majority of a day, and the ability to adapt quickly to software changes. Each skill is presented with a frequency histogram comparing practitioner and faculty responses.

The first skill evaluated was efficiency. No statistically significant differences or correlations were found. However a visual comparison between practitioner and faculty data reveals an interesting discovery in Figure 2. Roughly equivalent numbers of practitioners and faculty rated efficiency at a 4 or above. However the response differences between 4 and 5 are substantial. The majority of practitioners rated efficiency at an importance level of 5 while the majority of faculty rated efficiency at an importance level of only 4. While this may not lead to a statistical difference in means, it is clearly a difference in expectation, although an appropriate one. Efficiency is a skill achieved by practice and experience and students will continue to improve in efficiency as they build experience. However this should not discourage faculty from providing opportunities for students to increase efficiency skills before they graduate.

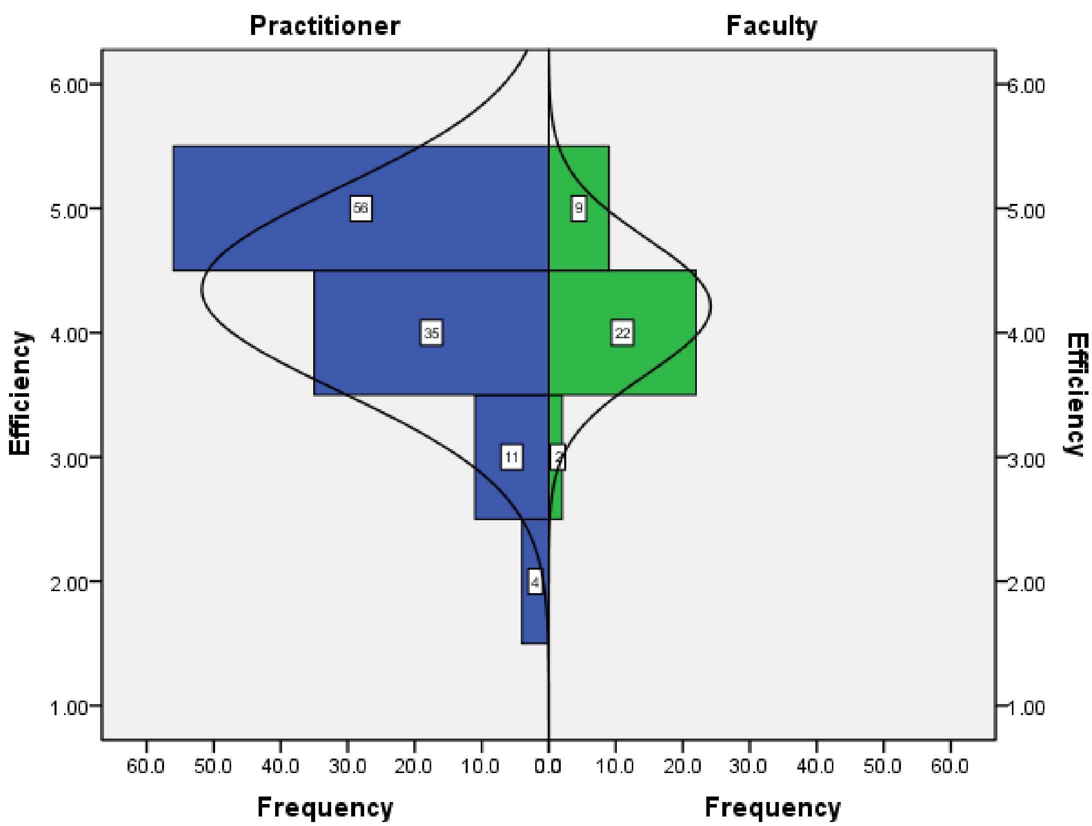

Figure 2.

Frequency Comparison Between Practitioners and Faculty on Efficiency Skill

The next skill rated was accuracy. Percentages between practitioners and faculty were extremely similar and no statistical differences were reported. Both practitioners and faculty report that CAD drafting accuracy is an essential entry-level skill and a statistically significant correlation was reported at the .05 level.

Problem solving skills were rated next. While similar percentages were reported between practitioners and faculty, it was surprising to see how the importance ratings were low and spread out compared to skills, for instance, accuracy and efficiency where the majority of a group tended toward a single response. The highest frequency of faculty and practitioners rated problem solving abilities at either a 3 (practitioners) or a 4 (faculty) with a wide variation. It is possible that additional research using a clearly defined definition of “problem solving” would clarify why the scores are so widely varied.

Data on the ability of an entry-level interior designer to follow CAD standards reflected a statistically significant difference and statistically significant correlation between practitioner and faculty response in Figure 3. Half of practitioners rated the ability to follow CAD standards as essential while an additional 36% rated the ability as very important. By comparison, significantly lower percentages of faculty reported the same results and the faculty data had a significantly larger variance indicating that CAD standards are not equally important in all CIDA accredited programs. The negative correlation confirms the relationship between practitioner and faculty responses on the ability of entry-level interior designers to follow CAD standards. This finding also reflects the same tendency indicated in the question about which CAD standard practitioners and faculty use that reported that 20% of faculty did not require their students to use a CAD standard.

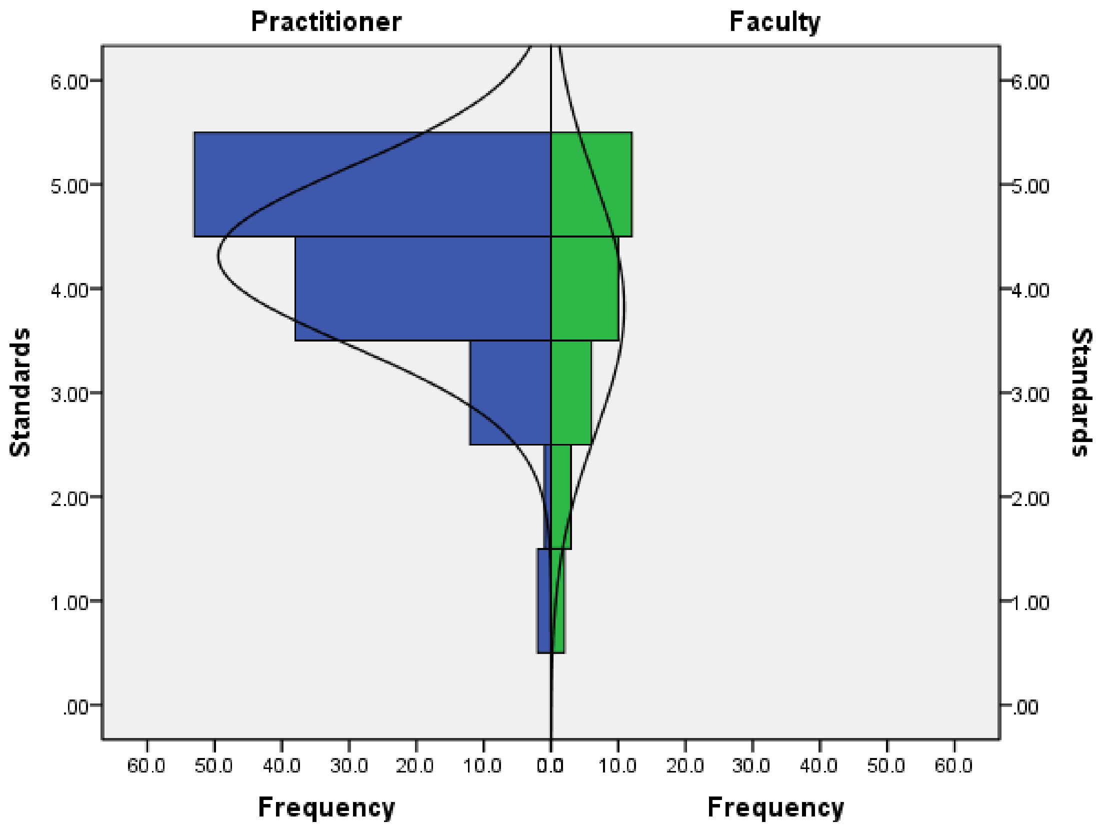

Figure 3.

Frequency Comparison Between Practitioners and Faculty on Ability to Follow CAD Standards

The next skill evaluated was the ability or motivation of an entry-level interior designer to increase their CAD skills on their own time. No statistically significant differences or correlations were found. The fact that this finding is not statistically significant is noteworthy because it indicates that there is not a well-defined reaction to this skill that can summarize either group. Data from practitioner responses was especially varied leaving nearly equal response percentages on scores 4, 5 and 6. Faculty data was slightly more directional with the 4 being the most frequent response (45%) as shown in Figure 4.

Practitioners and faculty reported similar percentages for the ability to estimate how long a task will take. Understanding how long it takes to complete tasks in CAD is closely related to efficiency and is typically gained from experience. However studio projects that mimic entry-level type projects can help students begin to grasp how long CAD tasks take to complete. No statistically significant differences or correlations were found and both response sets followed a normal curve closely with the majority of practitioners (44%) and faculty (39%) reporting the ability to estimate how long a CAD task will take to be very important (a rating of 4 on the scale of 1 to 5).

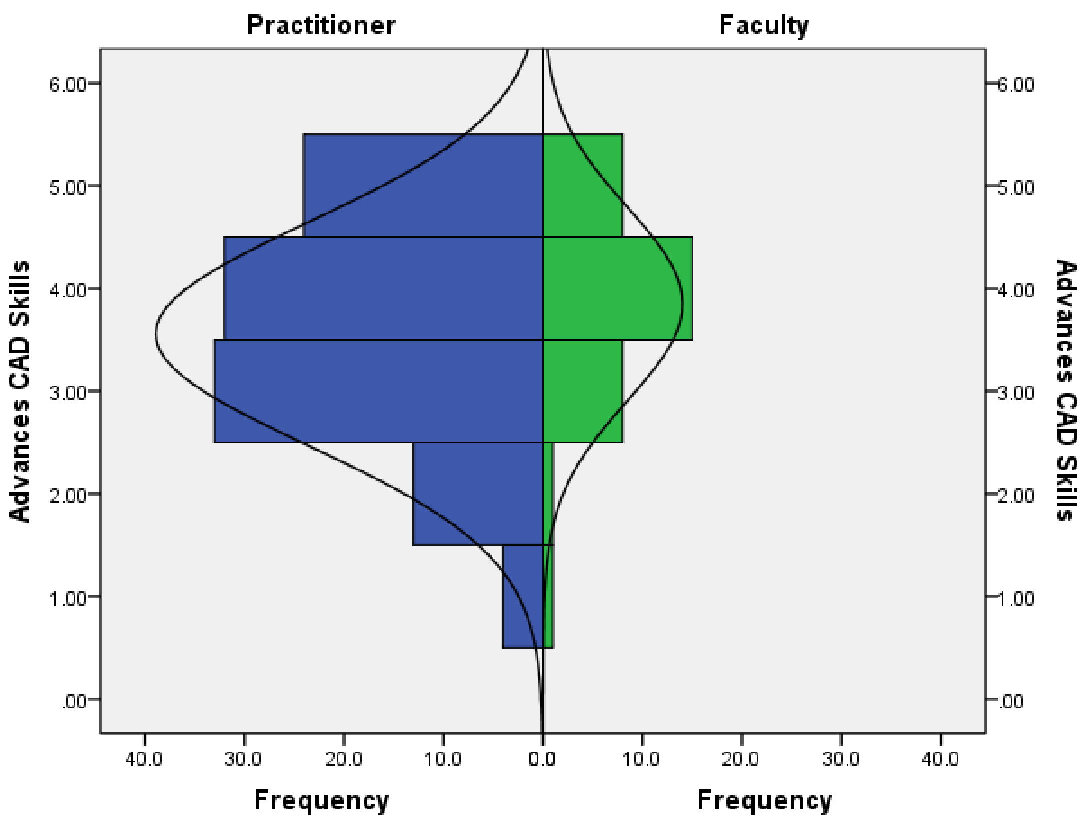

Figure 4.

Frequency Comparison Between Practitioners and Faculty on Ability to Advance CAD Skills

The next ability measured was how important it was for entry-level interior designers to be able to work without supervision for the majority of the day. Frequencies for practitioners and faculty followed a similar curve and no statistically significant differences or correlations were found. The majority of practitioners (47%) and faculty (55%) reported the ability to work without supervision to be very important (a rating of 4 on the scale of 1 to 5). The results from this question and the previous question indicate that time management skills are a very important factor success factor for entry-level interior design.

The final ability in the drafting mindset survey section is the ability of an entry-level interior designer to learn and adapt quickly to software changes or upgrades. Practitioners and faculty reported this skill to be very important to essential. 42% of practitioners rated the importance of this skill at a 5 and another 47% rated the importance at a 4. Faculty reported similar percentages: 64% rated the importance of this skill at a 5 while an additional 27% rated the importance at a 4. No statistically significant differences or correlations were found; practitioners and faculty both agree that students must be able to adapt to software changes.

Practitioners and Faculty agree on most of the drafting mindset skills. Few statistically significant differences were found. Overall it was reported that faculty and practitioners agree that accuracy skills, time management related skills including efficiency and the ability work without constant supervision, and the ability to adapt to software changes are crucial skills for entry-level interior design practice. Significant differences were found between practitioner and faculty responses on the importance of the ability of entry-level interior designers to follow a CAD standard. Practitioners rated it significantly higher than faculty and 20% of faculty indicated that they did not require students to follow any CAD standard. Appendix G reports the mean comparison and significance levels of each variable in the drafting mindset survey section with statistically significant differences indicated.

Expected knowledge. The second section of the survey asked participants to rate CAD skills related to expected field knowledge. Questions for this section were based on the top 20 NCIDQ KSAs from the 2008 Practice Analysis (NCIDQ, 2008).The skills rated included knowledge of basic construction types, basic construction members, basic egress requirements, space planning, ability to read and interpret working drawings from related disciplines, the ability to design and detail simple millwork pieces, knowledge of codes and federal guidelines, and knowledge of and the ability to use interior design and architecture vocabulary. Each skill is presented with a frequency histogram comparing practitioner and faculty responses.

The first knowledge area surveyed was basic construction types. This was defined as knowing basic information and differences between wood, steel and concrete construction. Statistically significant differences were found between practitioner and faculty responses as well as a statistically significant correlation of .329 was significant at the 0.01 level of probability in Figure 5. The highest percentage of practitioners (33%) rated the knowledge of basic construction types as only moderately important. However responses were fairly evenly distributed indicating that there is not a high level of agreement in the industry about the importance of this knowledge at the entry-level. Faculty responses however indicate a much higher level of agreement with the highest percentage of faculty (64%) reporting the knowledge of basic construction types to be essential to entry-level practice. This is an interesting difference because these results indicate that knowledge level is not likely to be the source of the communication disconnect between practitioners and faculty. This trend continues in the expected knowledge section data (see Appendix H).

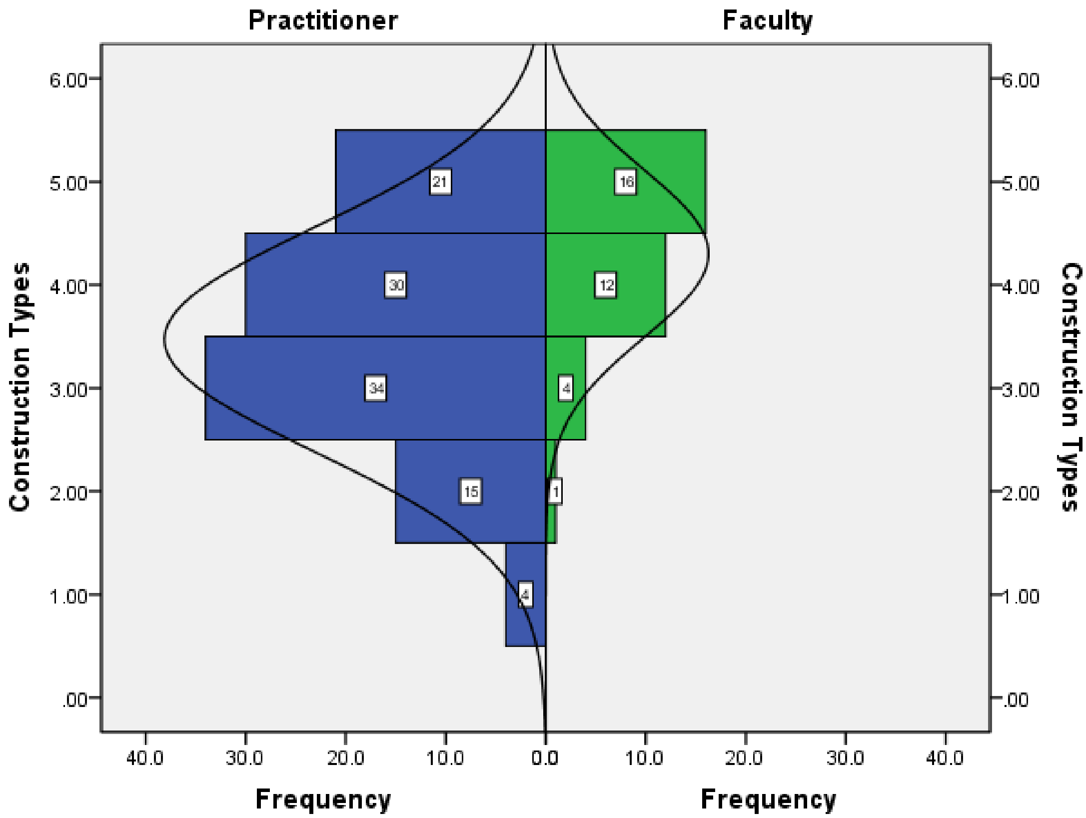

Figure 5.

Frequency Comparison Between Practitioners and Faculty on Knowledge of Basic Construction Types

The next knowledge area surveyed was basic construction members. Knowledge of basic construction member was defined as knowing dimensions of actual and nominal stud sizes. Statistically significant differences were found between practitioner and faculty responses as well as a statistically significant correlation of 0.330 which was significant at the 0.01 level of probability (Figure 6). The highest percentage of practitioners (35%) rated the knowledge of basic construction members as only moderately important. However responses were fairly evenly distributed indicating that there is not a high level agreement in the industry about the importance of this knowledge at the entry-level. Faculty responses however indicate a much higher level of agreement as the highest percentage of faculty (55%) reported the knowledge of basic construction members to be essential to entry-level practice. These results are congruent with data from the first knowledge area further confirming that it is unlikely that knowledge level is the source of the communication disconnect.

Knowledge of construction members was followed by knowledge of basic egress requirements. Egress is defined as means to exit a building safely during an emergency. Building codes mandate specific requirements that must be applied to floor plan layouts. Essential sub-knowledge areas included in understanding basic egress requirements are occupancy load (how many people a room or building is designed to support), exit widths(including door, corridor and aisle widths),and travel distance to the nearest exit. Statistically significant differences were reported between practitioner and faculty data in Figure 7. However, the difference in this case does not represent a difference of position but rather the intensity of position and level of agreement by group. The response rate is much stronger on the faculty side with the practitioner data displaying a higher level of variance indicating a lower level of agreement. The majority of practitioners (49%) indicated that knowledge of basic egress requirements was essential to entry-level practice. Faculty agreed and the majority (82%) reported knowledge of basic egress requirements to be essential to entry-level practice. Both groups agree that the skill is essential; faculty are simply more united as a group on this variable.

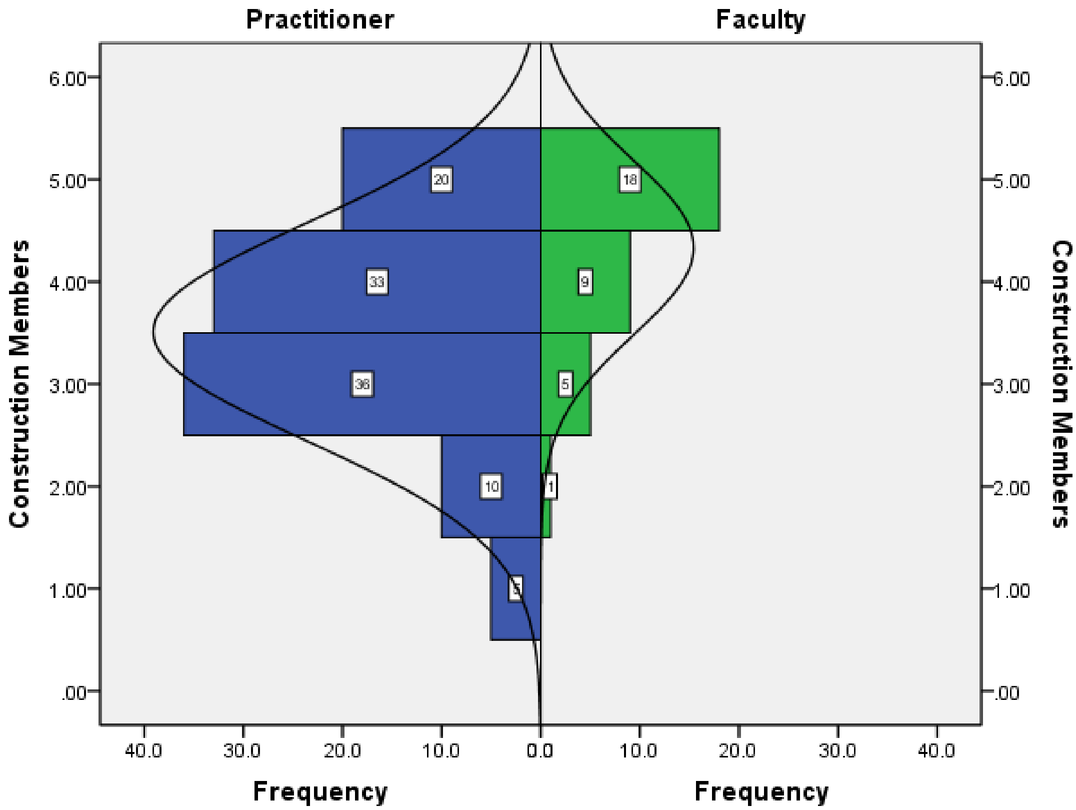

Figure 6.

Frequency Comparison Between Practitioners and Faculty on Basic Construction Member Knowledge

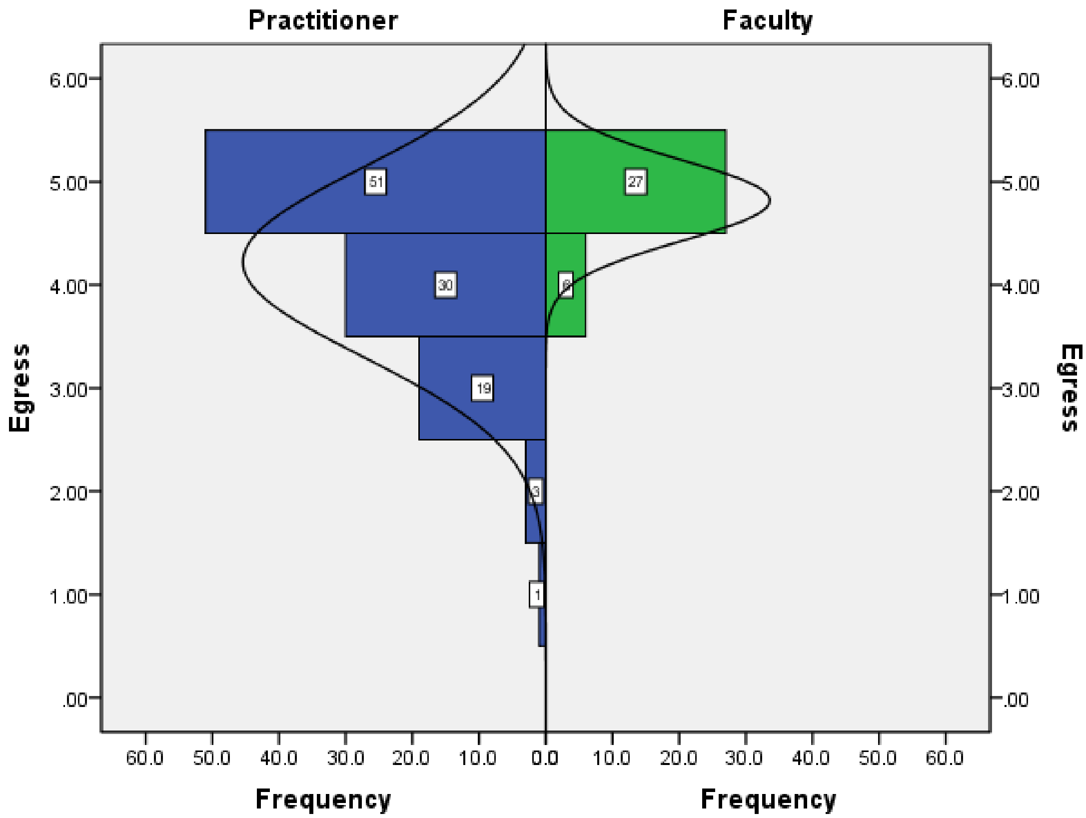

Figure 7.

Frequency Comparison Between Practitioners and Faculty on Basic Egress Knowledge

The next skill surveyed was space planning. Space planning is defined as the process of layout an interior floor plan to meet client requirements while following clearance requirements, building codes, and the principles of design. Similar results to egress requirement knowledge were reported. Both the majority of practitioners (50%) and the majority of faculty (82%) agree that space planning skills are essential to entry-level practice. Faculty agree more strongly, although the data are positively correlated indicating a similar position in both groups.

After space planning, the ability to read and interpret working drawings from consultants was rated. This is an important skill because interior designers work with building systems outside their area of expertise and must be able to coordinate their designs with drawings from other disciplines. For example, interior designers do not design load bearing structures, but would need to know where structural columns were to space plan around them. Practitioner data indicate that there is not a high level of agreement about the importance of this knowledge area as it relates to CAD (see Figure 8). Practitioner responses are evenly distributed between ranks 3, 4 and 5 indicating that the importance of this task is rated as somewhere between moderate and essential. Faculty results were similar but responses were mainly distributed between ranks 4 and 5. Thirty-nine percent of faculty indicated the ability to read an interpret consultant drawings was very important while 42% indicated this knowledge area was essential for entry-level practice (see Figure 8). A statistically significant positive correlation of 0.189 at the 0.01 level of probability was found between practitioner and faculty data indicating that overall, practitioners and faculty agree that the ability to read consultant drawings is important for entry-level practice.

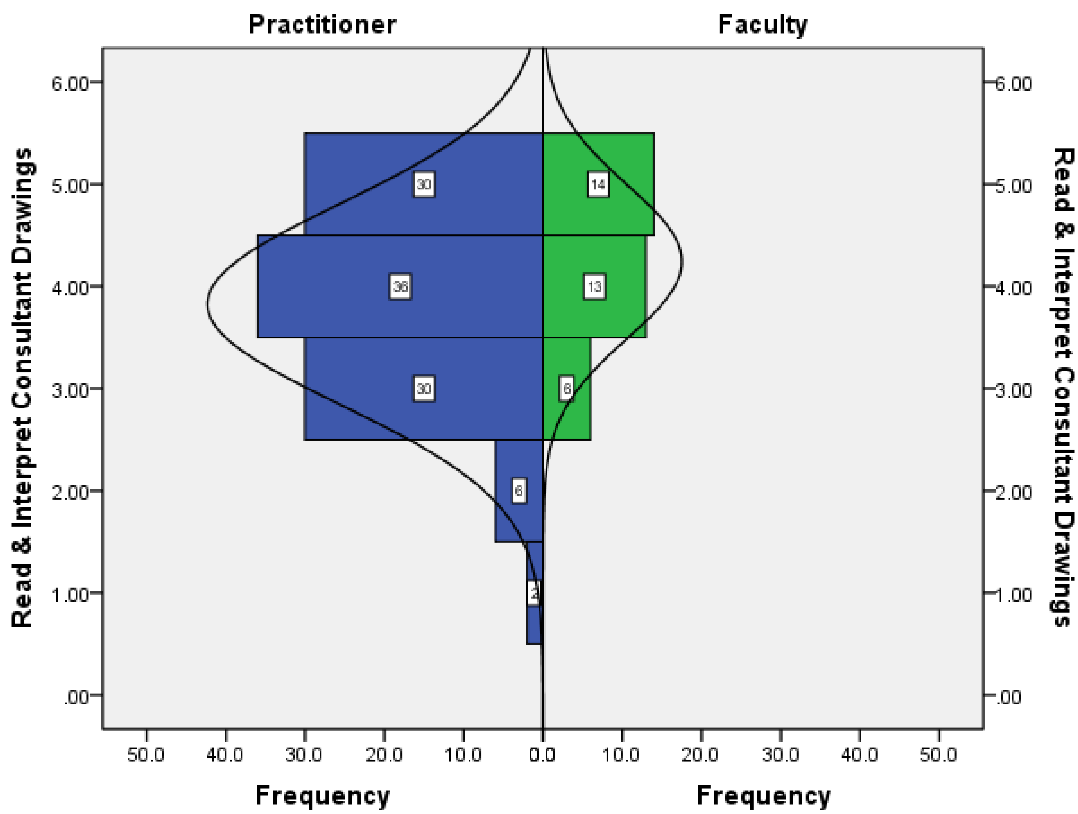

Figure 8.

Frequency Comparison Between Practitioners and Faculty on Ability to Interpret Construction Drawings

The next skill rated was the ability to design and detail simple millwork pieces that meet building codes and are constructible. The example provided to clarify the definition was: an accessible vanity counter with the sink rim at the correct height and enough room to support the counter material and allow for the necessary knee space. The highest frequency of practitioners reported that this knowledge area was essential to entry-level practice, however responses were fairly evenly distributed between moderately important and essential (ratings ranging from 3 to 5 out of 5). This indicates that there is not a high level of agreement in the field on the level of importance of this knowledge area. The majority of faculty (58%) reported that this skill was essential and an additional 30% indicated the knowledge was very important (a rating of 4 out of 5). Both practitioners and faculty agree that the ability to design millwork is important, but faculty felt more strongly that it was an essential skill (see Figure 9). A statistically significant correlation of 0.179 (significant at the 0.05 level of probability) was found between practitioner and faculty data indicating that practitioners and faculty agree that the ability to design and detail simple millwork is important for entry-level practice.

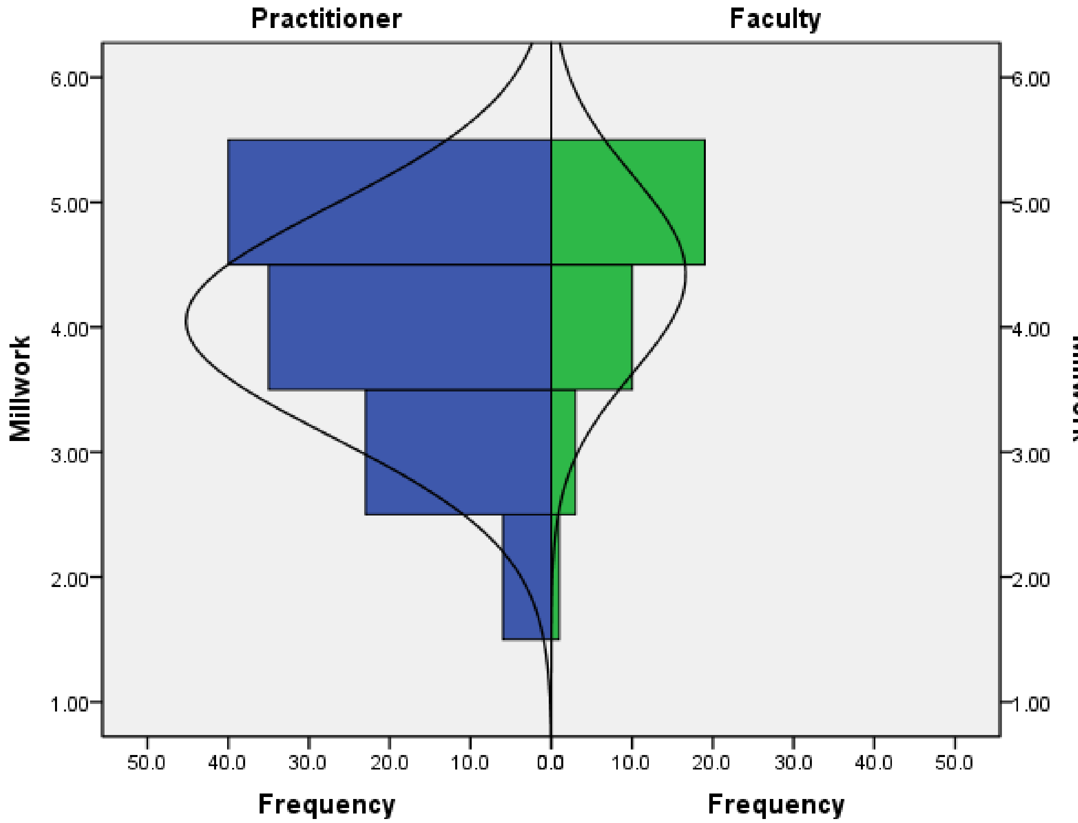

Figure 9.

Frequency Comparison Between Practitioners and Faculty on Basic Millwork Knowledge

The next knowledge area was codes and federal guidelines related to building construction. A statistically significant difference between practitioner and faculty responses was found at the .01 level of probability. The difference here is very surprising because the majority of practitioners (37%) reported that knowledge of building codes was only moderately important for entry-level interior design practice. In contrast, 67% of faculty indicated that this skill was essential to entry-level practice (Figure 10). It is possible that a more precise definition that described the knowledge area as being related to interior space construction and layout might have gained higher ranks from practitioners. However the 2008 NCDIQ Practice Analysis included this knowledge area in the top 20 KSAs for entry-level practice and ADA guidelines which heavily influence space planning, furniture layout, and millwork design, are federal requirements that apply to all states; as a result even with the definition that was used, the low ratings from practitioners remain puzzling.

While differences exist between practitioners and faculty on the importance of building code knowledge, both groups firmly agree on the importance of the ability of entry-level interior designers to understand and use interior design and architecture related vocabulary. The majority of both groups rated this ability as essential for entry-level interior design practice and a statistically significant positive correlation confirms the relationship between the group responses.

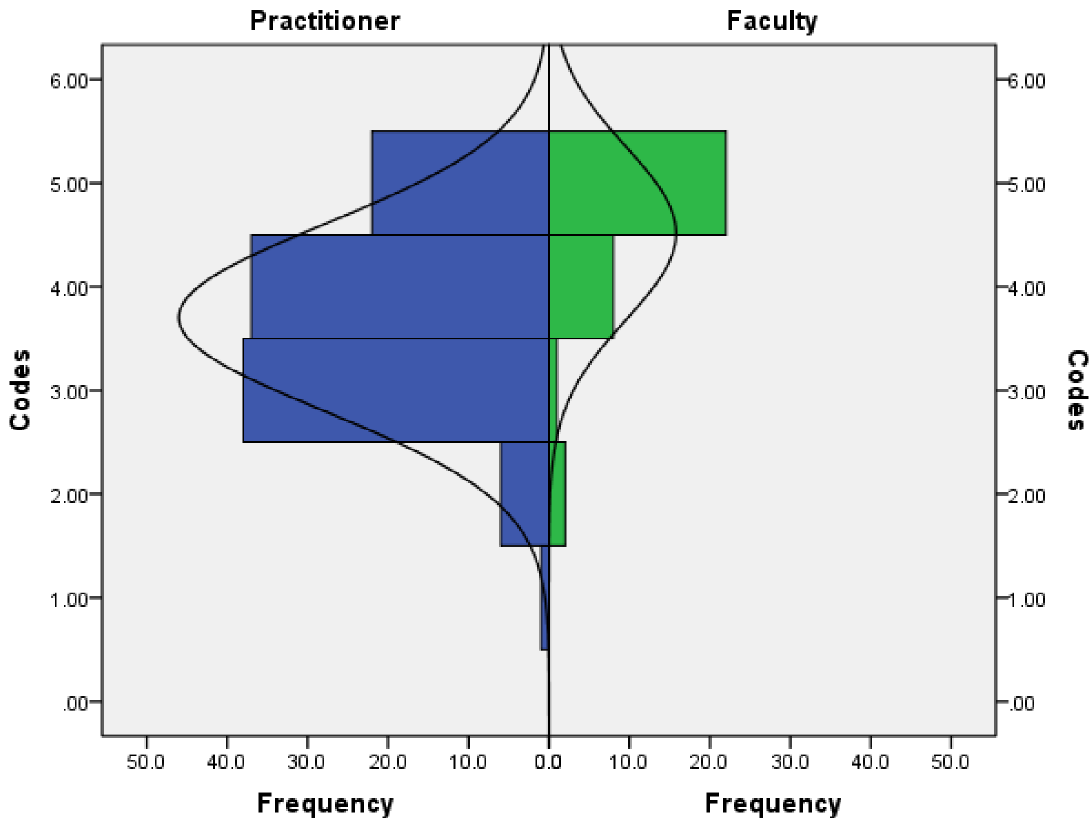

Figure 10.

Frequency Comparison Between Practitioners and Faculty on Basic Codes Knowledge

General CAD abilities. The next section of skills focused on drawing level technical CAD skills. A high level of agreement existed on the first ability which asked participants to rank the importance of the ability of entry-level interior designers to understand what they were drawing as opposed to simply transferring a sketch from paper into CAD. Seventy percent of practitioners reported this skill to be essential to entry-level practice and 85% of faculty indicated the same response.

The next skill was the ability to understand and use different coordinate systems. Most drafting programs use a form of graph coordinates as the method of data input for drawing geometry. Various methods and systems exist within any given program making it important to understand the user coordinate systems (UCS). Statistically significant differences were reported between practitioner and faculty responses. The majority of practitioners (45%) rated this skill to be moderately important for interior design practice with an additional 21% rating it very important and 16% rating it essential. While this skill would not rank as the most essential entry-level CAD skill, practitioner responses indicated that it was an important skill to for entry-level interior designers to have. Faculty indicated that there was not a high level of agreement on the importance of the ability to use multiple user coordinate systems. Faculty responses were evenly spread across ranks 3 to 5 with the greatest frequency representing only 36% in Figure 11.

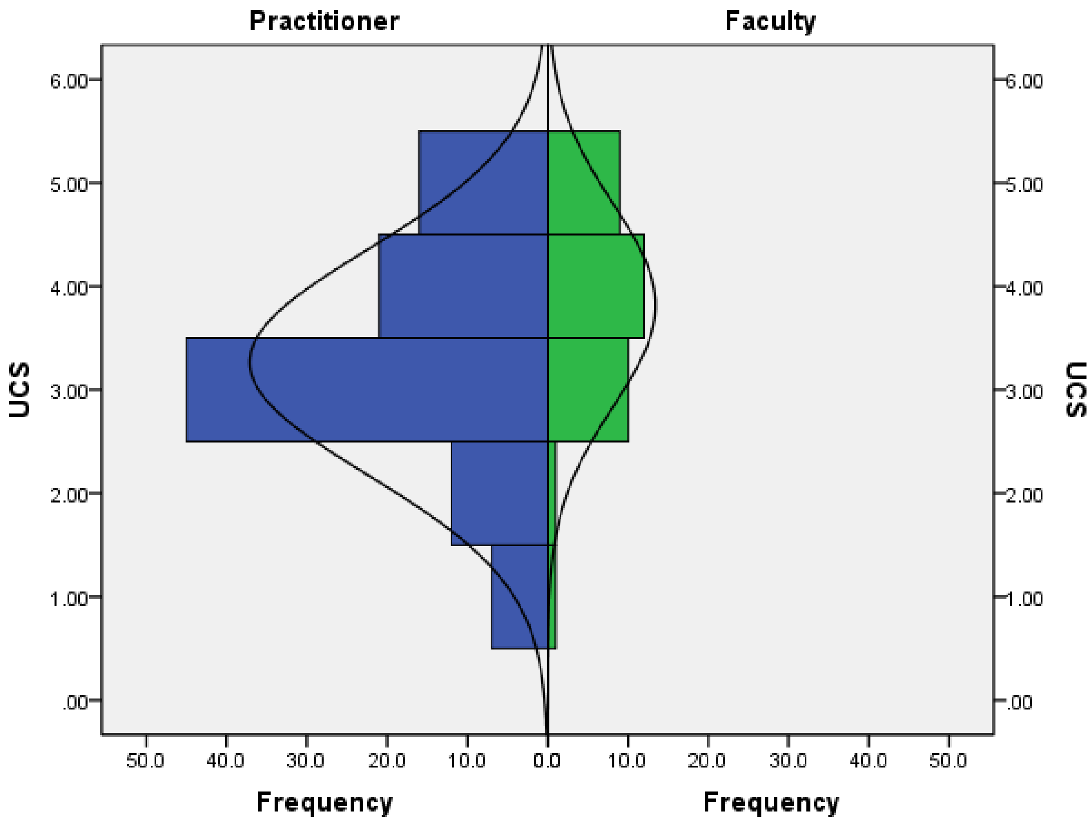

Figure 11.

Frequency Comparison Between Practitioners and Faculty on Knowledge of User Coordinate Systems

The next skill was the ability to understand and set up drawing units. Each design related discipline uses a specific industry standard set of drawing units. Interior design uses architectural units meaning that construction documents are drawing in inches and dimensioned using feet and inches. Practitioners were divided between ranks 4 and 5: 39% indicated the ability to set up drawing units was essential to entry-level practice and 35% indicated the ability was very important. The majority of faculty (55%) indicated the skill was essential for entry-level practice (see Figure 12). No statistically significant differences were found between practitioner and faculty responses, indicating that the groups agree that the ability to set up drawing units is very important for entry-level interior design practice.

Statistically significant differences were found in the next ability: setup drawings for both metric and imperial units. Practitioner responses were spread evenly across the lowest three ranks from 1 to 3; the highest frequency (26%) indicated that this skill was unimportant (ranked 1 out of 5). Faculty responses were also fairly spread out; the responses were divided across the three highest ranks from 3 to 5; the highest reported frequency (33%) occurred at moderately important with an additional 27% in ranks 4 and 5 indicating the skill is very important or essential to entry-level practice (see Figure 12). It is unclear if faculty ranked the ability to use metric units more highly than practitioners because they are actually teaching this skill. However, the data indicated that if teaching time is being spent on this topic, it might be better served on a more highly ranked topic. The ability to set up drawings using metric units was the lowest practitioner ranked ability.

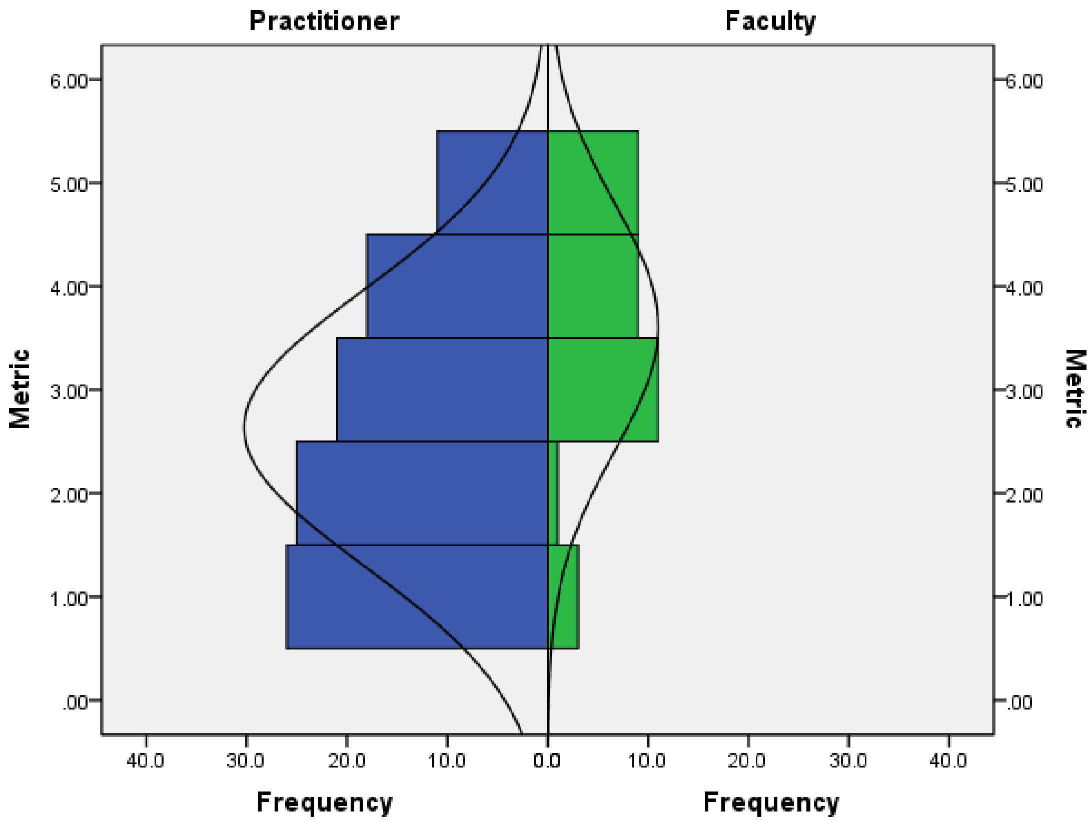

Figure 12.

Frequency Comparison Between Practitioners and Faculty on Ability to Setup Drawings Using Metric Units

The next skill was the ability to use table functions to create schedules. Schedules are an important part of interior design construction documents as they can be used to list and reference room finishes, doors and hardware, furniture, and other important information. Practitioners were somewhat divided on the importance of this skill; the highest reported frequency (at rank 5 for essential importance) represented only 36% of the responses. In contrast, 55% of faculty reported this skill to be essential for entry-level practice in Figure 13. While agreement on this topic seems likely, faculty appear to feel more strongly about the importance level.

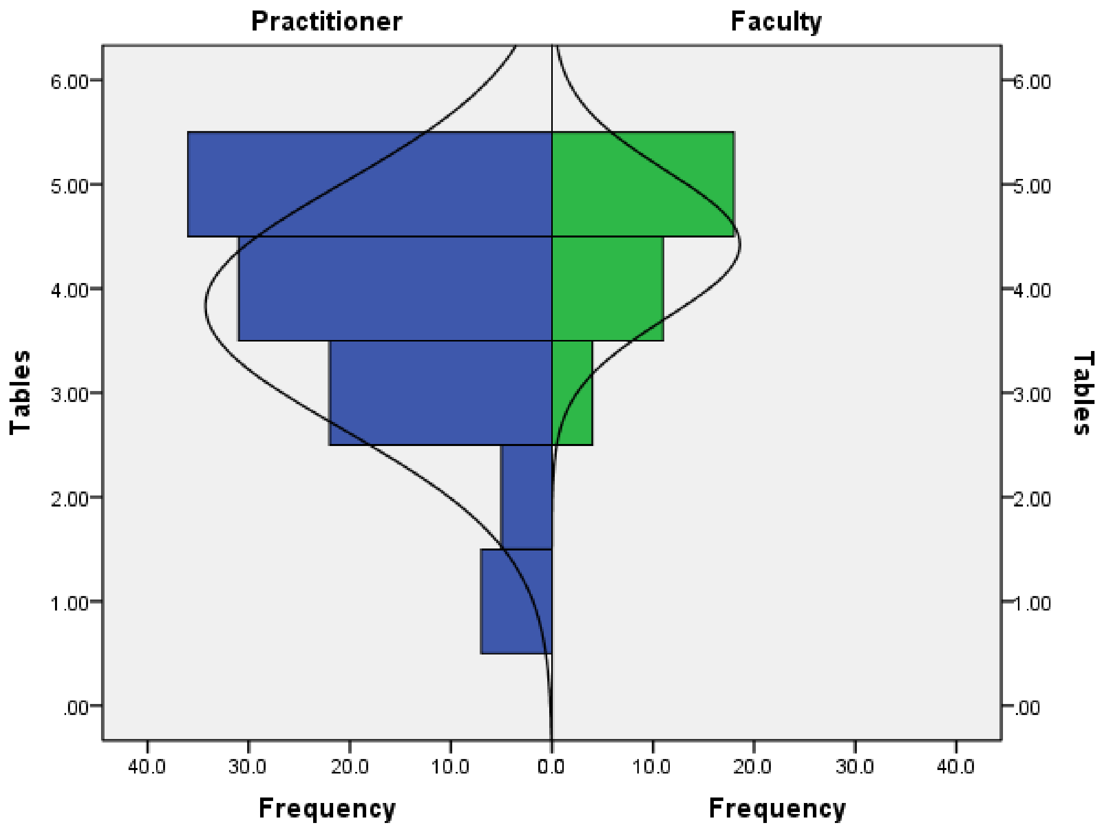

Figure 13

Frequency Comparison Between Practitioners and Faculty on Ability to Use Table Tools

No statistically significant differences were found between practitioner and faculty responses on the final two skills in this section: the ability to use selection tools and the ability to use modify tools such as mirror, rotate, stretch, fillet and trim. Practitioners and faculty agree that both skills are essential for entry-level interior design practice (See Appendix I).

CAD workspace habits. The next skill section focused on CAD drawing organizational abilities. The first ability was sheet layout and organization. Construction drawing pages typically contain multiple plans and details at different scales and must be clearly displayed and organized on a sheet. Using the sheet space wisely and organizing content so that it flows logically within the sheet and from one sheet to the next takes practice. The majority of practitioners (46%) and faculty (62%) both reported this skill to be essential to entry-level practice.

The next skill is closely related to the first but describes the technical ability necessary to achieve the organizational ability. The ability to setup paper space layouts was rated as essential by the majority of practitioners (56%) and faculty (69%). Most drafting programs have two separate areas: the first, often referred to as model space or world view, is for drafting where everything is drawn at 1:1 scale and the user is simply zoomed out enough to see it on the computer screen. The second area is where virtual construction drawing sheets are setup on layouts that accurately represent the size of the paper the drawings will be printed on and drawings are displayed at scales that will fit on the sheet. Practitioners and faculty agree that the ability to set up paper space layouts is essential for entry-level interior design practice. Of the remaining skills in this set, there were no statistically significant differences were found. All of the skills were ranked as essential by practitioners and faculty. The skills include working with drawing templates, using externally referenced drawings (Xrefs), configuring osnaps or snap modes, creating blocks using good practice, naming layers based on a CAD standard, working with layer states, controlling drawing visibility by layer, and creating proper drawing labels for sheet views.

CAD communication skills. The next set of questions focused on skills related to the ability to communicate design intent clearly through construction documents. Questions addressed annotation and dimensioning practices, hatch use and scale, and drawing note clarity. The only skill that was reported to have a statistically significant difference between practitioner and faculty responses was the ability to set up dimension styles. A wider spread of practitioner responses resulted in a lower response mean. The majority of both practitioner (54%) and faculty (62%) indicated that the ability to set up dimension styles was essential for entry-level practice, however 0% of faculty ranked this skill either 1 (unimportant) or 2 (not very important) while 4% and 5% of practitioners respectively ranked the skill 1 or 2 in Figure 14. This indicates that there is a higher level of agreement in the faculty group regarding the importance of this skill to entry-level practice.

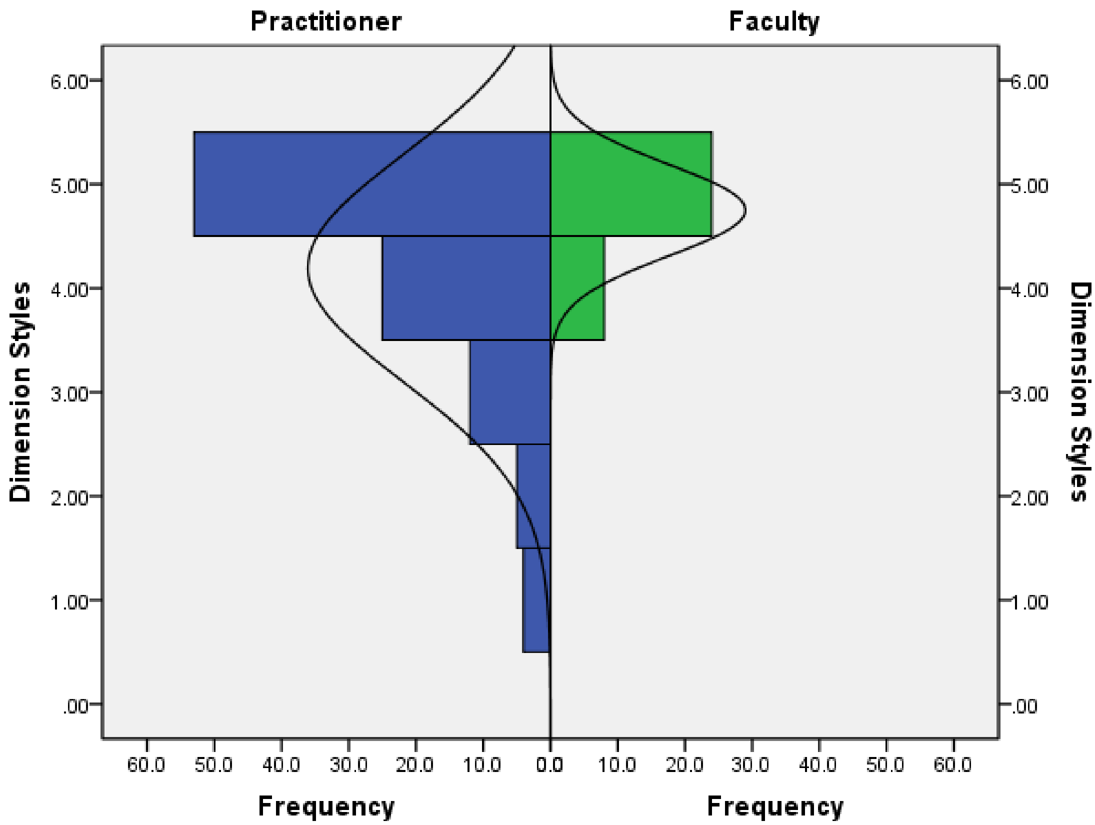

Figure 14.

Frequency Comparison Between Practitioners and Faculty on Ability to Setup Dimension Styles

CAD Accuracy Skills. Equally important to the ability to communicate, is the ability to create accurate drawings. The next set of skills addressed drawing geometry accuracy, dimensional tolerances, ability to measure area, draw using grids, and create accurate custom furniture blocks. The first two questions surveyed the ability to use basic drawing tools to create geometry and also to create geometry that relates to items already drawn (e.g. draw a line tangent to a circle). The majority of practitioners (68%) and faculty (69%) reported the ability to use basic drawing tools to be essential for entry level practice. A similar level of agreement was found for the question about creating geometry in relation to other geometry; 42% of practitioners and 53% of faculty reported this skill to be essential. The next surveyed skill was the ability to evenly and accurately divide geometry into equal portions. Practitioners (47%) and faculty (45%) agreed that this was skill was essential for entry-level practice. An additional 32% of practitioners and 41% of faculty indicated the ability to divide geometry was very important. While the majority of both groups agree that this skill is essential, there was a lower level of agreement between practitioners on the importance level of this skill compared to the level of agreement between faculty members. All faculty rated the ability to divide as either essential or very important (4 or 5) while 17% of practitioners rated this skill as moderately important (3 out of 5), and 7% rated it 2 or below. This variance in the data in Figure 15 resulted in a lower mean for the practitioner responses on this question resulting in a statistically significant difference between practitioner and faculty responses even though the majority of both groups agree.

A high level of agreement was also found on the next skill. The majority of practitioners (73%) and faculty (78%) agree that the ability to draw accurate angles is an essential entry-level CAD skill. Similar levels of agreement are found on the next three skills: the ability to set accurate dimensions precision settings, the ability to create accurate offsets, and the ability to accurately measure area. Over 70% of practitioners and faculty rated those skills as essential for entry-level practice.

The next two questions surveyed the importance of the ability to use a grid system while drafting. Two major types of drafting grids exist: rectangular and isometric. Practitioner and faculty are divided on the importance of these two skills, both between groups and within groups. The ability to draft using a rectangular grid was rated as very important by 50% of faculty. In contrast, practitioners were highly divided on the importance of the ability.

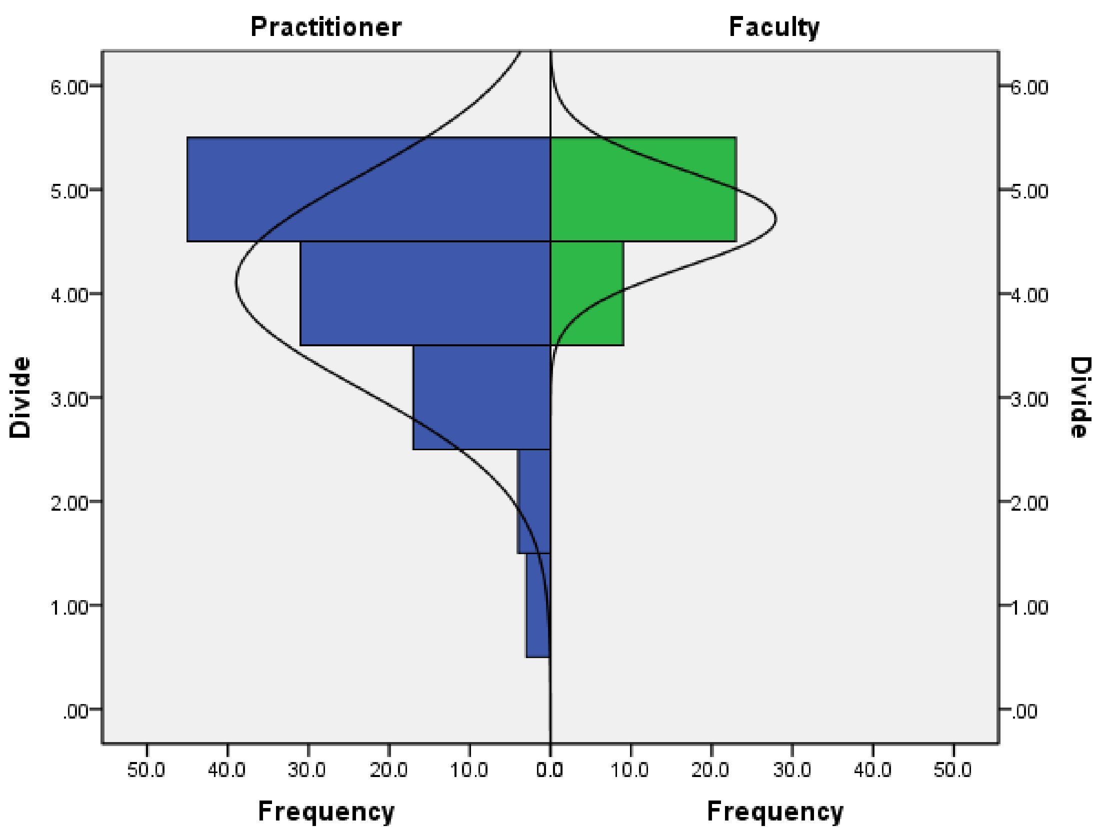

Figure 15.

Frequency Comparison Between Practitioners and Faculty on Ability to use Divide Tool

Twenty-nine percent rated the skill as essential, 28% rated the skill as very important, and additional 28% rated the skill as moderately important Figure 16. An additional 16% rated the skill as not very important or below (1 to 2 out of 5). Similar levels of disagreement exist on the ability to use an isometric grid. Isometric drawing is a 2D drawing method of representing 3D objects using lines at specific angles enabling the use of a grid. The majority of faculty (28%) reported this skill to be very important while the majority of practitioners (31%) reported this skill to be moderately important. A high level of disagreement among groups indicates that the use of this skill varies widely among firms and faculty. The last skill in this group was the ability to draw accurate custom furniture blocks. The majority of both practitioners (48%) and faculty (53%) agree that this skill is essential for entry-level practice.

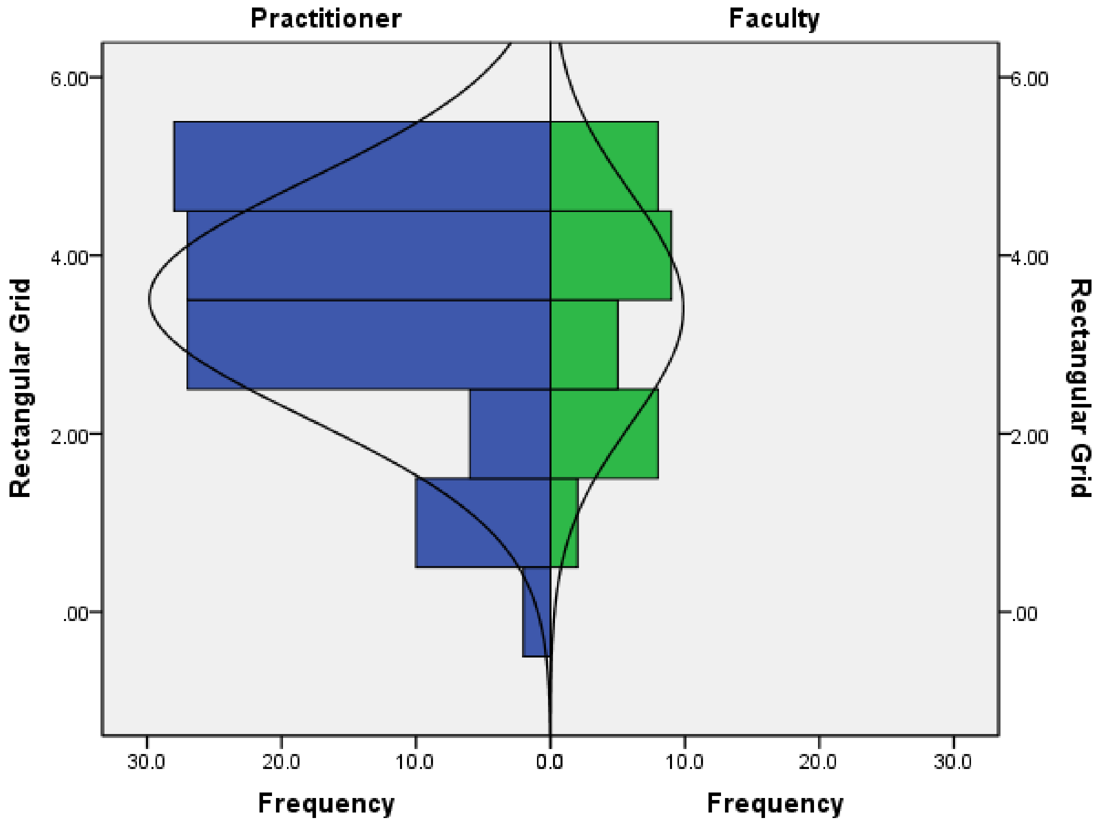

Figure 16.

Frequency Comparison Between Practitioners and Faculty on Ability to Drafting Using Rectangular Grid

Advanced CAD skills. The next set of questions addressed skills that could be considered advanced, as they typically use features that are available only in the more recent versions of CAD software or are simply less commonly used tools. You can perform basic drafting tasks without these tools, although using them can make the completion of some entry-level tasks more efficient. The first skill surveyed was the ability to create blocks with attributes. Attributes are data fields that are attached to blocks that can identify information such as the dimensions, price, vendor contact, and product number. Creating blocks with attributes requires more skill than simply creating blocks without them. A high level of disagreement among groups existed for this question. The majority of practitioners (34%) ranked this skill as only moderately important, closely followed by an additional 20% who ranked this skill as very important. Relatively high percentages of practitioners rated this skill as essential (20%) and as not very important (11%). Clearly practitioner opinions on this skill vary greatly. A similar level of disagreement exists for the faculty responses. Forty-seven percent ranked the ability create blocks with attributes as very important, while 28% ranked it as essential and an additional 16% ranked it as only moderately important. The level of disagreement indicates that this skill would probably be appropriate to learn on the job since the employer may or may not use the skill and in addition would probably have proprietary standards on how to create them.

The next skill surveyed was the ability to work with parametric objects. Parametric objects are geometry controlled by variables. They are different from blocks whose attributes simply describe them because if you change the information in a data field on a parametric object, the object changes to match the data input. Parametric objects are a more recent trend and are more widely used in BIM software, although they are available in some CAD packages. The majority of practitioners (41%) indicated that this skill was only moderately important. This is reflective of the fact that BIM and parametric design are still in the early stages of industry adoption, similar to where CAD was 20 years ago. Faculty responses varied much more widely than practitioner responses. The majority of faculty (38%) ranked this skill as very important, followed closely by 25% ranking the skill as moderately important and additional 22% ranking the skill as essential in Figure 17.

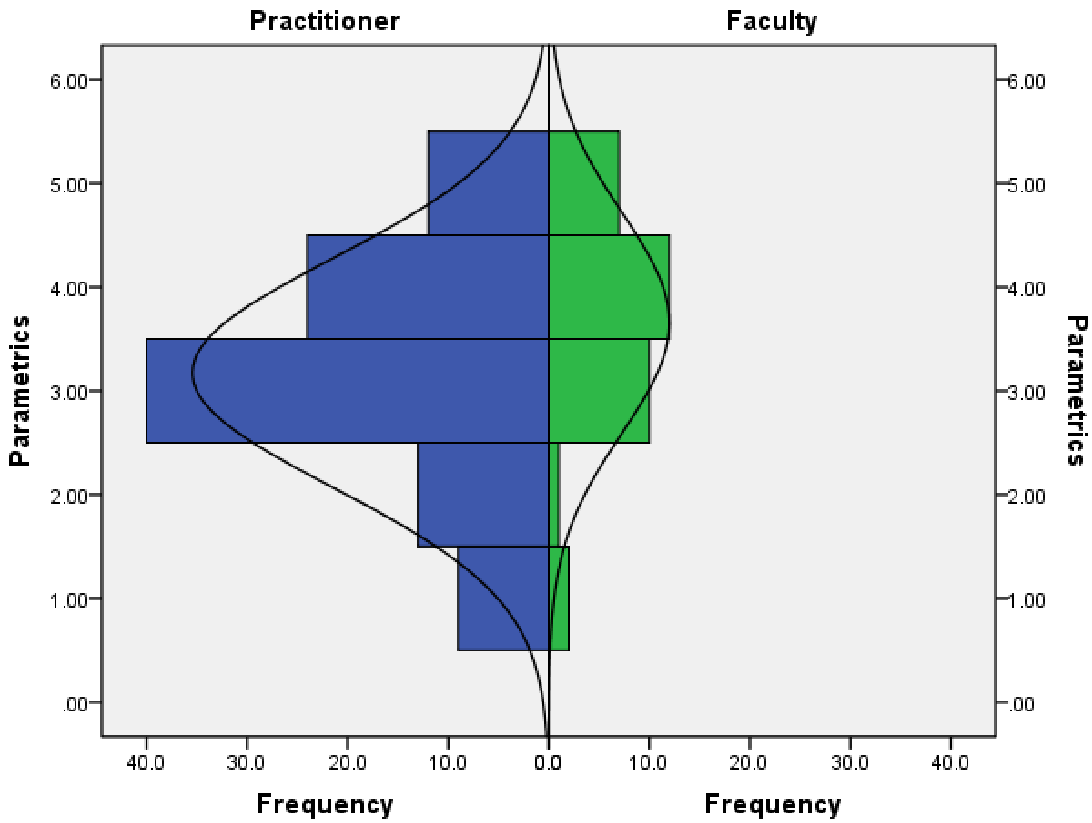

Figure 17.

Frequency Comparison Between Practitioners and Faculty on Ability to Use Parametric Objects

The next skill surveyed was the ability to extract attribute data from blocks (or parametric objects). The data contained in objects can be extracted and placed in another format, such as an excel spread sheet to aid in project tracking, budgeting, and analysis.

The highest percentage of practitioners (43%) ranked this skill as only moderately important. In Figure 18, Faculty responses were divided with the highest percentage (38%) ranking the skill to extract attribute data as very important, followed closely by 31% ranking the skill as moderately important and an additional 22% ranking it as essential.

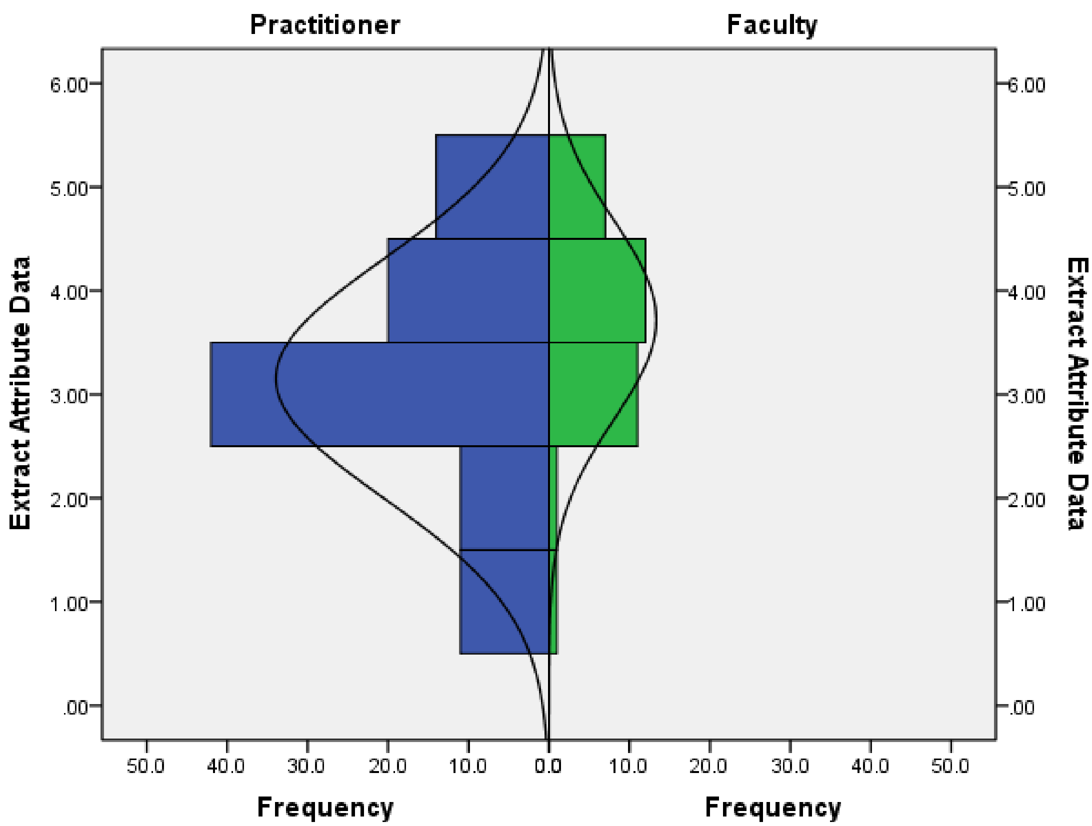

Figure 18.

Frequency Comparison Between Practitioners and Faculty on Ability to Extract Attribute Data.

Following data extraction, the ability to work with dynamic blocks was next on the survey. Dynamic blocks are blocks that can be adjusted without losing the block definition (having to explode the block and losing any associated data and grouping benefits). They are similar to parametric blocks but are adjusted physically (by using the mouse to adjust parts) rather than being adjusted through text fields. Dynamic blocks are a more recent feature and require substantial understanding and have a high learning curve. Forty-two percent of practitioners reported that this skill was only moderately important. A similar percentage of faculty (38%) also ranked this skill as moderately important. The final two skills: the ability to work with annotative objects (objects that adjust in size based on scale) and the ability to work with regions (an advanced area measurement tool that automatically adds up areas of non-conjoining oddly shaped spaces) were ranked as moderately important by the majority of practitioners and faculty. As expected, the skills in the advanced CAD section were typically ranked as less important overall than skillsets in previous sections.

Demographics. Practitioners and faculty provided information on a few key areas that help further describe the sample populations. Practitioners reported from 11 of the 13 surveyed states. No practitioners from North Dakota or South Dakota responded. The majority of practitioners surveyed worked for very small firms with 10 employees or less (53%) and the second largest percentage of practitioners was employed by large firms of 31 or more employees. Seventy-three percent of practitioners provided contract or commercial services, with only 13% offering primarily residential services. The majority of practitioners (78%) used CAD as the primary means of creating construction documents.

Faculty reported from 9 of the 13 states; no faculty responded from Iowa, Texas, Virginia or West Virginia. The majority of faculty (90%) taught at institutions with 10 or fewer instructors involved in teaching courses that use a CAD program. Seventy-one percent of faculty taught for institutions that provide student instruction in both commercial and residential design.

Conclusions and Recommendations

Conclusions

The goal of this study was to measure how effectively CIDA accredited interior design programs are meeting interior design industry needs for entry-level CAD preparedness. Previous research has indicated that there is a communication gap between industry and academia in relation to entry-level CAD skills. Multiple studies indicated that more and a higher level of CAD training was necessary to meet industry requirements. To help define where the communication gap may be occurring, a detailed survey instrument asked NCIDQ certified practitioners and faculty at CIDA accredited interior design programs to rate the importance of individual CAD skills, abilities and related knowledge.

The answers to the research questions are as follows: Yes, there are statistically significant differences between the software used by interior design practitioners and the software taught by interior design. Yes, there are statistically significant differences between the interior design practitioner and interior design faculty expectations of CAD use in an entry-level interior design position. Statistically significant differences occurred in several areas between practitioner and faculty responses. Those that did occur typically resulted in one of two scenarios: The majority of both groups agreed on the importance of a skill but one group had a higher level of agreement, or faculty rated a skill more highly than it had been rated by practitioners. Yes, there are statistically significant differences between specific technical entry-level CAD skills expected by interior design practitioners and interior design faculty. However the statistically significant differences occurred in only a few areas and overall practitioners and faculty generally saw eye to eye on the importance of knowledge areas and technical CAD abilities (See Appendices J and K).

Despite the high level of agreement between faculty and practitioners on knowledge areas and technical skills, the survey also reported that the majority of practitioners experienced CAD problems with entry-level interior designers and those that used entry-level interior designers also experienced an increased likelihood of drafting errors that cost the firm money or delayed projects. The results indicated that the knowledge level was not likely to be the problem. One possible explanation for the discrepancy between practitioner/faculty agreement and practitioner satisfaction levels is that faculty could be over representing what is covered in CAD courses taught at CIDA accredited interior design programs. The survey was not very specific in asking faculty to only rate skills that were taught in courses. It is possible that while faculty feel a skill is important, the skill is not being covered in the CAD curriculum.

However, there is a second possible scenario that seems a more likely explanation. In addition to high levels of agreement between practitioners and faculty, nearly all of the knowledge sections and technical skills were rated as essential for entry-level practice. There was only one skill rated as unimportant by practitioners (the ability to use metric units) and typically only items in the advanced CAD skills section were rated as moderately important. The initial question of the study might be better phrased to ask “How effectively are interior design practitioners communicating what CAD skills are necessary for entry-level practice?" When practitioners list that every skill is equally important to entry level practice, it does not provide any basis for prioritizing teaching time or curriculum content. Just like a good design needs a focal point and accents to guide the eye, any skill set consists of points that are essential and others that are helpful, but not quite as important.

It is simply a fact that education programs have limited time and resources. They have a limited number of credit hours in which to fit all of the required general education requirements, design principle skills, and professional practice skills in addition to technical CAD skill requirements. The curriculum simply would not be able to cover every single skill in elaborate detail. When curriculum is too broad and attempts to cover too many skills, the result is familiarity with many concepts but mastery of none. If this is happening, it could explain why practitioners are not satisfied with the CAD skill level of entry-level interior designers. Based on the results of this survey, practitioners could be more specific about what is truly essential to help faculty prioritize the skills that will meet the entry-level practice CAD skill requirements.

Recommendations for Further Study

This study was effective at determining where the communication problem is not. It also revealed some insights into why there is a discrepancy between levels of agreement and practitioner levels of satisfaction. However it raises more questions that could be the basis of additional research. This study asked participants to rate individual CAD skills and knowledge areas in level of importance. In order to help practitioners communicate which skills are most important, a study asking practitioners rank the skills against each other could provide substantial insight on what CAD skills are essential and must be covered before a student graduates, and which are merely helpful but could be learned on the job without costing the employer excessive productivity loss. In addition, further studies could be done to ask faculty which skills are actually being covered CAD curriculum and to rank student performance by CAD skill or learning objective. Lastly, as previous research indicates and this study confirms that the trend toward BIM software is growing, additional research will need to be done to develop a similar skill list for BIM products and to ask similar questions to find out what skills practitioners need entry-level interior designers to possess upon graduation.

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Appendix A

NCIDQ 2008 Practice Analysis

Appendix B

Institutional Review Board Approval

September 30, 2010

IRB Application #: 10118

Proposal Title: Computer aided drafting skills: A comparison of interior design industry and academia entry level expectations

Type of Review: Initial-Expedited

Investigators:

Ms. Sarah Urquhart

Professor Valerie Settles

Department of Design

College of Fine Arts and Design

Campus Box 195

University of Central Oklahoma

Edmond, OK 73034

Dear Ms. Urquhart and Professor Settles:

Re: Application for IRB Review of Research Involving Human Subjects

We have received your application for IRB approval. The UCO IRB has determined that the above named application is APPROVED BY EXPEDITED REVIEW. The Board has provided expedited review under 45 CFR 46.110, for research involving no more that minimal risk and research category 7.

Date of Approval: 09/30/2010

Date of Approval Expiration: 09/29/2011

If applicable, informed consent (and HIPAA authorization) must be obtained from subjects or their legally authorized representatives and documented prior to research involvement. Please note that you should include a statement in your consent emails indicating that the project has IRB approval and include the application number (above). Please send us a revised copy of each of those for our files. While this project is approved for the period noted above, any modification to the procedures and/or consent form must be approved prior to incorporation into the study. A written request is needed to initiate the amendment process. You will be contacted in writing prior to the approval expiration to determine if a continuing review is needed, which must be obtained before the anniversary date. Notification of the completion of the project must be sent to the IRB office in writing and all records must be retained and available for audit for at least 3 years after the research has ended.

It is the responsibility of the investigators to promptly report to the IRB any serious or unexpected adverse events or unanticipated problems that may be a risk to the subjects.

On behalf of the UCO IRB, I wish you the best of luck with your research project. If our office can be of any further assistance, please do not hesitate to contact us.

Sincerely,

Jill A. Devenport, Ph.D.

Chair, Institutional Review Board

Director of Research Compliance, Academic Affairs

Campus Box 159

University of Central Oklahoma

Edmond, OK 73034

405-974-5479

jdevenport@uco.edu

Appendix C

Practitioner Consent & Recruit Email Script

Dear Interior Design Industry Member:

My name is Sarah Urquhart and I am a master's student in Design within the University of Central Oklahoma Department of Design. I am studying how effectively CIDA accredited programs are meeting the expectations of Interior Design industry members regarding the CAD proficiency of Interior Design graduates.

This research study will compare the perceptions of interior design industry professionals and faculty of four-year undergraduate Interior Design programs accredited by the Council for Interior Design Accreditation (CIDA) concerning the computer aided drafting (CAD) preparedness of recent graduates as they begin an entry level Interior Design or Interior Design related position.

You have been randomly selected to participate in this opportunity to share your expectations of entry-level Interior Designers regarding computer aided design (CAD) skills. Your participation in this survey will aid Interior Design educators in providing well-rounded courses that meet the needs of industry employers such as yourself.

The online survey contains questions about your perceptions and observations of what CAD skills are necessary for entry-level Interior Design employment (two years or less industry experience). The survey is completely anonymous and will not collect any personal or company information that could be used for identification purposes. All data will be stored on the secure server provided by ZipSurvey and will be destroyed at the end of this study in December 2010. This survey is expected to take 15 minutes. There are no known risks associated with this study greater than those you would find in daily life.

To participate in this study you must be at least 18 years of age. Your participation in this study is completely voluntary. If you prefer to not participate, please reply to this email or send an email to surquhart1@uco.edu with "Opt Out" in the subject line. You may also withdraw at anytime during the study with no penalties. If you have any questions, please contact the primary researcher, Sarah Urquhart at the contact information below or her faculty mentor, Valerie Settles. You may also contact the Institutional Review Board at the University of Central Oklahoma. This project has IRB approval under application # 10118.

This study is the last step towards fulfilling the requirements of my M.F.A. I would be extremely grateful if you would take time out of your busy schedule to complete the survey. At the completion of the project, I would be happy to send you a report detailing the results.

Please click the link below to begin the research survey. By clicking on the link below, you agree that you understand and are giving your consent to participate.

(link will be inserted here)

Sincerely,

Sarah Urquhart
Principal Investigator
MFA Graduate Student
Department of Design
University of Central Oklahoma
surquhart1@uco.edu

Valerie Settles
Co-Principal Investigator & Faculty Mentor
Director of Interior Design
University of Central Oklahoma
Department of Design
100 N. University Drive
Edmond, OK 73034

405-974-5219
vsettles@uco.edu

Office of Research & Grants, Academic Affairs

Lillard Administration Building, Room 216

University of Central Oklahoma

100 N. University Drive

Edmond, OK 73034

405-974-3825

research@uco.edu

Appendix D

Faculty Consent & Recruit Email Script

Dear Interior Design Faculty Member:

My name is Sarah Urquhart and I am a master's student in Design within the University of Central Oklahoma Department of Design. I am studying how effectively CIDA accredited programs are meeting the expectations of Interior Design industry members regarding the CAD proficiency of Interior Design graduates.

This research study will compare the perceptions of interior design industry professionals and faculty of four-year undergraduate Interior Design programs accredited by the Council for Interior Design Accreditation (CIDA) concerning the computer aided drafting (CAD) preparedness of recent graduates as they begin an entry level Interior Design or Interior Design related position.

You have been randomly selected to participate in this opportunity to share your expectations of entry-level Interior Designers regarding computer aided design (CAD) skills. Your participation in this survey will aid Interior Design educators such as yourself in providing well-rounded courses that meet the needs of industry employers.

The online survey contains questions about your perceptions and observations of what CAD skills are necessary for entry-level Interior Design employment (two years or less industry experience). The survey is completely anonymous and will not collect any personal or company information that could be used for identification purposes. All data will be stored on the secure server provided by ZipSurvey and will be destroyed at the end of this study in December 2010. This survey is expected to take 15 minutes. There are no known risks associated with this study greater than those you would find in daily life.

To participate in this study you must be at least 18 years of age. Your participation in this study is completely voluntary. If you prefer to not participate, please reply to this email or send an email to surquhart1@uco.edu with "Opt Out" in the subject line. You may also withdraw at anytime during the study with no penalties. If you have any questions, please contact the primary researcher, Sarah Urquhart at the contact information below or her faculty mentor, Valerie Settles. You may also contact the Institutional Review Board at the University of Central Oklahoma. This project has IRB approval under application # 10118.

This study is the last step towards fulfilling the requirements of my M.F.A. I would be extremely grateful if you would take time out of your busy schedule to complete the survey. At the completion of the project, I would be happy to send you a report detailing the results.

Please click the link below to begin the research survey. By clicking on the link below, you agree that you understand and are giving your consent to participate.

(link will be inserted here)

Sincerely,

Sarah Urquhart
Principal Investigator
MFA Graduate Student
Department of Design
University of Central Oklahoma
surquhart1@uco.edu

Valerie Settles
Co-Principal Investigator & Faculty Mentor
Director of Interior Design
University of Central Oklahoma
Department of Design
100 N. University Drive
Edmond, OK 73034
405-974-5219
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Lillard Administration Building, Room 216
University of Central Oklahoma
100 N. University Drive
Edmond, OK 73034
405-974-3825
research@uco.edu

Appendix E

Practitioner Survey Instrument

Interior Design Practitioner Survey

[redacted]

What primary software package & version do you use for CAD operations?

- ○ AutoCAD (including vertical products e.g. AutoCAD Architecture)
- ○ Revit
- ○ Microstation
- ○ Other (please specify) ______

Which version of AutoCAD do you use? [▾]

Which version of Revit do you use? [▾]

Which version of Microstation do you use? [▾]

How often does your firm typically upgrade your software package?

- ○ With each new release
- ○ Every 2-4 years
- ○ Every 5-10 years
- ○ Other (please specify) ______

During which phases of the design process does your firm typically use CAD? (mark all that apply)

- ☐ Programming
- ☐ Preliminary/Schematic Design
- ☐ Design Development
- ☐ Construction Documents
- ☐ Contract Administration

☐ Other (please specify) [ ]

What type of CAD standard does your firm use? (mark all that apply)

☐ National CAD Standard (e.g. NCS CAD Standard or AIA CAD standard)
☐ Custom CAD Standard developed for your firm.
☐ Client specific (e.g. government project CAD standards)
☐ None
☐ Other (please specify) [ ]

How many hours of company provided CAD training does an employee in your firm typically receive each year?

○ 0-5
○ 6-10
○ 11-20
○ 21-30
○ 31 or more

When hiring a new entry-level interior designer do you expect to provide CAD training before they are able perform basic daily functions at your firm?

○ Yes
○ No

How important would you rate the role of the entry-level interior designer in the production of construction drawings?

○ Essential - Entry-level employees perform the majority of drafting time required to create construction drawings.
○ Important - Entry-level employees perform at least 50% of the drafting time required to create construction drawings.
○ Unimportant - Entry-level employees perform less than 25% of the drafting time required to create construction drawings.
○ Other (please specify) [ ]

How many hours per day does an entry-level interior designer (employees in an interior design role with 2 or less years of experience) at your firm typically spend using CAD?

- 0-2
- 3-5
- 6-8
- 9 or more

Are entry-level interior designers at your firm expected to perform problem solving design functions (as opposed to just drafting from a provided sketch) using CAD?

- Yes
- No

How would you rate your perception of the CAD preparedness of entry-level interior designers hired by your firm in the last 5 years?

- Excellent – Most were able to adapt to our firm's CAD standards easily and were technically competent and knowledgeable enough to begin working right away.
- Acceptable – Most had a basic knowledge of CAD but there were some issues with technical ability or level of knowledge
- Unprepared – Most lacked the necessary CAD skills to work productively and training was necessary.

How many incidents occurred in the last 5 years where poor CAD drafting cost your firm money or delayed a project?

- None
- 1-5
- 6-10
- 11-15
- 16 or more

For the following section, please rate each CAD related skill by level of importance from 1-5 for an entry-level (2 years or less experience) interior designer performing CAD - operations. When reviewing each skill, please rate it based on what the ideal candidate would be able to do.

5 = Extremely important
4 = Very important
3 = Of moderate importance
2 = Of low importance
1 = Not very important

Drafting Mindset

	High				Low
	5	**4**	**3**	**2**	**1**
Efficiency (hours spent in CAD per drawing produced)	○	○	○	○	○
Accuracy	○	○	○	○	○
Problem solving	○	○	○	○	○
Follow your firm's CAD standards	○	○	○	○	○
Advances CAD skills on own time	○	○	○	○	○
Estimates how long a task will take	○	○	○	○	○
Works without direct supervision for the majority of a day	○	○	○	○	○
Learns and adapts quickly to software changes or upgrades	○	○	○	○	○

For the following section, please rate each CAD related skill by level of importance from 1-5 for an entry-level (2 years or less experience) interior designer performing CAD - operations. When reviewing each skill, please rate it based on what the ideal candidate would be able to do.

5 = Extremely important
4 = Very important
3 = Of moderate importance
2 = Of low importance
1 = Not very important

Expected Knowledge

	High 5	4	3	2	Low 1
Basic construction types (e.g. wood, steel, concrete)	○	○	○	○	○
Basic construction members (e.g. actual vs. nominal stud sizes)	○	○	○	○	○
Basic egress requirements	○	○	○	○	○
Space planning	○	○	○	○	○
Read and interpret working drawings from consultants (e.g. structural drawings, MEP drawings)	○	○	○	○	○
Design and detail simple millwork pieces that are to code and are constructable (e.g. an accessible vanity counter with the sink rim at the correct height and enough room to support the counter material and allow for the necessary knee space)	○	○	○	○	○
Codes and federal guidelines related to building construction	○	○	○	○	○
Understand & use basic interior design and architecture vocabulary	○	○	○	○	○

For the following section, please rate each CAD related skill by level of importance from 1-5 for an entry-level (2 years or less experience) interior designer performing CAD -operations. When reviewing each skill, please rate it based on what the ideal candidate would be able to do.

5 = Extremely important
4 = Very important
3 = Of moderate importance
2 = Of low importance
1 = Not very important

General CAD Abilities

	High 5	4	3	2	Low 1
Coordinate with drawings from other disciplines	○	○	○	○	○
Ability to understand what they are drawing (vs. just transfer a sketch to CAD)	○	○	○	○	○
Understand and use different coordinate systems (e.g. relative, polar, or absolute; rotate UCS)	○	○	○	○	○
Understand and set up drawing units	○	○	○	○	○
Setup drawings for both metric and imperial units	○	○	○	○	○
Ability to use table functions (e.g. to create finish or room schedules)	○	○	○	○	○
Effectively use selection tools (e.g. fence selection or crossing window)	○	○	○	○	○
Use modify tools (e.g. mirror, rotate, stretch, fillet, and trim)	○	○	○	○	○

For the following section, please rate each CAD related skill by level of importance from 1-5 for an entry-level (2 years or less experience) interior designer performing CAD -operations. When reviewing each skill, please rate it based on what the ideal candidate would be able to do.

5 = Extremely important
4 = Very important
3 = Of moderate importance
2 = Of low importance
1 = Not very important

CAD Workspace Habits

	High 5	4	3	2	Low 1
Sheet/Layout organization	○	○	○	○	○
Setup paper space layouts	○	○	○	○	○
Work with drawing templates	○	○	○	○	○
Work with external references files (e.g. Xrefs)	○	○	○	○	○
Configure and use osnaps or snap modes	○	○	○	○	○
Create blocks using good practice (e.g. selecting an appropriate base point, managing	○	○	○	○	○
color and layer behavior)	○	○	○	○	○
Name layers based on CAD standards	○	○	○	○	○
Work with layer filters or layer states	○	○	○	○	○
Organize drawing visibility by placing objects on correct layers	○	○	○	○	○
Maintain good layer habits by controlling item visibility "by layer" instead of by individual properties	○	○	○	○	○
Create proper drawing labels on sheets	○	○	○	○	○

For the following section, please rate each CAD related skill by level of importance from 1-5 for an entry-level (2 years or less experience) interior designer performing CAD -operations. When reviewing each skill, please rate it based on what the ideal candidate would be able to do.

5 = Extremely important
4 = Very important
3 = Of moderate importance
2 = Of low importance
1 = Not very important

CAD Communication Skills

	High 5	4	3	2	Low 1
Use and properly size text for drawing annotation	○	○	○	○	○
Accurately draw and correctly stack dimension strings	○	○	○	○	○
Accurately draw leader arrows	○	○	○	○	○
Select and scale hatches appropriately	○	○	○	○	○
Setup dimension styles	○	○	○	○	○
Clear communication through notes on drawings	○	○	○	○	○

For the following section, please rate each CAD related skill by level of importance from 1-5 for an entry-level (2 years or less experience) interior designer performing CAD -operations. When reviewing each skill, please rate it based on what the ideal candidate would be able to do.

5 = Extremely important
4 = Very important
3 = Of moderate importance
2 = Of low importance
1 = Not very important

CAD Accuracy Skills

	High 5	4	3	2	Low 1
Use basic drawing tools to create geometry (e.g. line tool, arc tool)	○	○	○	○	○
Use geometry knowledge to draw geometry that relates to other geometry (e.g. draw a line tangent to a circle)	○	○	○	○	○
Use tools to accurately and evenly divide geometry into equal portions	○	○	○	○	○
Draw accurate, buildable angles as opposed to "eyeballing" what looks right	○	○	○	○	○
Use appropriate and accurate dimension precision settings	○	○	○	○	○
Create accurate offsets (e.g. for wall thicknesses or room sizes)	○	○	○	○	○
Accurately measure area	○	○	○	○	○
Setup and draw using rectangular grid	○	○	○	○	○
Setup and draw using isometric grid	○	○	○	○	○
Create accurate custom furniture blocks (typical sizes & specified pieces)	○	○	○	○	○

For the following section, please rate each CAD related skill by level of importance from 1-5 for an entry-level (2 years or less experience) interior designer performing CAD - operations. When reviewing each skill, please rate it based on what the ideal candidate would be able to do.

5 = Extremely important
4 = Very important
3 = Of moderate importance
2 = Of low importance
1 = Not very important

Advanced CAD Skills

	High				Low
	5	**4**	**3**	**2**	**1**
Create blocks with attributes	◯	◯	◯	◯	◯
Work with parametric objects	◯	◯	◯	◯	◯
Extract data from block attributes	◯	◯	◯	◯	◯
Work with dynamic blocks	◯	◯	◯	◯	◯
Work with regions	◯	◯	◯	◯	◯
Work with annotative objects	◯	◯	◯	◯	◯

You are almost done! Before you finish, please answer a few general questions about your firm.

Please select the state in which you are located. If you have recently moved, please select the state you have registered with NCIDQ. **(Required)**

What general category of design or architectural services does your firm primarily offer?

Please mark the total number of employees in your firm.

What percentage of your firms' projects use CAD software as the primary tool for creating working drawings?

If you have any comments, or if you see something I missed or forgot please put them here. Thank you very much for your time.

Appendix F

Faculty Survey Instrument

Interior Design Faculty Survey

What primary software package & version does your institution teach for CAD operations?

- (•) AutoCAD (including vertical products e.g. AutoCAD Architecture)
- ( ) Revit
- ( ) Microstation
- ( ) Other (please specify) [ ]

Which version of AutoCAD do you use?

[▾]

Which version of Revit do you use?

[▾]

Which version of Microstation do you use?

[▾]

How often does your institution typically upgrade your software package?

- ( ) With each new release
- ( ) Every 2-4 years
- ( ) Every 5-10 years
- ( ) Other (please specify) [ ]

During which phases of the design process does your institution typically include CAD in student instruction? (mark all that apply)

- [ ] Programming
- [ ] Preliminary/Schematic Design
- [ ] Design Development

- ☐ Construction Documents
- ☐ Contract Administration
- ☐ Other (please specify) [ ]

What type of CAD standard does your department require students to learn and follow? (mark all that apply)

- ☐ National CAD Standard (e.g. NCS CAD Standard or AIA CAD standard)
- ☐ Custom CAD Standard developed for your institution.
- ☐ None
- ☐ Other (please specify) [ ]

How many semester or quarter hours of CAD training does an interior design student attending your institution typically receive during their degree program?

- ○ 0-5
- ○ 6-10
- ○ 11-20
- ○ 21-30
- ○ 31 or more

Do you expect firms hiring graduates of your interior design degree program to provide CAD training before they are able perform basic daily functions?

- ○ Yes
- ○ No

How important would you rate the role of the entry-level interior designer in the production of construction drawings?

- ○ Essential - Entry-level employees perform the majority of drafting time required to create construction drawings.
- ○ Important - Entry-level employees perform at least 50% of the drafting time required to create construction drawings.
- ○ Unimportant - Entry-level employees perform less than 25% of the drafting time required to create construction drawings.

- Other (please specify) [ ]

How many hours per day do you expect an entry-level interior designer (employees in an interior design role with 2 or less years of experience) to spend using CAD?

- 0-2
- 3-5
- 6-8
- 9 or more

Do you expect entry-level interior designers at a firm to perform problem solving design functions (as opposed to just drafting from a provided sketch) using CAD?

- Yes
- No

How would you rate your perception of the CAD preparedness of graduates of your interior design program in the last 5 years?

- Excellent – Most were able to adapt to our firm's CAD standards easily and were technically competent and knowledgeable enough to begin working right away.
- Acceptable – Most had a basic knowledge of CAD but there were some issues with technical ability or level of knowledge
- Unprepared – Most lacked the necessary CAD skills to work productively and training was necessary.

How important is CAD accuracy in your classroom as it relates to dimensioning precision?

- Extremely Important – Dimensions are not rounded and accurately reflect what is drawn. Students are expected to draw using actual and exact dimensions of materials.
- Moderately Important – Dimensions are rounded but not above 1/8" precision. Fractions smaller than 1/8" occur in our drawings but are not typically reflected in the dimensions.
- Somewhat Important – Dimensions are rounded above 1/8" precision. The CAD drawings reflect nominal dimensions that should be field verified.

- ○ Not Important – Dimensions are rounded above ¼” precision. CAD drawings reflect our design intent rather than an exact model of what will be built. We require the contractor in the field to verify and field fit designs.

What percentage of required courses in your interior design program require students to use CAD software as the primary tool for creating working drawings?

[▾]

For the following section, please rate each CAD related skill by level of importance from 1-5 for an entry-level (2 years or less experience) interior designer performing CAD -operations. When reviewing each skill, please rate it based on what the ideal graduate would be able to do.

5 = Extremely important
4 = Very important
3 = Of moderate importance
2 = Of low importance
1 = Not very important

Drafting Mindset

	High				Low
	5	**4**	**3**	**2**	**1**
Efficiency (hours spent in CAD per drawing produced)	○	○	○	○	○
Accuracy	○	○	○	○	○
Problem solving	○	○	○	○	○
Follow your institution’s CAD standards	○	○	○	○	○
Advances CAD skills on own time	○	○	○	○	○
Estimates how long a task will take	○	○	○	○	○
Works without direct supervision for the majority of a day	○	○	○	○	○
Learns and adapts quickly to software changes or upgrades	○	○	○	○	○

For the following section, please rate each CAD related skill by level of importance from 1-5 for an entry-level (2 years or less experience) interior designer performing CAD - operations. When reviewing each skill, please rate it based on what the ideal graduate would be able to do.

5 = Extremely important
4 = Very important
3 = Of moderate importance
2 = Of low importance
1 = Not very important

Expected Knowledge

	High				Low
	5	**4**	**3**	**2**	**1**
Basic construction types (e.g. wood, steel, concrete)	○	○	○	○	○
Basic construction members (e.g. actual vs. nominal stud sizes)	○	○	○	○	○
Basic egress requirements	○	○	○	○	○
Space planning	○	○	○	○	○
Read and interpret working drawings from consultants (e.g. structural drawings, MEP drawings)	○	○	○	○	○
Design and detail simple millwork pieces that are to code and are constructible (e.g. an accessible vanity counter with the sink rim at the correct height and enough room to support the counter material and allow for the necessary knee space)	○	○	○	○	○
Codes and federal guidelines related to building construction	○	○	○	○	○
Understand & use basic interior design and architecture vocabulary	○	○	○	○	○

For the following section, please rate each CAD related skill by level of importance from 1-5 for an entry-level (2 years or less experience) interior designer performing CAD - operations. When reviewing each skill, please rate it based on what the ideal graduate would be able to do.

5 = Extremely important
4 = Very important
3 = Of moderate importance
2 = Of low importance
1 = Not very important

General CAD Abilities

	High 5	4	3	2	Low 1
Coordinate with drawings from other disciplines	○	○	○	○	○
Ability to understand what they are drawing (vs. just transfer a sketch to CAD)	○	○	○	○	○
Understand and use different coordinate systems (e.g. relative, polar, or absolute; rotate UCS)	○	○	○	○	○
Understand and set up drawing units	○	○	○	○	○
Setup drawings for both metric and imperial units	○	○	○	○	○
Ability to use table functions (e.g. to create finish or room schedules)	○	○	○	○	○
Effectively use selection tools (e.g. fence selection or crossing window)	○	○	○	○	○
Use modify tools (e.g. mirror, rotate, stretch, fillet, and trim)	○	○	○	○	○

For the following section, please rate each CAD related skill by level of importance from 1-5 for an entry-level (2 years or less experience) interior designer performing CAD -operations. When reviewing each skill, please rate it based on what the ideal graduate would be able to do.

5 = Extremely important
4 = Very important
3 = Of moderate importance
2 = Of low importance
1 = Not very important

CAD Workspace Habits

	High 5	4	3	2	Low 1
Sheet/Layout organization	○	○	○	○	○
Setup paper space layouts	○	○	○	○	○
Work with drawing templates	○	○	○	○	○
Work with external references files (e.g. Xrefs)	○	○	○	○	○
Configure and use osnaps or snap modes	○	○	○	○	○
Create blocks using good practice (e.g. selecting an appropriate base point, managing color and layer behavior)	○	○	○	○	○
Name layers based on CAD standards	○	○	○	○	○
Work with layer filters or layer states	○	○	○	○	○
Organize drawing visibility by placing objects on correct layers	○	○	○	○	○
Maintain good layer habits by controlling item visibility “by layer” instead of by individual properties	○	○	○	○	○
Create proper drawing labels on sheets	○	○	○	○	○

For the following section, please rate each CAD related skill by level of importance from 1-5 for an entry-level (2 years or less experience) interior designer performing CAD -operations. When reviewing each skill, please rate it based on what the ideal candidate would be able to do.

5 = Extremely important
4 = Very important
3 = Of moderate importance
2 = Of low importance
1 = Not very important

CAD Communication Skills

	High 5	4	3	2	Low 1
Use and properly size text for drawing annotation	○	○	○	○	○
Accurately draw and correctly stack dimension strings	○	○	○	○	○
Accurately draw leader arrows	○	○	○	○	○
Select and scale hatches appropriately	○	○	○	○	○
Setup dimension styles	○	○	○	○	○
Clear communication through notes on drawings	○	○	○	○	○

For the following section, please rate each CAD related skill by level of importance from 1-5 for an entry-level (2 years or less experience) interior designer performing CAD -operations. When reviewing each skill, please rate it based on what the ideal graduate would be able to do.

5 = Extremely important
4 = Very important
3 = Of moderate importance
2 = Of low importance
1 = Not very important

CAD Accuracy Skills

	High 5	4	3	2	Low 1
Use basic drawing tools to create geometry (e.g. line tool, arc tool)	○	○	○	○	○
Use geometry knowledge to draw geometry that relates to other geometry (e.g. draw a line tangent to a circle)	○	○	○	○	○
Use tools to accurately and evenly divide geometry into equal portions	○	○	○	○	○
Draw accurate, buildable angles as opposed to "eyeballing" what looks right	○	○	○	○	○
Use appropriate and accurate dimension precision settings	○	○	○	○	○
Create accurate offsets (e.g. for wall thicknesses or room sizes)	○	○	○	○	○
Accurately measure area	○	○	○	○	○
Setup and draw using rectangular grid	○	○	○	○	○
Setup and draw using isometric grid	○	○	○	○	○
Create accurate custom furniture blocks (typical sizes & specified pieces)	○	○	○	○	○

For the following section, please rate each CAD related skill by level of importance from 1-5 for an entry-level (2 years or less experience) interior designer performing CAD -operations. When reviewing each skill, please rate it based on what the ideal graduate would be able to do.

5 = Extremely important
4 = Very important
3 = Of moderate importance
2 = Of low importance
1 = Not very important

Advanced CAD Skills

	High				Low
	5	**4**	**3**	**2**	**1**
Create blocks with attributes	○	○	○	○	○
Work with parametric objects	○	○	○	○	○
Extract data from block attributes	○	○	○	○	○
Work with dynamic blocks	○	○	○	○	○
Work with regions	○	○	○	○	○
Work with annotative objects	○	○	○	○	○

You are almost done! Before you finish, please answer a few general questions about your institution.

Please select the state in which you are located, if you have recently moved, please select the state you registered with NCIDQ. **(Required)**

What general category of design services does your institution primarily provide student instruction in?

How many people in your department teach courses that use a computer aided drafting (CAD) program?

If you have any comments, or if you see something I missed or forgot please put them here. Thank you very much for your time.

Appendix G

Independent Samples Test of Means for Drafting Mindset Skills

		Levene's Test for Equality of Variances							95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Efficiency	Equal variances assumed	8.288	.005	.533	137	.595	.08977	.16847	-.24338	.42291
	Equal variances not assumed			.690	91.555	.492	.08977	.13018	-.16881	.34834
Accuracy	Equal variances assumed	17.146	.000	2.117	137	.036	.21469	.10143	.01411	.41527
	Equal variances not assumed			1.578	38.153	.123	.21469	.13606	-.06070	.49009
Problem Solving	Equal variances assumed	.015	.902	-.927	137	.356	-.17667	.19063	-.55363	.20028
	Equal variances not assumed			-.889	50.229	.378	-.17667	.19865	-.57564	.22229
Standards	Equal variances assumed	6.432	.012	2.604	137	.010	.49314	.18937	.11867	.86760
	Equal variances not assumed			2.177	42.392	.035*	.49314	.22653	.03611	.95017
Advance	Equal variances assumed	4.008	.047	-1.561	137	.121	-.33905	.21726	-.76866	.09056
	Equal variances not assumed			-1.721	63.498	.090	-.33905	.19705	-.73276	.05466
Estimate	Equal variances assumed	.515	.474	.654	137	.514	.11292	.17267	-.22851	.45436
	Equal variances not assumed			.619	49.255	.539	.11292	.18245	-.25367	.47951
Supervision	Equal variances assumed	.665	.416	-.535	137	.593	-.09434	.17622	-.44279	.25411
	Equal variances not assumed			-.528	52.335	.600	-.09434	.17862	-.45271	.26403
Adapts	Equal variances assumed	.182	.671	-1.882	137	.062	-.29074	.15451	-.59627	.01479
	Equal variances not assumed			-2.079	63.778	.042	-.29074	.13982	-.57008	-.01139

* Significant difference found at the .05 level

Appendix H

Independent Samples Test of Means for Expected Knowledge

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		Levene's Test for Equality of Variances							95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Construction Types	Equal variances assumed	5.236	.024	-4.047	135	.000	-.83188	.20555	-1.23838	-.42537
	Equal variances not assumed			-4.707	71.858	.000	-.83188	.17674	-1.18422	-.47953
Construction Members	Equal variances assumed	2.061	.153	-4.058	135	.000	-.82372	.20297	-1.22513	-.42231
	Equal variances not assumed			-4.540	66.115	.000	-.82372	.18145	-1.18598	-.46145
Egress	Equal variances assumed	27.022	.000	-3.643	135	.000	-.59703	.16388	-.92113	-.27293
	Equal variances not assumed			-5.304	123.479	.000	-.59703	.11256	-.81982	-.37424
Space Planning	Equal variances assumed	18.446	.000	-3.210	135	.002	-.48019	.14958	-.77601	-.18436
	Equal variances not assumed			-4.136	91.959	.000	-.48019	.11610	-.71077	-.24960
Read Consultant Construction Drawings	Equal variances assumed	2.144	.145	-2.234	135	.027	-.41550	.18596	-.78327	-.04774
	Equal variances not assumed			-2.560	69.570	.013	-.41550	.16228	-.73919	-.09181
Millwork	Equal variances assumed	.444	.506	-2.117	135	.036	-.37617	.17772	-.72765	-.02468
	Equal variances not assumed			-2.285	61.623	.026	-.37617	.16461	-.70525	-.04708
Codes	Equal variances assumed	1.396	.239	-4.593	135	.000	-.81323	.17704	-1.16336	-.46309
	Equal variances not assumed			-4.785	57.698	.000	-.81323	.16995	-1.15345	-.47300
Vocabulary	Equal variances assumed	22.458	.000	-2.181	135	.031	-.25233	.11571	-.48117	-.02349
	Equal variances not assumed			-2.848	95.227	.005	-.25233	.08859	-.42820	-.07646

Appendix I

Independent Samples Test of Means for General CAD Abilities

		Levene's Test for Equality of Variances							95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Coordinate	Equal variances assumed	1.323	.252	-.106	132	.916	-.01920	.18113	-.37750	.33910
	Equal variances not assumed			-.114	61.960	.910	-.01920	.16866	-.35636	.31795
Understanding	Equal variances assumed	1.696	.195	-.946	132	.346	-.09481	.10026	-.29312	.10351
	Equal variances not assumed			-.890	49.590	.378	-.09481	.10647	-.30870	.11909
UCS	Equal variances assumed	.351	.555	-2.588	132	.011	-.55086	.21281	-.97181	-.12990
	Equal variances not assumed			-2.723	59.553	.008	-.55086	.20232	-.95561	-.14610
Units	Equal variances assumed	.909	.342	-1.929	132	.056	-.39334	.20393	-.79674	.01006
	Equal variances not assumed			-2.265	74.946	.026	-.39334	.17370	-.73936	-.04731
Metric	Equal variances assumed	1.849	.176	-3.728	132	.000	-.97240	.26080	-1.48830	-.45650
	Equal variances not assumed			-3.937	59.975	.000	-.97240	.24701	-1.46650	-.47830
Tables	Equal variances assumed	5.918	.016	-2.734	132	.007	-.59256	.21671	-1.02124	-.16388
	Equal variances not assumed			-3.486	91.702	.001	-.59256	.16996	-.93013	-.25499
Selection	Equal variances assumed	.097	.755	-1.355	132	.178	-.28383	.20949	-.69822	.13056
	Equal variances not assumed			-1.376	55.935	.174	-.28383	.20623	-.69697	.12931
Modify	Equal variances assumed	1.340	.249	.381	132	.704	.04740	.12433	-.19853	.29334
	Equal variances not assumed			.349	47.579	.729	.04740	.13598	-.22605	.32086

Appendix J

Frequency Report for Practitioner Survey

Interior Design Practitioner Survey

Filter: All Responses

1. What primary software package & version do you use for CAD operations?	Response Percent	Response Total
AutoCAD (including vertical products e.g. AutoCAD Architecture)	75%	89
Revit	14%	17
Microstation	2%	2
Other Selection: View Responses	9%	11
Total Responses	119	
2. Which version of AutoCAD do you use?	**Response Percent**	**Response Total**
2010-2011	38%	38
2007-2009	36%	36
2004-2006	8%	8
2000-2002	7%	7
R14 or previous	1%	1
Not Applicable	10%	10
Total Responses	100	
3. Which version of Revit do you use?	**Response Percent**	**Response Total**
Architecture 2010-2011	100%	17
Architecture 2008-2009	0%	0
Building 9 or previous	0%	0
Other	0%	0
Total Responses	17	
4. Which version of Microstation do you use?	**Response Percent**	**Response Total**
V7.0-7.1	100%	2
V8.0-8.11	0%	0
V5.7 or previous	0%	0
Total Responses	2	
5. How often does your firm typically upgrade your software package?	**Response Percent**	**Response Total**
With each new release	26%	31
Every 2-4 years	51%	60

Every 5-10 years		16%	19
Other Selection: View Responses		6%	7
	Total Responses	117	
6. During which phases of the design process does your firm typically use CAD? (mark all that apply)		**Response Percent**	**Response Total**
Programming		12%	51
Preliminary/Schematic Design		22%	94
Design Development		25%	106
Construction Documents		24%	102
Contract Administration		14%	61
Other Selection: View Responses		2%	10
	Total Responses	424	
7. What type of CAD standard does your firm use? (mark all that apply)		**Response Percent**	**Response Total**
National CAD Standard (e.g. NCS CAD Standard or AIA CAD standard)		32%	46
Custom CAD Standard developed for your firm.		41%	59
Client specific (e.g. government project CAD standards)		13%	19
None		11%	16
Other Selection: View Responses		3%	4
	Total Responses	144	
8. How many hours of company provided CAD training does an employee in your firm typically receive each year?		**Response Percent**	**Response Total**
0-5		74%	85
6-10		17%	19
11-20		5%	6
21-30		3%	3
31 or more		2%	2
	Total Responses	115	
9. When hiring a new entry-level interior designer do you expect to provide CAD training before they are able perform basic daily functions at your firm?		**Response Percent**	**Response Total**
Yes		32%	37
No		68%	79
	Total Responses	116	
10. How important would you rate the role of the entry-level interior designer in the production of construction drawings?		**Response Percent**	**Response Total**

Essential - Entry-level employees perform the majority of drafting time required to create construction drawings.		35%	**41**
Important - Entry-level employees perform at least 50% of the drafting time required to create construction drawings.		46%	**53**
Unimportant - Entry-level employees perform less than 25% of the drafting time required to create construction drawings.		10%	**12**
Other Selection: View Responses		9%	**10**
	Total Responses	**116**	
11. How many hours per day does an entry-level interior designer (employees in an interior design role with 2 or less years of experience) at your firm typically spend using CAD?		**Response Percent**	**Response Total**
0-2		17%	**19**
3-5		38%	**43**
6-8		38%	**43**
9 or more		6%	**7**
	Total Responses	**112**	
12. Are entry-level interior designers at your firm expected to perform problem solving design functions (as opposed to just drafting from a provided sketch) using CAD?		**Response Percent**	**Response Total**
Yes		71%	**79**
No		29%	**32**
	Total Responses	**111**	
13. How would you rate your perception of the CAD preparedness of entry-level interior designers hired by your firm in the last 5 years?		**Response Percent**	**Response Total**
Excellent Most were able to adapt to our firm s CAD standards easily and were technically competent and knowledgeable enough to begin working right away.		34%	**37**
Acceptable Most had a basic knowledge of CAD but there were some issues with technical ability or level of knowledge		56%	**61**
Unprepared Most lacked the necessary CAD skills to work productively and training was necessary.		9%	**10**

	Total Responses	**108**	

14. How many incidents occurred in the last 5 years where poor CAD drafting cost your firm money or delayed a project?		Response Percent	Response Total
None		41%	45
1-5		44%	48
6-10		5%	6
11-15		3%	3
16 or more		7%	8
	Total Responses	**110**	

15. Drafting Mindset		Response Percent	Response Total
Efficiency (hours spent in CAD per drawing produced)			
5		52%	55
4		33%	35
3		10%	11
2		4%	4
1		0%	0
	Total Responses	**105**	
Mean: **4.3429** Standard Deviation: **0.8184**			
Accuracy			
5		83%	88
4		16%	17
3		1%	1
2		0%	0
1		0%	0
	Total Responses	**106**	
Mean: **4.8208** Standard Deviation: **0.4093**			
Problem solving			
5		21%	22
4		33%	35
3		37%	39
2		8%	9
1		1%	1
	Total Responses	**106**	
Mean: **3.6415** Standard Deviation: **0.938**			
Follow your firm s CAD standards			

5		**50%**	**53**
4		**36%**	**38**
3		**11%**	**12**
2		**1%**	**1**
1		**2%**	**2**
	Total Responses	**106**	
Mean: **4.3113** Standard Deviation: **0.8548**			
Advances CAD skills on own time			
5		**22%**	**23**
4		**30%**	**32**
3		**31%**	**33**
2		**12%**	**13**
1		**4%**	**4**
	Total Responses	**105**	
Mean: **3.5429** Standard Deviation: **1.0833**			
Estimates how long a task will take			
5		**16%**	**17**
4		**44%**	**47**
3		**33%**	**35**
2		**6%**	**6**
1		**1%**	**1**
	Total Responses	**106**	
Mean: **3.6887** Standard Deviation: **0.8436**			
Works without direct supervision for the majority of a day			
5		**25%**	**27**
4		**47%**	**50**
3		**21%**	**22**
2		**6%**	**6**
1		**1%**	**1**
	Total Responses	**106**	
Mean: **3.9057** Standard Deviation: **0.8786**			
Learns and adapts quickly to software changes or upgrades			
5		**42%**	**44**
4		**47%**	**50**
3		**8%**	**9**

2		1%	**1**
1		2%	**2**
	Total Responses	**106**	
Mean: **4.2547** Standard Deviation: **0.8055**			
16. Expected Knowledge		**Response Percent**	**Response Total**
Basic construction types (e.g. wood, steel, concrete)			
5		20%	**21**
4		29%	**30**
3		33%	**34**
2		14%	**15**
1		4%	**4**
	Total Responses	**104**	
Mean: **3.4712** Standard Deviation: **1.0879**			
Basic construction members (e.g. actual vs. nominal stud sizes)			
5		19%	**20**
4		32%	**33**
3		35%	**36**
2		10%	**10**
1		5%	**5**
	Total Responses	**104**	
Mean: **3.5096** Standard Deviation: **1.0612**			
Basic egress requirements			
5		49%	**51**
4		29%	**30**
3		18%	**19**
2		3%	**3**
1		1%	**1**
	Total Responses	**104**	
Mean: **4.2212** Standard Deviation: **0.9133**			
Space planning			
5		50%	**52**
4		34%	**35**
3		13%	**14**
2		3%	**3**

1		**0%**	**0**
	Total Responses	**104**	
Mean: **4.3077** Standard Deviation: **0.8134**			
Read and interpret working drawings from consultants (e.g. structural drawings, MEP drawings)			
5		**29%**	**30**
4		**35%**	**36**
3		**29%**	**30**
2		**6%**	**6**
1		**2%**	**2**
	Total Responses	**104**	
Mean: **3.8269** Standard Deviation: **0.9798**			
Design and detail simple millwork pieces that are to code and are constructable (e.g. an accessible vanity counter with the sink rim at the correct height and enough room to support the counter material and allow for the necessary knee space)			
5		**38%**	**40**
4		**34%**	**35**
3		**22%**	**23**
2		**6%**	**6**
1		**0%**	**0**
	Total Responses	**104**	
Mean: **4.0481** Standard Deviation: **0.9178**			
Codes and federal guidelines related to building construction			
5		**21%**	**22**
4		**36%**	**37**
3		**37%**	**38**
2		**6%**	**6**
1		**1%**	**1**
	Total Responses	**104**	
Mean: **3.7019** Standard Deviation: **0.9018**			
Understand & use basic interior design and architecture vocabulary			
5		**67%**	**70**
4		**25%**	**26**
3		**8%**	**8**
2		**0%**	**0**
1		**0%**	**0**
	Total Responses	**104**	

Mean: **4.5962** Standard Deviation: **0.6312**			
17. General CAD Abilities		**Response Percent**	**Response Total**
Coordinate with drawings from other disciplines			
5		**33%**	**33**
4		**37%**	**37**
3		**25%**	**25**
2		**5%**	**5**
1		**1%**	**1**
	Total Responses	**101**	
Mean: **3.9505** Standard Deviation: **0.9314**			
Ability to understand what they are drawing (vs. just transfer a sketch to CAD)			
5		**70%**	**71**
4		**29%**	**29**
3		**1%**	**1**
2		**0%**	**0**
1		**0%**	**0**
	Total Responses	**101**	
Mean: **4.6931** Standard Deviation: **0.4846**			
Understand and use different coordinate systems (e.g. relative, polar, or absolute; rotate UCS)			
5		**16%**	**16**
4		**21%**	**21**
3		**45%**	**45**
2		**12%**	**12**
1		**7%**	**7**
	Total Responses	**101**	
Mean: **3.2673** Standard Deviation: **1.0853**			
Understand and set up drawing units			
5		**39%**	**39**
4		**35%**	**35**
3		**15%**	**15**
2		**9%**	**9**
1		**3%**	**3**
	Total Responses	**101**	
Mean: **3.9703** Standard Deviation: **1.0813**			

Setup drawings for both metric and imperial units			
5		**11%**	**11**
4		**18%**	**18**
3		**21%**	**21**
2		**25%**	**25**
1		**26%**	**26**
	Total Responses	**101**	
Mean: **2.6337** Standard Deviation: **1.3321**			
Ability to use table functions (e.g. to create finish or room schedules)			
5		**36%**	**36**
4		**31%**	**31**
3		**22%**	**22**
2		**5%**	**5**
1		**7%**	**7**
	Total Responses	**101**	
Mean: **3.8317** Standard Deviation: **1.1753**			
Effectively use selection tools (e.g. fence selection or crossing window)			
5		**43%**	**43**
4		**32%**	**32**
3		**17%**	**17**
2		**6%**	**6**
1		**3%**	**3**
	Total Responses	**101**	
Mean: **4.0495** Standard Deviation: **1.0524**			
Use modify tools (e.g. mirror, rotate, stretch, fillet, and trim)			
5		**71%**	**72**
4		**23%**	**23**
3		**6%**	**6**
2		**0%**	**0**
1		**0%**	**0**
	Total Responses	**101**	
Mean: **4.6535** Standard Deviation: **0.5905**			

18. CAD Workspace Habits	Response Percent	Response Total
Sheet/Layout organization		

5		**46%**	**46**
4		**41%**	**41**
3		**10%**	**10**
2		**1%**	**1**
1		**2%**	**2**
	Total Responses	**100**	
Mean: **4.28** Standard Deviation: **0.8418**			
Setup paper space layouts			
5		**56%**	**56**
4		**32%**	**32**
3		**9%**	**9**
2		**1%**	**1**
1		**2%**	**2**
	Total Responses	**100**	
Mean: **4.39** Standard Deviation: **0.8516**			
Work with drawing templates			
5		**51%**	**50**
4		**31%**	**30**
3		**17%**	**17**
2		**1%**	**1**
1		**0%**	**0**
	Total Responses	**98**	
Mean: **4.3163** Standard Deviation: **0.7943**			
Work with external references files (e.g. Xrefs)			
5		**51%**	**50**
4		**23%**	**23**
3		**21%**	**21**
2		**2%**	**2**
1		**3%**	**3**
	Total Responses	**99**	
Mean: **4.1616** Standard Deviation: **1.0273**			
Configure and use osnaps or snap modes			
5		**46%**	**46**
4		**32%**	**32**
3		**16%**	**16**

2		3%	**3**
1		2%	**2**
	Total Responses	**99**	

Mean: **4.1818**
Standard Deviation: **0.9515**

Create blocks using good practice (e.g. selecting an appropriate base point, managing

5		47%	**46**
4		38%	**37**
3		12%	**12**
2		2%	**2**
1		1%	**1**
	Total Responses	**98**	

Mean: **4.2755**
Standard Deviation: **0.8346**

color and layer behavior)

5		52%	**49**
4		34%	**32**
3		7%	**7**
2		4%	**4**
1		2%	**2**
	Total Responses	**94**	

Mean: **4.2979**
Standard Deviation: **0.937**

Name layers based on CAD standards

5		45%	**45**
4		31%	**31**
3		15%	**15**
2		5%	**5**
1		4%	**4**
	Total Responses	**100**	

Mean: **4.08**
Standard Deviation: **1.0795**

Work with layer filters or layer states

5		41%	**40**
4		30%	**29**
3		21%	**21**
2		7%	**7**
1		1%	**1**
	Total Responses	**98**	

Mean: **4.0204** Standard Deviation: **1.0049**			
Organize drawing visibility by placing objects on correct layers			
5		67%	**67**
4		27%	**27**
3		5%	**5**
2		1%	**1**
1		0%	**0**
	Total Responses	**100**	
Mean: **4.6** Standard Deviation: **0.6356**			
Maintain good layer habits by controlling item visibility by layer instead of by individual properties			
5		64%	**64**
4		28%	**28**
3		6%	**6**
2		2%	**2**
1		0%	**0**
	Total Responses	**100**	
Mean: **4.54** Standard Deviation: **0.7024**			
Create proper drawing labels on sheets			
5		56%	**56**
4		35%	**35**
3		6%	**6**
2		2%	**2**
1		1%	**1**
	Total Responses	**100**	
Mean: **4.43** Standard Deviation: **0.7818**			
19. CAD Communication Skills		**Response Percent**	**Response Total**
Use and properly size text for drawing annotation			
5		61%	**60**
4		33%	**33**
3		5%	**5**
2		0%	**0**
1		1%	**1**
	Total Responses	**99**	
Mean: **4.5253** Standard Deviation: **0.6902**			

Accurately draw and correctly stack dimension strings			
5		**67%**	**66**
4		**26%**	**26**
3		**6%**	**6**
2		**1%**	**1**
1		**0%**	**0**
	Total Responses	**99**	

Mean: **4.5859**
Standard Deviation: **0.6548**

Accurately draw leader arrows			
5		**60%**	**59**
4		**32%**	**32**
3		**7%**	**7**
2		**1%**	**1**
1		**0%**	**0**
	Total Responses	**99**	

Mean: **4.5051**
Standard Deviation: **0.6757**

Select and scale hatches appropriately			
5		**56%**	**55**
4		**30%**	**30**
3		**12%**	**12**
2		**2%**	**2**
1		**0%**	**0**
	Total Responses	**99**	

Mean: **4.3939**
Standard Deviation: **0.7801**

Setup dimension styles			
5		**54%**	**53**
4		**25%**	**25**
3		**12%**	**12**
2		**5%**	**5**
1		**4%**	**4**
	Total Responses	**99**	

Mean: **4.1919**
Standard Deviation: **1.0943**

Clear communication through notes on drawings			
5		**69%**	**68**
4		**22%**	**22**

3		6%	**6**
2		2%	**2**
1		0%	**0**
	Total Responses	**98**	
Mean: **4.5918** Standard Deviation: **0.7011**			
20. CAD Accuracy Skills		**Response Percent**	**Response Total**
Use basic drawing tools to create geometry (e.g. line tool, arc tool)			
5		68%	**68**
4		20%	**20**
3		9%	**9**
2		1%	**1**
1		2%	**2**
	Total Responses	**100**	
Mean: **4.51** Standard Deviation: **0.8586**			
Use geometry knowledge to draw geometry that relates to other geometry (e.g. draw a line tangent to a circle)			
5		42%	**42**
4		32%	**32**
3		20%	**20**
2		2%	**2**
1		3%	**3**
	Total Responses	**99**	
Mean: **4.0909** Standard Deviation: **0.9907**			
Use tools to accurately and evenly divide geometry into equal portions			
5		45%	**45**
4		31%	**31**
3		17%	**17**
2		4%	**4**
1		3%	**3**
	Total Responses	**100**	
Mean: **4.11** Standard Deviation: **1.0239**			
Draw accurate, buildable angles as opposed to eyeballing what looks right			
5		73%	**73**
4		15%	**15**
3		9%	**9**

2		2%	2
1		1%	1
	Total Responses	**100**	
Mean: **4.57** Standard Deviation: **0.8196**			
Use appropriate and accurate dimension precision settings			
5		71%	71
4		19%	19
3		8%	8
2		1%	1
1		1%	1
	Total Responses	**100**	
Mean: **4.58** Standard Deviation: **0.7678**			
Create accurate offsets (e.g. for wall thicknesses or room sizes)			
5		72%	72
4		20%	20
3		7%	7
2		1%	1
1		0%	0
	Total Responses	**100**	
Mean: **4.63** Standard Deviation: **0.6614**			
Accurately measure area			
5		80%	80
4		11%	11
3		7%	7
2		1%	1
1		1%	1
	Total Responses	**100**	
Mean: **4.68** Standard Deviation: **0.7369**			
Setup and draw using rectangular grid			
5		29%	28
4		28%	27
3		28%	27
2		6%	6
1		10%	10
	Total Responses	**98**	

Mean: **3.5816**
Standard Deviation: **1.2512**

Setup and draw using isometric grid			
5		**21%**	**21**
4		**21%**	**21**
3		**31%**	**31**
2		**12%**	**12**
1		**14%**	**14**
	Total Responses	**99**	

Mean: **3.2323**
Standard Deviation: **1.308**

Create accurate custom furniture blocks (typical sizes & specified pieces)			
5		**48%**	**48**
4		**23%**	**23**
3		**20%**	**20**
2		**8%**	**8**
1		**1%**	**1**
	Total Responses	**100**	

Mean: **4.09**
Standard Deviation: **1.0454**

21. Advanced CAD Skills		**Response Percent**	**Response Total**
Create blocks with attributes			
5		**20%**	**20**
4		**32%**	**31**
3		**34%**	**33**
2		**11%**	**11**
1		**3%**	**3**
	Total Responses	**98**	

Mean: **3.551**
Standard Deviation: **1.0367**

Work with parametric objects			
5		**12%**	**12**
4		**24%**	**24**
3		**41%**	**40**
2		**13%**	**13**
1		**9%**	**9**
	Total Responses	**98**	

Mean: **3.1735**
Standard Deviation: **1.1032**

Extract data from block attributes			
5		**14%**	**14**
4		**20%**	**20**
3		**43%**	**42**
2		**11%**	**11**
1		**11%**	**11**
	Total Responses	**98**	

Mean: **3.1531**
Standard Deviation: **1.1519**

Work with dynamic blocks			
5		**17%**	**17**
4		**17%**	**17**
3		**42%**	**41**
2		**13%**	**13**
1		**10%**	**10**
	Total Responses	**98**	

Mean: **3.1837**
Standard Deviation: **1.1784**

Work with regions			
5		**10%**	**10**
4		**19%**	**19**
3		**42%**	**41**
2		**16%**	**16**
1		**12%**	**12**
	Total Responses	**98**	

Mean: **2.9898**
Standard Deviation: **1.126**

Work with annotative objects			
5		**18%**	**18**
4		**24%**	**24**
3		**38%**	**37**
2		**12%**	**12**
1		**7%**	**7**
	Total Responses	**98**	

Mean: **3.3469**
Standard Deviation: **1.1316**

22. Please select the state in which you are located. If you have recently moved, please select the state you have registered with NCIDQ.		**Response Percent**	**Response Total**
AR		**1%**	**1**

CO		12%	12
FL		12%	12
GA		13%	13
IA		3%	3
MN		9%	9
ND		0%	0
NY		12%	12
OK		8%	8
SD		0%	0
TX		15%	15
VA		14%	14
WV		1%	1
	Total Responses	**100**	

23. What general category of design or architectural services does your firm primarily offer?		**Response Percent**	**Response Total**
Contract/Commercial		73%	72
Residential		13%	13
Both		14%	14
	Total Responses	**99**	

24. Please mark the total number of employees in your firm.		**Response Percent**	**Response Total**
1-10		53%	53
11-20		10%	10
21-30		6%	6
31 or more		31%	31
	Total Responses	**100**	

25. What percentage of your firms' projects use CAD software as the primary tool for creating working drawings?		**Response Percent**	**Response Total**
0 25%		6%	6
26 50%		6%	6
51 75%		10%	10
76 100%		78%	78
	Total Responses	**100**	

26. If you have any comments, or if you see something I missed or forgot please put them here. Thank you very much for your time.	**Response Total**
View Responses	**20**
Total Responses	**20**

Appendix K

Frequency Report for Faculty Survey

Interior Design Faculty Survey

Filter: All Responses

1. What primary software package & version does your institution teach for CAD operations?		Response Percent	Response Total
AutoCAD (including vertical products e.g. AutoCAD Architecture)		70%	26
Revit		16%	6
Microstation		0%	0
Other Selection: View Responses		14%	5
	Total Responses	37	

2. Which version of AutoCAD do you use?		Response Percent	Response Total
2010-2011		79%	23
2007-2009		7%	2
2004-2006		10%	3
2000-2002		0%	0
R14 or previous		0%	0
Not Applicable		3%	1
	Total Responses	29	

3. Which version of Revit do you use?		Response Percent	Response Total
Architecture 2010-2011		100%	5
Architecture 2008-2009		0%	0
Building 9 or previous		0%	0
Other		0%	0
	Total Responses	5	

4. Which version of Microstation do you use?		Response Percent	Response Total
V7.0-7.1		0%	0
V8.0-8.11		0%	0
V5.7 or previous		0%	0
	Total Responses	0	

5. How often does your instituition typically upgrade your software package?		Response Percent	Response Total
With each new release		68%	23
Every 2-4 years		21%	7

Every 5-10 years		6%	2
Other Selection: View Responses		6%	2
	Total Responses	34	
6. During which phases of the design process does your institution typically include CAD in student instruction? (mark all that apply)		**Response Percent**	**Response Total**
Programming		6%	5
Preliminary/Schematic Design		23%	18
Design Development		35%	27
Construction Documents		30%	23
Contract Administration		4%	3
Other Selection: View Responses		1%	1
	Total Responses	77	
7. What type of CAD standard does your department require students to learn and follow? (mark all that apply)		**Response Percent**	**Response Total**
National CAD Standard (e.g. NCS CAD Standard or AIA CAD standard)		36%	12
Custom CAD Standard developed for your institution.		39%	13
None		21%	7
Other Selection: View Responses		3%	1
	Total Responses	33	
8. How many semester or quarter hours of CAD training does an interior design student attending your institution typically receive during their degree program?		**Response Percent**	**Response Total**
0-5		33%	11
6-10		48%	16
11-20		3%	1
21-30		3%	1
31 or more		12%	4
	Total Responses	33	
9. Do you expect firms hiring graduates of your interior design degree program to provide CAD training before they are able perform basic daily functions?		**Response Percent**	**Response Total**
Yes		12%	4
No		88%	29
	Total Responses	33	
10. How important would you rate the role of the entry-level interior designer in the production of construction drawings?		**Response Percent**	**Response Total**
Essential - Entry-level employees perform the			

majority of drafting time required to create construction drawings.		39%	13
Important - Entry-level employees perform at least 50% of the drafting time required to create construction drawings.		61%	20
Unimportant - Entry-level employees perform less than 25% of the drafting time required to create construction drawings.		0%	0
Other Selection: View Responses		0%	0
	Total Responses	33	

11. How many hours per day do you expect an entry-level interior designer (employees in an interior design role with 2 or less years of experience) to spend using CAD?		**Response Percent**	**Response Total**
0-2		0%	0
3-5		58%	19
6-8		36%	12
9 or more		6%	2
	Total Responses	33	

12. Do you expect entry-level interior designers at a firm to perform problem solving design functions (as opposed to just drafting from a provided sketch) using CAD?		**Response Percent**	**Response Total**
Yes		79%	26
No		21%	7
	Total Responses	33	

13. How would you rate your perception of the CAD preparedness of graduates of your interior design program in the last 5 years?		**Response Percent**	**Response Total**
Excellent Most were able to adapt to our firm s CAD standards easily and were technically competent and knowledgeable enough to begin working right away.		64%	21
Acceptable Most had a basic knowledge of CAD but there were some issues with technical ability or level of knowledge		33%	11
Unprepared Most lacked the necessary CAD skills to work productively and training was necessary.		3%	1
	Total Responses	33	

14. How important is CAD accuracy in your classroom as it relates to dimensioning precision?		**Response Percent**	**Response Total**
Extremely Important Dimensions are not rounded and accurately reflect what is drawn. Students are expected to draw using actual and exact dimensions of materials.		**64%**	**21**
Moderately Important Dimensions are rounded but not above 1/8 precision. Fractions smaller than 1/8 occur in our drawings but are not typically reflected in the dimensions.		**24%**	**8**
Somewhat Important Dimensions are rounded above 1/8 precision. The CAD drawings reflect nominal dimensions that should be field verified.		**9%**	**3**
Not Important Dimensions are rounded above precision. CAD drawings reflect our design intent rather than an exact model of what will be built. We require the contractor in the field to verify and field fit designs.		**3%**	**1**
	Total Responses	**33**	

15. What percentage of required courses in your interior design program require students to use CAD software as the primary tool for creating working drawings?		**Response Percent**	**Response Total**
0 25%		**13%**	**4**
26 50%		**35%**	**11**
51 75%		**32%**	**10**
76 100%		**19%**	**6**
	Total Responses	**31**	

16. Drafting Mindset		**Response Percent**	**Response Total**
Efficiency (hours spent in CAD per drawing produced)			
5		**27%**	**9**
4		**67%**	**22**
3		**6%**	**2**
2		**0%**	**0**
1		**0%**	**0**

	Total Responses	**33**	
Mean: **4.2121** Standard Deviation: **0.5453**			
Accuracy			
5		**73%**	**24**
4		**18%**	**6**
3		**6%**	**2**
2		**3%**	**1**
1		**0%**	**0**
	Total Responses	**33**	
Mean: **4.6061** Standard Deviation: **0.7475**			
Problem solving			
5		**27%**	**9**
4		**39%**	**13**
3		**24%**	**8**
2		**6%**	**2**
1		**3%**	**1**
	Total Responses	**33**	
Mean: **3.8182** Standard Deviation: **1.0141**			
Follow your institution s CAD standards			
5		**36%**	**12**
4		**30%**	**10**
3		**18%**	**6**
2		**9%**	**3**
1		**6%**	**2**
	Total Responses	**33**	
Mean: **3.8182** Standard Deviation: **1.2107**			
Advances CAD skills on own time			
5		**24%**	**8**
4		**45%**	**15**
3		**24%**	**8**
2		**3%**	**1**
1		**3%**	**1**
	Total Responses	**33**	
Mean: **3.8485** Standard Deviation: **0.9395**			

Estimates how long a task will take			
5		**15%**	**5**
4		**39%**	**13**
3		**36%**	**12**
2		**6%**	**2**
1		**3%**	**1**
	Total Responses	**33**	
Mean: **3.5758** Standard Deviation: **0.9364**			
Works without direct supervision for the majority of a day			
5		**27%**	**9**
4		**55%**	**18**
3		**12%**	**4**
2		**3%**	**1**
1		**3%**	**1**
	Total Responses	**33**	
Mean: **4** Standard Deviation: **0.9014**			
Learns and adapts quickly to software changes or upgrades			
5		**64%**	**21**
4		**27%**	**9**
3		**9%**	**3**
2		**0%**	**0**
1		**0%**	**0**
	Total Responses	**33**	
Mean: **4.5455** Standard Deviation: **0.6657**			

17. Expected Knowledge		**Response Percent**	**Response Total**
Basic construction types (e.g. wood, steel, concrete)			
5		**48%**	**16**
4		**36%**	**12**
3		**12%**	**4**
2		**3%**	**1**
1		**0%**	**0**
	Total Responses	**33**	
Mean: **4.303** Standard Deviation: **0.8095**			
Basic construction members (e.g. actual vs. nominal stud sizes)			

5		**55%**	**18**
4		**27%**	**9**
3		**15%**	**5**
2		**3%**	**1**
1		**0%**	**0**
	Total Responses	**33**	
Mean: **4.3333** Standard Deviation: **0.8539**			
Basic egress requirements			
5		**82%**	**27**
4		**18%**	**6**
3		**0%**	**0**
2		**0%**	**0**
1		**0%**	**0**
	Total Responses	**33**	
Mean: **4.8182** Standard Deviation: **0.3917**			
Space planning			
5		**82%**	**27**
4		**15%**	**5**
3		**3%**	**1**
2		**0%**	**0**
1		**0%**	**0**
	Total Responses	**33**	
Mean: **4.7879** Standard Deviation: **0.4846**			
Read and interpret working drawings from consultants (e.g. structural drawings, MEP drawings)			
5		**42%**	**14**
4		**39%**	**13**
3		**18%**	**6**
2		**0%**	**0**
1		**0%**	**0**
	Total Responses	**33**	
Mean: **4.2424** Standard Deviation: **0.7513**			
Design and detail simple millwork pieces that are to code and are constructable (e.g. an accessible vanity counter with the sink rim at the correct height and enough room to support the counter material and allow for the necessary knee space)			
5		**58%**	**19**
4		**30%**	**10**

3		9%	**3**
2		3%	**1**
1		0%	**0**
	Total Responses	**33**	
Mean: **4.4242** Standard Deviation: **0.7918**			
Codes and federal guidelines related to building construction			
5		67%	**22**
4		24%	**8**
3		3%	**1**
2		6%	**2**
1		0%	**0**
	Total Responses	**33**	
Mean: **4.5152** Standard Deviation: **0.8337**			
Understand & use basic interior design and architecture vocabulary			
5		85%	**28**
4		15%	**5**
3		0%	**0**
2		0%	**0**
1		0%	**0**
	Total Responses	**33**	
Mean: **4.8485** Standard Deviation: **0.3641**			
18. General CAD Abilities		**Response Percent**	**Response Total**
Coordinate with drawings from other disciplines			
5		27%	**9**
4		45%	**15**
3		24%	**8**
2		3%	**1**
1		0%	**0**
	Total Responses	**33**	
Mean: **3.9697** Standard Deviation: **0.8095**			
Ability to understand what they are drawing (vs. just transfer a sketch to CAD)			
5		85%	**28**
4		9%	**3**
3		6%	**2**

2		0%	**0**
1		0%	**0**
	Total Responses	33	
Mean: **4.7879** Standard Deviation: **0.5453**			
Understand and use different coordinate systems (e.g. relative, polar, or absolute; rotate UCS)			
5		27%	**9**
4		36%	**12**
3		30%	**10**
2		3%	**1**
1		3%	**1**
	Total Responses	33	
Mean: **3.8182** Standard Deviation: **0.9828**			
Understand and set up drawing units			
5		55%	**18**
4		27%	**9**
3		18%	**6**
2		0%	**0**
1		0%	**0**
	Total Responses	33	
Mean: **4.3636** Standard Deviation: **0.7833**			
Setup drawings for both metric and imperial units			
5		27%	**9**
4		27%	**9**
3		33%	**11**
2		3%	**1**
1		9%	**3**
	Total Responses	33	
Mean: **3.6061** Standard Deviation: **1.1974**			
Ability to use table functions (e.g. to create finish or room schedules)			
5		55%	**18**
4		33%	**11**
3		12%	**4**
2		0%	**0**
1		0%	**0**
	Total Responses	33	

Mean: **4.4242** Standard Deviation: **0.7084**			
Effectively use selection tools (e.g. fence selection or crossing window)			
5		**58%**	**19**
4		**30%**	**10**
3		**3%**	**1**
2		**6%**	**2**
1		**3%**	**1**
	Total Responses	**33**	
Mean: **4.3333** Standard Deviation: **1.0206**			
Use modify tools (e.g. mirror, rotate, stretch, fillet, and trim)			
5		**73%**	**24**
4		**15%**	**5**
3		**12%**	**4**
2		**0%**	**0**
1		**0%**	**0**
	Total Responses	**33**	
Mean: **4.6061** Standard Deviation: **0.7044**			
19. CAD Workspace Habits		**Response Percent**	**Response Total**
Sheet/Layout organization			
5		**62%**	**20**
4		**31%**	**10**
3		**6%**	**2**
2		**0%**	**0**
1		**0%**	**0**
	Total Responses	**32**	
Mean: **4.5625** Standard Deviation: **0.6189**			
Setup paper space layouts			
5		**69%**	**22**
4		**19%**	**6**
3		**9%**	**3**
2		**0%**	**0**
1		**3%**	**1**
	Total Responses	**32**	
Mean: **4.5** Standard Deviation: **0.9158**			

Work with drawing templates			
5		**50%**	**16**
4		**28%**	**9**
3		**19%**	**6**
2		**3%**	**1**
1		**0%**	**0**
	Total Responses	**32**	
Mean: **4.25** Standard Deviation: **0.8799**			
Work with external references files (e.g. Xrefs)			
5		**47%**	**15**
4		**38%**	**12**
3		**9%**	**3**
2		**6%**	**2**
1		**0%**	**0**
	Total Responses	**32**	
Mean: **4.25** Standard Deviation: **0.8799**			
Configure and use osnaps or snap modes			
5		**62%**	**20**
4		**19%**	**6**
3		**19%**	**6**
2		**0%**	**0**
1		**0%**	**0**
	Total Responses	**32**	
Mean: **4.4375** Standard Deviation: **0.8007**			
Create blocks using good practice (e.g. selecting an appropriate base point, managing color and layer behavior)			
5		**62%**	**20**
4		**22%**	**7**
3		**16%**	**5**
2		**0%**	**0**
1		**0%**	**0**
	Total Responses	**32**	
Mean: **4.4688** Standard Deviation: **0.7613**			
Name layers based on CAD standards			
5		**59%**	**19**
4		**28%**	**9**

3		12%	**4**
2		0%	**0**
1		0%	**0**
	Total Responses	32	
Mean: **4.4688** Standard Deviation: **0.7177**			
Work with layer filters or layer states			
5		44%	**14**
4		34%	**11**
3		19%	**6**
2		3%	**1**
1		0%	**0**
	Total Responses	32	
Mean: **4.1875** Standard Deviation: **0.859**			
Organize drawing visibility by placing objects on correct layers			
5		71%	**22**
4		23%	**7**
3		6%	**2**
2		0%	**0**
1		0%	**0**
	Total Responses	31	
Mean: **4.6452** Standard Deviation: **0.6082**			
Maintain good layer habits by controlling item visibility by layer instead of by individual properties			
5		62%	**20**
4		34%	**11**
3		3%	**1**
2		0%	**0**
1		0%	**0**
	Total Responses	32	
Mean: **4.5938** Standard Deviation: **0.5599**			
Create proper drawing labels on sheets			
5		77%	**24**
4		19%	**6**
3		3%	**1**
2		0%	**0**
1		0%	**0**

	Total Responses	**31**	
Mean: **4.7419** Standard Deviation: **0.5143**			
20. CAD Communication Skills		**Response Percent**	**Response Total**
Use and properly size text for drawing annotation			
5		**78%**	**25**
4		**16%**	**5**
3		**3%**	**1**
2		**3%**	**1**
1		**0%**	**0**
	Total Responses	**32**	
Mean: **4.6875** Standard Deviation: **0.6927**			
Accurately draw and correctly stack dimension strings			
5		**72%**	**23**
4		**25%**	**8**
3		**3%**	**1**
2		**0%**	**0**
1		**0%**	**0**
	Total Responses	**32**	
Mean: **4.6875** Standard Deviation: **0.5351**			
Accurately draw leader arrows			
5		**66%**	**21**
4		**28%**	**9**
3		**6%**	**2**
2		**0%**	**0**
1		**0%**	**0**
	Total Responses	**32**	
Mean: **4.5938** Standard Deviation: **0.6148**			
Select and scale hatches appropriately			
5		**59%**	**19**
4		**38%**	**12**
3		**3%**	**1**
2		**0%**	**0**
1		**0%**	**0**
	Total Responses	**32**	

Mean: **4.5625**
Standard Deviation: **0.5644**

Setup dimension styles			
5		**62%**	**20**
4		**31%**	**10**
3		**6%**	**2**
2		**0%**	**0**
1		**0%**	**0**
	Total Responses	**32**	

Mean: **4.5625**
Standard Deviation: **0.6189**

Clear communication through notes on drawings			
5		**75%**	**24**
4		**25%**	**8**
3		**0%**	**0**
2		**0%**	**0**
1		**0%**	**0**
	Total Responses	**32**	

Mean: **4.75**
Standard Deviation: **0.4399**

21. CAD Accuracy Skills		**Response Percent**	**Response Total**
Use basic drawing tools to create geometry (e.g. line tool, arc tool)			
5		**69%**	**22**
4		**28%**	**9**
3		**3%**	**1**
2		**0%**	**0**
1		**0%**	**0**
	Total Responses	**32**	

Mean: **4.6563**
Standard Deviation: **0.5453**

Use geometry knowledge to draw geometry that relates to other geometry (e.g. draw a line tangent to a circle)			
5		**53%**	**17**
4		**38%**	**12**
3		**6%**	**2**
2		**3%**	**1**
1		**0%**	**0**
	Total Responses	**32**	

Mean: **4.4063**
Standard Deviation: **0.756**

Use tools to accurately and evenly divide geometry into equal portions			
5		**47%**	**15**
4		**41%**	**13**
3		**12%**	**4**
2		**0%**	**0**
1		**0%**	**0**
	Total Responses	**32**	
Mean: **4.3438** Standard Deviation: **0.7007**			
Draw accurate, buildable angles as opposed to eyeballing what looks right			
5		**72%**	**23**
4		**28%**	**9**
3		**0%**	**0**
2		**0%**	**0**
1		**0%**	**0**
	Total Responses	**32**	
Mean: **4.7188** Standard Deviation: **0.4568**			
Use appropriate and accurate dimension precision settings			
5		**78%**	**25**
4		**22%**	**7**
3		**0%**	**0**
2		**0%**	**0**
1		**0%**	**0**
	Total Responses	**32**	
Mean: **4.7813** Standard Deviation: **0.42**			
Create accurate offsets (e.g. for wall thicknesses or room sizes)			
5		**75%**	**24**
4		**22%**	**7**
3		**3%**	**1**
2		**0%**	**0**
1		**0%**	**0**
	Total Responses	**32**	
Mean: **4.7188** Standard Deviation: **0.5227**			
Accurately measure area			
5		**75%**	**24**
4		**25%**	**8**

3		**0%**	**0**
2		**0%**	**0**
1		**0%**	**0**
	Total Responses	**32**	
Mean: **4.75** Standard Deviation: **0.4399**			
Setup and draw using rectangular grid			
5		**50%**	**16**
4		**19%**	**6**
3		**22%**	**7**
2		**6%**	**2**
1		**3%**	**1**
	Total Responses	**32**	
Mean: **4.0625** Standard Deviation: **1.1341**			
Setup and draw using isometric grid			
5		**25%**	**8**
4		**28%**	**9**
3		**16%**	**5**
2		**25%**	**8**
1		**6%**	**2**
	Total Responses	**32**	
Mean: **3.4063** Standard Deviation: **1.2916**			
Create accurate custom furniture blocks (typical sizes & specified pieces)			
5		**53%**	**17**
4		**34%**	**11**
3		**9%**	**3**
2		**0%**	**0**
1		**3%**	**1**
	Total Responses	**32**	
Mean: **4.3438** Standard Deviation: **0.9019**			

22. Advanced CAD Skills		**Response Percent**	**Response Total**
Create blocks with attributes			
5		**28%**	**9**
4		**47%**	**15**
3		**16%**	**5**

2		**9%**	**3**
1		**0%**	**0**
	Total Responses	**32**	
Mean: **3.9375** Standard Deviation: **0.9136**			
Work with parametric objects			
5		**22%**	**7**
4		**38%**	**12**
3		**25%**	**8**
2		**6%**	**2**
1		**9%**	**3**
	Total Responses	**32**	
Mean: **3.5625** Standard Deviation: **1.1897**			
Extract data from block attributes			
5		**22%**	**7**
4		**38%**	**12**
3		**31%**	**10**
2		**3%**	**1**
1		**6%**	**2**
	Total Responses	**32**	
Mean: **3.6563** Standard Deviation: **1.0659**			
Work with dynamic blocks			
5		**22%**	**7**
4		**38%**	**12**
3		**34%**	**11**
2		**3%**	**1**
1		**3%**	**1**
	Total Responses	**32**	
Mean: **3.7188** Standard Deviation: **0.9583**			
Work with regions			
5		**12%**	**4**
4		**31%**	**10**
3		**41%**	**13**
2		**6%**	**2**
1		**9%**	**3**
	Total Responses	**32**	

Mean: **3.3125**
Standard Deviation: **1.0906**

Work with annotative objects

5		34%	**11**
4		31%	**10**
3		28%	**9**
2		6%	**2**
1		0%	**0**
	Total Responses	32	

Mean: **3.9375**
Standard Deviation: **0.9483**

23. Please select the state in which you are located, if you have recently moved, please select the state you registered with NCIDQ.		**Response Percent**	**Response Total**
AR		3%	**1**
CO		9%	**3**
FL		22%	**7**
GA		9%	**3**
IA		0%	**0**
MN		9%	**3**
ND		3%	**1**
NY		28%	**9**
OK		12%	**4**
SD		3%	**1**
TX		0%	**0**
VA		0%	**0**
WV		0%	**0**
	Total Responses	32	

24. What general category of design services does your institution primarily provide student instruction in?		**Response Percent**	**Response Total**
Contract/Commercial		29%	**9**
Residential		0%	**0**
Both		71%	**22**
	Total Responses	31	

25. How many people in your department teach courses that use a computer aided drafting (CAD) program?		**Response Percent**	**Response Total**
1-10		90%	**28**
11-20		10%	**3**
21-30		0%	**0**
31 or more		0%	**0**

Total Responses	**31**	

26. If you have any comments, or if you see something I missed or forgot please put them here. Thank you very much for your time.	**Response Total**
View Responses	**9**
Total Responses	**9**