

Getting Their Hands Dirty: Qualitative Study on Hands-on Learning for Architectural Students in Design-build Course

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Abstract

This qualitative study provides an in-depth perspective of hands-on learning through the observation and analysis of architectural students' views in a design-build program at the University of Nebraska-Lincoln during the fall semester of 2008. Qualitative data was gathered from 14 participants involved in the construction of a low energy double-storey house in the city of Lincoln, Nebraska. The study inventoried the requisite characteristics of a design-build course. Participants' views and activities were studied to ascribe the qualitative benefits of hands-on learning. In addition, students' motivation towards hands-on activities were evaluated in reference to student confidence and independence levels towards their future career as architects, designers or other design-build professionals. The findings showed the design-build course could offer a specific knowledge that link between theoretical subjects and the practical expect of building contractions.

Keywords: *hands-on learning, design-build, architectural education, architectural students, qualitative research.*

Introduction

I am a firm believer and an advocate of hands-on learning in both architectural education and the profession. I had been in the profession for almost twelve years before I became an academician. My six years of architecture education at the architecture school had provided limited experience in design-build hands-on learning. Since I started working as an architect since 1988, I have learned more about architecture from observation of and actual participation in building construction than the actual practice itself. With such experience have I been able to understand the connections between design and building technology theories that I learned in the past, with the actual construction of a building.

I grew up in a rural village in Malaysia in the 1960s, with no electricity, no clean water supply, and no modern sanitary system. As a child, I spent much of my time playing in my neighborhood and watching the construction of buildings, bridge and roads. My childhood independent mobility and playing outdoors has made me who I am today. I remember vividly how I played around a single-storey timber framed traditional Malay house that was built by my 70 year old grandfather. The house was designed and built without aid of any plans or architect. I observed how he constructed the house using traditional construction techniques, using his bare hands and a few basic hand tools. Today, I realize that I had been exposed to the “hands-on learning” phenomena at a very early age.

In the built environment, designing and building are integral to the process of building construction. In the architectural profession, design means process of prepare preliminary sketches or plans for the work or idea to be executed (Lawson, 1997). Often, works are built by contractors (builders) who won the bid for the project according to drawing specifications and are supervised by architects. In ‘design-bid-build’ procurement, both builder and designer tend to guard their own area. Leveson (1996) argued that this could be the result of a philosophical difference between thinkers (designers) and doers (builders). The separation of ‘design’ and ‘build’ in architectural practice and education remain strong since the birth of modern architecture. While design education remains strong

with consistent outcome despite the historical evolution of approaches in architecture, building construction education has not been equally emphasized by mainstream architectural schools despite the popularity of design-build project procurement (Carpenter, 1997). Subjects related to construction techniques and technologies are mostly delivered in a didactic manner. As shown in appendix A, only a few architectural schools in the US emphasize or offer design-build course with full hands-on learning that connects the students with the reality of full scale design through innovative, efficient and practical construction education.

A modern-day architectural education delivers too many architectural subjects and topics to students, forcing them to spend too much time studying in each week, hence affecting their healthy and productive lifestyle (Bachman & Bachman, 2006). There was concern of time required to learn the competencies for adequately functioning as an architect (Bunch, 1993). Architectural education has also shifted from a traditional apprenticeship system to a university setting which emphasizes on academic excellence (Stewart, 1989). With the exception of design studio subjects, experiential learning is often ignored in most other subjects. Kroloff (1996) criticized that there is a wide gap between architectural education and professions. Architectural graduates often lack of technical proficiencies that required in the construction industries (Webber, 2000). Design-build education could offer students a deeper meaning behind their design studio and other lecture-base subjects as the much needed connection between the abstract and real world could be nurtured through experiential learning as a team on a construction site (Carpenter, 1997). This connection would build better foundations in design-build services, and in turn, could enhance the architectural profession with more efficient services and better control of project delivery (Vestuti, 1993).

Several scholars have addressed the current and future of architectural education and practice in general. Boyer & Mitgang's (1996) report outlines two of seven goals, a connected curriculum and building community, are directly connected to design-build education. While most academics agree that design studios have already proven to provide sound knowledge and skills in architecture, only a

few provide the connection to the ‘build’ element in architectural education. Building industry players tend to guard their own areas of expertise and make little attempt to learn from each other. The result is a philosophical rift between designers and builders which has fast become an architectural fallacy, as the former tends to view the world through aesthetic abstraction while the latter tends to only focus on practical skills (Sennett, 2008; Kelbaugh, 2004; Boyer et al., 1996; Leveson, 1996). Some scholars highlight the rise of demand in design-build services in the construction industry, yet there is still the lack of leadership in design-build education and stymied response from architectural educators (Sell, 2003; Elvin & Carpenter 2003; Carpenter, 1997).

Hands-on learning provides learning by doing, helping learner acquire knowledge and skills outside of the classroom. Learning can occur through work, play and other life experiences. In architectural education, hands-on learning plays a major role in its pedagogy. In ‘design-build’ courses, learners design their own ideas and construct or build their designs with their own hands, under the supervision of master builders, instructors or architects.

The Need for Qualitative Study

In depth qualitative and quantitative research publications on design-build programs are, unfortunately, still presently lacking at the date of this study. To exemplify, the EBSCOhost library search engine for UNL lists only 63 number of articles under the keyword search “design-build”, of which, when scrutinized, only 3 articles specifically examine actual case studies of implemented design-build courses. The available literature merely points out the significance of design-build programs, but do not examine all relevant issues in depth. Particularly, the question regarding what sort of experiences do students get from participating in design-build programs has not yet been widely researched or published.

Subsequently, this author intends to investigate the experience of hands-on learning in a design-build course, namely, focusing on the learning outcomes of studying building design, technology and construction, in a targeted architectural education case study.

Research Questions

The purpose of this qualitative study is to describe and understand the attribute of hands-on learning by architectural students participating in a design-build course at the College of Architecture. In this study, hands-on learning will be generally defined as hands-on engagement in actual construction of buildings or structures. In design-build courses the learners are required to design and construct their design ideas in 'full scale'. The projects are usually conducted in a team of between 8-15 participants.

The central question of this study is primarily: how do architectural students describe their experiences of hands-on learning in design-build courses? The secondary questions are: how do students view hands-on learning in relation to their formal architectural education, and how do these views relate to the students' background experiences.

Relevant Design-Build Education Theory and Philosophy

There is no specific theory for design-build education, but there are several learning theories that indirectly relate to hands-on learning or learning by doing in architecture. There is a close relationship between independent mobility and the actualization of affordances. According to Kytta (2006), children could learn from their own mobility and playing in outdoor spaces through the actualization of affordances. Vestuti (1993) pointed out that hands-on discovery in design-build programs are valuable learning affordances, because students experience as they come into contact with actual materials, as well as directly resolve problems of structuring, assembling, detailing, coloring and other physical activities related to architectural building. Architectural students involved in design-build programs are free to move about and experience full hands-on actualization of

affordances, as described by Vestuti (1993). This type of hands-on learning experience would have positive psychological influences in architectural student development. Similarly, Broadbent (1995) argued that architects need a profound understanding of physiological, psychological and social human values in the resolution of complex problems. In this light, hands-on learning through design-build curricula could become an effective tool in architectural education, as it would enhance student development.

Carpenter (1997), argued that current architectural theory is out of touch with human needs and that the current theory has no connection with the process of construction. This out of touch reality is due to the lack of hands-on experience in building construction and technology in many architectural studios. Typical architectural studio teaching only reaches ‘schematic design’ stage. In architecture, ‘schematic design’ is only the first in a series of stages of an overall project. Design-build allows the students to continue with the ‘design development’ and construction stages, in other words, all the way to the completion of a project. The learning of structures, materials, and communication skills, could be discovered through hands-on learning in design-build programs (Carpenter, 1997) and hidden learning outcomes of the collaborative process (Erdman & Weddle, 2002).

Method

Why Qualitative?

A qualitative approach is selected because the outcome of architectural learning is very subjective and depends on a learner’s perception of their educational and life experiences. In-depth exploration and understanding of learner experiences in design-build courses would enable this author to explain what are the attributes of hands-on learning and what sort of experiences the students learn in design-build course.

Participants and Site

The study was part of an initial study for the author’s doctoral dissertation. Permission to conduct this research was obtained through the University of Nebraska-Lincoln (UNL) Internal

Review Board (Appendix F). The application was approved based on compliance with the institutions' Federal Wide Assurance 00002258 and the DHHS Regulations for the Protection of Human Subjects (45 CFR 46).

The participants for this study were 14 Caucasian architectural students, registered in Arch 866, a 3 credit elective design-build course. The course main objective was to complete the construction of a single storey timber frame house at 631 N. 24th St in a historic neighborhood in Lincoln, Nebraska. The house design was conceived by architectural students in a previous design studio course at the UNL College of Architecture. The students designed all aspects of the house, including its passive solar techniques, materials and building methods, which are essential for a sustainable architecture design. This included the incorporation of 'hay bales' as insulation into the walls to reduce energy consumption.

In this study, three types of data were collected by the author: interviews, photographs and field notes. As an active participant, the author also officially enrolled in the course. Some photographs and field notes were used to record the course weekly activities and meetings. The author solicited four samples of participants for one-on-one interviews based on their construction and hands-on experiences. Novices and experienced students were identified as the author observed and interacted with them on site. Based on their informal responses, the author was able to lock-on participants with different levels of previous constructing experience. All participants mentioned in this study are pseudonyms to protect the students' true identity and privacy. Two novice Caucasian female participants, Mariah and Lesley, and two more experienced Caucasian male participants, Moses and Rex, were chosen for this study. This sampling complied with typical case sampling criterion (McMillan, 2008), in which the chosen samples should represent the range of the overall population. The four chosen participants represented both ends of the experience spectrum, as well as the general learner population demographic background. As UNL's architectural program is attended by predominantly Caucasian students, there was no representation of minority races in the course.

The primary data were from the participants responses. Semi structured interviews were conducted with participants, lasting between 20 minutes to 35 minutes. The primary questions were designed to investigate how architectural students describe their experiences of hands-on learning and how that experience influences their learning process in the course of their architectural education. The secondary questions were aimed to determine the students' background and existing knowledge of design-build, in other words, what relevant input the students had received prior to their participation in this research study. The questions also aimed to solicit students' personal opinion of their existing knowledge and experience, in building and construction issues, and the relevancy of design-build programs to their education and future careers. The following are questions that represent the interview protocol.

The interview started with demographic type questions such as: Please tell me a little bit about your background, hobbies and your origin. Have you had any previous experience in hands-on learning? Why are you interested in this course? In the second part of the interview, the questions asked were about the participants' hands-on learning experiences in the course: What do you want to learn from this course? Describe what you do in this course. How do you spend your time to this course, compared to your other courses? Describe your experience in the beginning of this course. What have you learned differently from this course in comparison to other courses? Do you believe that you have learned more from this course than from your regular design studio courses? In the final part of the interview, the questions were designed to seek the students' views on how the course has influenced their learning. The questions were: Describe what you have accomplished in this course. Describe your understanding of how a house is built from your participation in this course. Describe any significant impact this course has had on you. Are you interested in attending future design-build courses or being involved in design-build as a professional in your future? Do you think all architectural schools should require their students to enroll in this type of courses? Do you think architectural professionals should expand their services to include design-build? Describe your preference between being a thinker or doer.

As an active participant in this course, the author collected a series of photographs and field notes. These data were used to analyze all the activities during the course. The pictures and field notes taken from the site were used to describe the implementation of the design-build course. To safeguard participants' identity, no close-up or identifiable pictures would be published in this study.

The interview was transcribed verbatim by the author and participants were given a copy of the transcript to review the accuracy of the transcript. First, the transcripts were read for overall understanding of what participants had said. The transcripts were coded manually according to the typed responses from the participants (Appendix -J). Next, the codes were re-arranged according to the qualitative themes that generally described these codes (Appendix H) and compared across each sample for consistencies or contradictions for each themes. As mentioned before, the photographs and observation notes were analyzed to search for meanings that were related to the overall themes.

The photographs were sorted according to specific activities similar to appendix D before they were analyzed. For example, the pictures of the first solo installation project was identified and labeled, matching each installation to its designer, which included the selected participants for this study. Subsequently, photographs were also taken during major activities during class meetings on site. Observation notes made by the author during construction activities were typed and compiled into one legible document. The photographs and observation notes were analyzed in relation to the codes derived from the interview transcripts. The photographs and notes were part of the validation strategy in reporting the findings of this study.

Findings

Design-build Course

In June 2008, the house foundation, including a half basement, was laid and all structural framing was completed. The Mayor of Lincoln had participated in the ground breaking ceremony as this 'green house' would be a show-case for the area. During the ceremony, the Mayor highlighted that this project was part of a community service effort, where corporate firms would donate funding for

building materials, and UNL architectural students would contribute time and effort towards construction.

The first assignment for the course was to transform an eight foot long 2 X 6 timber into a small design object. Each student was required to do this as an introductory exercise, independent of the actual house construction project. The task objects that were designed were to be installed either inside or outside the Architecture Department building at UNL (Appendix B). The remaining course requirement for the fourteen students in the Arch 866 course was to complete the construction of the outer and interior walls, as well as roofing of the assigned house. By the end of semester, the students were to design and build the interior spaces, such as bathrooms, kitchen and bedrooms for the house. The students were supposed to be involved in the design of electrical, plumbing and heating, as well as ventilation and air-conditioning (HVAC) systems, although the actual physical installation of the equipment and wiring systems would be carried out by an appointed contractor.

The class met weekly on Wednesdays from 6 to 8 pm. As daylight grew shorter in the Fall and Winter days, the instructor decided to meet earlier on Tuesdays, Thursdays and weekends. The students could choose any of the specified days to come and they had access to all construction tools, safety goggles and gloves for completing the task on site. In addition to the class instructors, the construction was assisted by expert builders. One of them was a contractor for another house that was concurrently being built adjacent to the site. Interestingly, the adjacent house was also a student based project, built with the help of volunteer high school students who were not in any formal architecture or construction program. The contractor would walk across from the adjacent site and offer assistance if any problems needed resolving or if any building materials needed to be replenished.

From my observation and the analysis of the available data, the hands-on experience from the design-build course in this case study has influenced the participants' learning in several ways. Firstly, the participants who have strong background in working with their hands prefer to learn by doing. Therefore, those who had previously built with their hands realized that full scale construction broadens their learning in architecture. On the other hand, the participants who did not have such

experience would continue to follow mainstream architectural education expectations to become thinkers (designers) rather than doers. As mentioned earlier in this study, the lack of practical construction courses in contemporary mainstream architectural education suggests that the architectural paternity promotes more thinkers than doers.

Secondly, all participants, regardless of their background, realized the connection between designing and building. They all wanted to learn the process of construction on site. By engaging themselves with the making of a house, the learners were able to create useful meanings that are relevant to their formal architectural education. According to cognitive theories, learners' perception of certain subject matter would be more effective when varieties of sensory receptors are activated (Sylwester, 1992). In hands-on engagement, learners begin to realize and make connections between the abstract nature of design and full scale environments. The learners had personally witnessed and been involved in the process of building construction, and thus, had reinforced their prior knowledge of architectural building technology and techniques.

Thirdly, in contrast to the author's prediction, not all hands-on lovers strongly advocate hands-on experience to others. This suggests that the passion for manual labor alone does not necessarily result in hands-on believers. Perhaps, the social status accorded to philosophical thinkers in architecture has influenced these participants' views in advocating the cause for hands-on learning.

Fourthly, as predicted, the participants voiced the importance of team work and communication within the group. Some began to enjoy the social hands-on learning experience more than that of their other classes. As an active participant, I also enjoyed the experience, and I even learned a few new construction techniques during this course, although I have had extensive past experience in the architectural profession.

Below are the findings from participants' responses, narrated in qualitative terms. The themes derived from this study are coined in the realms of learning, knowledge and general quality of learning. The first theme is realization and how the experience relates to learning. The second theme is participants' advocacy of hands-on learning. The third theme describes participants' feelings towards

the quality of their learning and participation in the design-build course. The fourth theme is the social aspect of learning. The final theme describes the unexpected issues voiced by the participants and observed by the author during the class meetings on the site.

Realization

As noted in the beginning of this report, I am a firm believer in hands-on learning in architecture. I realize how my hands-on experiences in construction have influenced my learning. Similarly, Moses-participant no. 2 said he realized that,

“... (I) learn a lot about construction and working out different things that come up in the field where you kind of missed out in the drawing”.

Rex-participant no 3 recalled that during his undergraduate program, he had only experienced architecture through 2-dimensional abstractions. In the design-build course, he realized that working with real scale has enabled him to see and understand buildings in greater detail.

“...so it actually help(ed) a lot seeing the details in real life as oppose(d) to see(ing) them on papers and understand(ing) it that way..”.

Lesley, the other female participant in this study wished to get involved from the very beginning of the construction, i.e. when the ground was dug and the basement wall was formed. She put it, “...I mean, there (were) pieces that I missed. I am witnessing something being built rather than reading or discussing about it”. On the other hand, Mariah, being a first timer of construction doer put it differently, “I just want to understand them (construction) for one”. She declared that she would rather just design and let others build it for her. She realized how difficult it was to put a house together. She did not see herself as the one who was constructing the building. As she put it, “I would need (the) studio way of learning, not (the) building way of learning”.

All the selected participants in this study realized how difficult and complex the construction process can be. This is especially true for those who were novices in construction knowledge. Mariah admitted that construction is a difficult process, but she knows that she needs to see it firsthand to

learn how it is done. “It takes a lot to build a house ...” she said. On the other hand, the experienced builders viewed the experience as a challenge. As Rex-car hobbyist put it,

“...there are always these problems, it’s (the) same when building a hot rod-when you don’t have all parts, and you have to think, OK, to do this you have to make these tools and so you have to think ahead, plan your steps, and hopefully it works out”.

The other similar learning realization that all participants described was a strong connection between builders and designers. Cultural differences between designers and builders should be reduced. A communication tool between the two trades emerged from the hands-on learning phenomenon in this design-build course. Moses related his previous internship experience with a design-build firm, “...we have a lot of communication with contractors, and so I think it is important to be at opposite ends of the drawing”. Early on, he realized that there was lots of lost communication between drawings and the actual building process. Designers could improve their communication skills by working hand-in-hand with builders in building construction. It is not surprising that novice participant-Mariah, who was not comfortable with power tools or physical activities in the course, echoed similar sentiments on the need for connection between designers and builders. As she put it, “...I connect what I draw by observing”.

The complexities of construction lead to the realization of importance for team work. A minimum of two people was required to do any task in building construction. The two had to constantly communicate verbally or non-verbally with each other in every step of doing the work on site. The communication entailed agreement, suggestion, reinforcement or disagreement. For example, in non-verbal communication, one member would watch and observe how the other member used power tools to minimize any unforeseen risks.

Some participants also realized that the time they spent on the site was equivalent to the time spent in other non-architecture classes. This was contrary to this author’s prediction, in which the author believed that learning construction on site would require more time than classroom learning. Instead, the four participants in this study stated that they spent more time in their design studio

(classroom) course than in their design-build course. Moses stated, "...it is equal as other course..." The nature of design studio course requires a learner to sit down alone and create an abstraction of a building, with occasional critiques from the instructors. Rex-car hobbyist sum it, "if compare to the studio, it may be one tenth of time you put in the studio" This, according to the participants, necessitates longer time. In contrast, Lesley-female novice participant said that it took more time compare to other 3-credit hour course but, "there is no actually class time, so probably it even out".

The students realized that mistakes made during building construction are just part of the learning experience. For example, the participants discovered that the task of installing hay bales insulation was quite difficult. Hay bale wall construction requires proper techniques and supervision by expert builders. After consulting with a few expert builders, the team decided to abandon the hay bale walls as it would have cost too much to put a 'stucco' on it later on. Moses thought that the lack of drawings could have been the reason for bad decisions being made. He said,

"...we don't actually have drawing to guide us, (it was) like we (were) almost winging it. In some sense it is not always a bad thing, it does restrict you to (follow the) drawing exactly..."

I found it ironic that this house was designed by architectural students, and yet, no specific drawings were produced for construction. In my previous experience, I had always vehemently argued with builders to build my design idea to my exact drawing specifications. My attitude has changed since being involved in this construction. As Moses put it "...it is important to be on opposite ends of the drawing". Working drawings do help designers and builders communicate with each other, but bad working drawings with bad details frustrate even experienced builders. In this course, the absence of drawings was better than bad drawings. Participants now realize that drawings are just communication tools, but what is more important is the ability for designers to communicate with builders using builder language and nuances.

Advocacy

Most participants in this study expressed their advocacy towards hands-on learning. Most of them agree that hands-on learning is a positive experience in architectural education. Whether in design studio or design-build courses, hands-on learning is part and parcel of learning the complexity of architectural subjects.

Interestingly, with the exception of Rex, all other participants in this study advocated that design-build courses should be available as an elective course where it is up to the individual to decide whether design-build courses should be part of their architecture program. In contrast, Rex-classic cars builder, advocated that design-build courses should be made mandatory in all architecture schools. He was more concerned that the architectural profession seems to be losing control over the construction industry. As he put it, “I would rather design and build (than be) in the profession that we are losing control (of)”. Interestingly, Moses, who also had design-build experience, advocated that “I don’t think it should be mandatory...I think architect(s) should want to take this course because I think they would learn more and they will be better architect(s)”. On the other extreme, Mariah-novice participant advocated that architects should just design and builders should do the construction. She said, “...so why not let them take control (of) the area that they are (more) experienced (in) than I am”.

Advocacies are based on one’s confidence and independence on a particular subject. The other female participant, who was more confident in hands-on activities, suggested that architectural schools should teach subjects such as building structures and HVAC systems based on design-build applications instead of using conventional teaching methods. Lesley, who designed and hung a ‘brilliant’ tree installation (appendix D), said, “...it is something for schools to consider teaching; it (would provide) more useful (information) than the normal classroom”.

In my own architectural education, building structures courses and building technology courses were taught in classroom settings. Unfortunately, the knowledge that I learned in those courses have now either become obsolete or are no longer applicable in my contemporary practice as a design architect. When I started visiting construction sites as a young practitioner, I was often ridiculed by plumbers or riggers, as I had wanted to learn from them how to install water supply pipes or how to

service small household cooling systems. I persistently watched them and tried to do it myself at home. Hands-on learning has given me confidence in problem solving.

Excitement

I have always had fun in constructing and building with my own hands. This, I discovered since I was four. From toys to household hardware, I would confidently figure a way to build or fix. For me, the do-it-yourself (DIY) culture is integral to hands-on learning. Generally, participants who prefer hands-on learning in architecture are those who find enjoyment in doing things with their hands. Rex-car hobbyist described how he enjoyed doing construction, “It is fun...it is a way to get out of (the) classroom”. Creating and constructing objects is just plain fun for those who cherish physical activity.

In this study, Rex, a seasoned builder whose hobby is fixing cars, enjoys manual labor. Similarly, there was one other participant in this course who had similar interests. Moses, who drove his re-conditioned 1956 Chevrolet Belair to the site, was also a DIY lover. Moses too was excited to participate in the design-build course. His response was, “I was really excited for it...I knew the professor has done this in the past...”. Lesley, who had had one hands-on learning experience, also responded in similar fashion, “..I (was) definitely excited about doing the design and building it...” However, it was Rex, car mechanic hobbyist, who summed it the best, “...I actually love manual labor, which is really sick! But I like it”.

Even more “sickening”, I have decided to continue working on the house after the semester has ended, until its completion. Based on my own reflection and participation in the class, working on the house had been just a simple enjoyment. However, I must admit, working outdoors in late November was quite harsh at times for a tropic native like me. But I know that there are added values to learning house construction. Officially, this study did not require me to actively participate in the physical design-build course. I could have chosen to work in isolation on a computer by regularly updating a communication webpage with the participants in this project. But I am glad that I had

decided to actively participate in the course because I have learned beyond the objectives of design-build itself. I have now learned how to conduct design-build courses, how students learn, what to avoid when conducting such courses, and why these courses could be useful in teaching architectural students.

Social learning

The participants of this course have voiced the importance of teamwork in building construction. Everyone in the team was willing to do the assigned tasks regardless of its complexities. The direction of the work was always provided by the instructor and each participant was encouraged to work on specific areas that interested them, besides helping out on other tasks, such as collecting trash and construction residue on site. The participants were always given the chance to voice their suggestions before executing certain tasks. Unlike in design courses, where individuals would claim ownership over the output produced, in construction, no one would claim their individual stakes. In summary, in a design-build course, everyone is treated equal despite their role in the team. Mariah sums it as, "...we go to the house and do random jobs..." Even the instructor sometimes got his hands dirty in order to lead the way and show the learners how to construct correctly.

Community Service

One unexpected finding was that the participants did not highlight how they had contributed their time and effort for this project for the community. In design-build projects, community services are always part of benefit for doing a design-build course. As mentioned earlier on, design-build course at the universities are usually linked with community design services where student and faculty collaborate with the surrounding community to build structure or building. In this project, the majority of the materials used for this house were donated by private businesses and the students donated their

time to work on the project. Upon completion, the house would be sold to a low income family. Most participants knew about this, but they seemed to enjoy the construction of the house rather than seeking for praises.

Discussion

This study has illustrated a glimpse of how hands-on experience in a design-build course can influence architectural students' learning. All participants in this study, regardless of their previous experience and gender, indicated a positive response towards their hands-on experience in the design-build course. Three out of four selected participants would consider design-build in their future professions. Although one participant-Mariah (novice handyman) would not consider design-build as her future career, she thought that hands-on experience is an extension of learning source for architectural design. Most participants believe that hands-on experience is relevant to architectural education and does influence their learning.

The scope of this study is limited to the author's institution, and although this was the first time the institution had offered a design-build course, the findings of this study are consistent with issues discussed by contemporary architect-scholars, as well as with this author's advocacy for hands-on learning. A more in-depth perspective of hands-on learning in different environments and contexts could be achieved by expanding this study to other institutions in the country that also offer design-build courses in their program.

At this juncture, the house in this case study has yet to be fully completed as planned. It is easy to underestimate the time that it would take to complete the construction. Unforeseen events such as conflict of events, technical problems, problems with materials and lack of manpower could arise unexpectedly. In this study, the installation of the hay bale straw walls on the north side was one of the major stumbling blocks. The participants were not familiar with this alternate construction method. Even expert builders were divided in giving their expertise advice on this issue. In the end, cost became the major deciding factor in determining the fate of the wall. Neither the participants nor the

expert builders in this project were confident or bold enough to complete the hay bale wall as originally planned. Thus, the design for the hay bale insulated walls was scrapped.

Incidentally, there is one institution in Vermont which does advocate building using unconventional materials such as hay bales. This institution, although unaccredited by the American Institute of Architects (AIA), offers design-build courses that are,

“...designed to demystify the designing and building processes using hands-on, experiential learning to teach students the art and wisdom of good design and the skill savvy of enduring craftsmanship as a single process”.pp 2 ([Yestermorrow, 2009](#))

Yestermorrow Design-build School (appropriately named) programs a specific session on how to build a wall with hay bales as insulation. This is just one example of how yesterday’s technology can become tomorrow’s application. Hay bale insulation, which was used in the past, is known to have excellent thermal properties, thus reducing the use of energy for heating and cooling.

Most architecture schools predominantly train their students to become designers not builders. But a good designer is able to make the connection between ideas and real objects. The architectural fraternity should not underestimate the importance of builders. Instead, they should advocate young designers to learn how things are built, as well as designed. The construction of the hay bale walls as discussed above is a perfect example of the disconnection between design ideals and realism. The whole wall could have been resolved if someone had been confident enough to take the lead, redesign the faulty design details, and proceed to build the wall as planned. This person would have had to be an expert in both skills: design as well as building.

Emphasis on design-build programs vary from one school to another. Kroloff (1996) criticized that there is a wide gap between architectural education and the profession. Graduates often lack technical proficiencies required in the construction industry. Kroloff warned that if the fundamentals of architectural education, which are design and construction, continue to be delivered in an abstract manner, rather than with a hands-on approach, architecture students would be ill-equipped with the knowledge and skills required for the design-build industry, and would be incompetent to assume leadership roles.

According to Sell (2003), contractors have taken the leadership role in design-build projects as many architects still refuse to accept design-build as a legitimate method of project delivery. "...this refusal to change to recognize the need to change even after the industry has changed around us leaves architects in a very vulnerable position" pp3. Clearly, architects would have already lost jobs to other professionals if they remain unequipped or unwilling to actively involve or venture into the design-build profession.

If the end products of architectural schools are nothing but architectural designers, then it is not hard to agree with the argument that the architectural profession is a sunset profession. David (1996) suggests that the profession has to decide if "architecture is to be the practicing of technical knowledge or only artistic insight with regard to the building process."

Although building laws stipulate that architects are the leaders in the construction industry, other team members such as planners, engineers, surveyors, landscape and interior architects are gaining ground in claiming their stakes in the construction industry. While it is quite impossible to expect architects to master all areas of specialization in the construction industry, it is possible to improve the understanding of building construction by becoming actively involved. Maybe be it is unfair to expect architects to take over the role of builders completely. However, full size mock-ups of key building details could ensure smooth communication between architects and builders.

This strategy is not new to the architect of yesteryear. Frank Lloyd had designed more than 1,000 projects, of which more than 500 of them were built. Working alongside his contractors, Frank Lloyd Wright involved himself in constructing and supervising full size mockups of certain parts of his building designs before implementing those details in his overall projects. His legacy was well-documented in architectural history.

Hands-on building culture has not been fully explored in mainstream contemporary architectural education. According to Bunch (1993), the typical core curriculum of architectural education consists of 25-30 percent for design courses and the balance are for technical systems, history, professional practice and elective subjects. Currently only design courses are taught using on

hands-on learning in studios, while all other subjects are taught in conventional classrooms via lectures and seminars. There are no specific subjects in mainstream architecture schools that are devoted to the understanding of design-build construction.

Kelbaugh (2002) argued that there are seven fallacies in present architecture practice. According to Kelbaugh, a 'solo artist' is an architect who uses buildings as a vehicle for personal exploration and expression. Kelbaugh argued that architecture should be more "social and public" than a fine art. Unfortunately, the 'solo artist' egoistic nature is nurtured in design studio courses, as students are compelled to produce individualized original, creative and spectacular design solutions, as pointed out by Kelbaugh (2002). On the other hand, in construction, no one person in a team would dare to claim the completed project as a personal achievement. This ironic duality continues to feed the "solo artist" fallacy. Subsequently, Kelbaugh (2002) highlighted that this fallacy produces academics and professionals who serve mainly rich clients or governing institutions only. Kelbaugh argued that academics and professionals need to do more social housing projects or utilitarian structures that benefit the masses. Few architectural schools have achieved this with their design-build programs.

If one asks architectural students how they spend their time, the students would say that their time is mainly spent in the studio. Similarly, the participants in this study said that they spent more time in their studio courses than in their design-build course. This shows that the emphasis on studio learning remains strong in present day education. Some critiques believe that contemporary studio learning is flawed. According to Nicol & Pilling (2000), studios lack structure for the development of self-responsibility in learning. Studios are designed to lead students from dependent to independent learning during undergraduate years. Not all tutors take on the responsibility to teach learning skills such as communication, group work and management of learning. Therefore, there are cases where students go through years of studio classes without learning these rudimentary skills.

Nicol et al (2000), argued that there are four challenges in architectural education; (1) students should develop more effective communication and interpersonal skills, (2) students should acquire a

team working culture to prepare themselves for the cross disciplinary working relationships which characterize professional life, (3) students need to be prepared for a changing society, where knowledge grows at a rapid rate, and the needs of society and the construction industry continuously evolve, (4) architecture schools should realign the learning process to promote the sense of community, develop sensitivity towards others, and nurture independence thought (Nicol et al., 2000).

Based on the above challenges, Nicol et al., (2000) listed five principles of learning in architecture.

- Learning is active rather than passive
- Reflection on learning develops wisdom or artistry in practice
- Collaborative learning enhances individual learning
- Authentic learning tasks develop professional competencies
- Self and peer assessments develop skills for lifelong learning.

Some of the principles mentioned are parallel to design-build principles. (appendix G) The table in Appendix G illustrates the comparison between design-build principles and Nicol & Pilling's principles of learning in architecture. Based on this parallel, it is clear that although the tradition of design studio should remain strong in architectural education, design-build programs could add the missing link between abstract design and real world design. These missing links, if incorporated into design-build programs, could serve as incidental instruction, or "Hidden Curricula" (Snyder, 1970), which in turn, could promote collaborative learning, develop peer assessment skills for lifelong learning, and nurture wisdom or artistry in practice.

Significance of the Study

I always believe that it is important to determine how hands-on learning would effect the way architectural students perform, think and learn. In this study, students' voice, motivation and stimulation towards design-build hands-on 'doing' activities have been evaluated in reference to their learning towards their future career as an architects, designers or design-build professionals.

In the US, design-build project delivery has grown from 5 percent of the market in 1985, to 40 percent of the market in 2002 (Elvin & Carpenter, 2003). A study by Penn State University showed that design-build projects could be produced in less time, better quality and less cost than other forms of project delivery (Sell, 2003). The importance of design-build education is clear as Weber (2006) concluded in his dissertation; the architectural profession will be left out if they fail to equip themselves with design-build education.

This author intends to expand this study to a national level, where more data would be collected from various architectural schools. With a wider source of data, the findings of the future expanded study would be more comprehensive, enriched with multiple students' perspectives. The validity of the proposed future study would be improved further with a broader sampling from different institutions. The findings could also be validated by scholars or peers who are actively involved in well established design-build courses and have similar beliefs and passion in hands-on learning, especially in design-build courses. Hopefully, this study will contribute to the existing pool of literature on alternate approaches to architectural education.

Conclusion

As a conclusion, the study has provided a comprehensive students' view on design-build course. The four students have given multiple view of design-build, there were similar themes and findings that are consistent with the author expectation of hands-on learning in architecture education. Although there is nothing new about design-build, this study shows that there are a lot of positive attribute of hands-on learning. For one, design-build education adds one more expertise area that the students could venture in the future. Most importantly, design-build course provided a connection between the theory and practical aspect of design and construction, hence suggests that it could help to provide holistic education in architecture.

Finally, there were a few findings that were not expected, or that contradicted the author's personal biases and beliefs. These findings, such as views on community services and time spent on

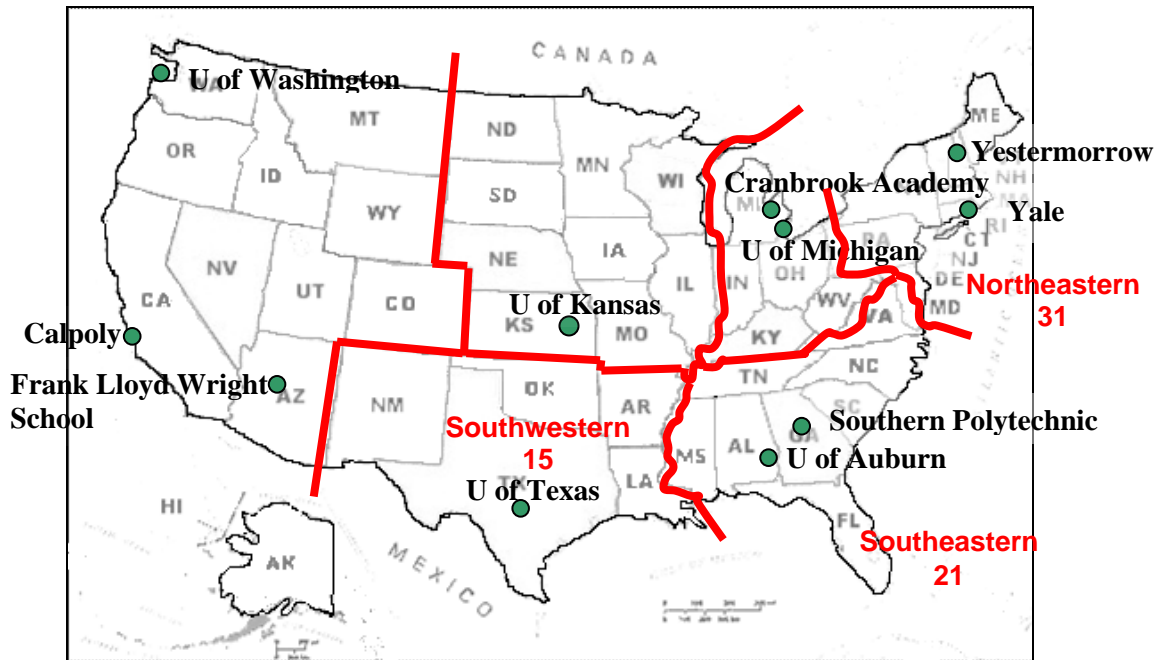
site, were not consistent with the author's observation. This discrepancy could have been due to how the course was run and its mismatched objectives. Incidentally, this course was the first attempt by the architectural department to offer a design-build course which combined community service and construction education. Perhaps, if this study were to be expanded to or repeated at other schools, these unexpected theme findings could be validated further.

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Appendix A: Number of accredited architectural schools with design-build program in the US. (Source: 2006 NAAB's list of Accredited Architectural Schools in the US.)



US Regions	Arch. Schools	No of Schools with Design-build program (no. of students)	No. of Arch Students
East Central	11	1 (429)	2154
Northeastern	31	1 (754)	7512
Southeastern	21	2 (800)	5117
Southwestern	15	1 (400)	4051
West Central	15	1 (564)	3960
Western	21	3 (1,204)	6785
total	114	9 (4,151)	29,578

Appendix B: Installation Project



2x6 timber2.JPG



2x6timber.JPG



authors design1.JPG



IMG_0628.JPG



participant 4 deisgn
4.JPG



participant A.JPG



participant B2.JPG



participant B3.JPG



participant B4.JPG



participant B.JPG



participant C2.JPG



participant C3.JPG



participant C.JPG



participant D.JPG



participant E.JPG



participant F.JPG



participant G2.JPG



participant G3.JPG



participant G4.JPG



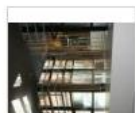
participant G5.JPG



participant G6.JPG



participant G.JPG



Participant H2.JPG



participant H3.JPG



participant H5.JPG



participant H.JPG



participant J1.JPG



participant J.JPG



Participant K2.JPG



Participant K.JPG



Participant L1.JPG



Participant L3.JPG



Participant L4.JPG



Participant L5.JPG



Participant M.JPG

Appendix C: Sample of transcription interview

courses and stuff. But I say it 8-10 hours per week. [00:04:32-2](#)

Q. Is this course require more time than other course? [00:04:39-0](#)

A. I say it equal, it kind of have its ups and lows like other course. It kind of ramps up for something need to get done right the way and spends sometimes doing it and it may dies off while we waiting for material or something, supplies, tools or something. [00:04:53-8](#)

Q. Are you apprehensive about this course in the beginning? [00:04:59-2](#)

A. I was really excited for it. I knew the professor has done this in the past and has done really. I am pretty exited about doing it. [00:05:13-5](#)

Q. How about learning experience? [00:05:22-1](#)

A. It is good, I learn a lot about construction and working out different thing that come up in the field where you kind of missed out in the drawings. And there always problem you have to work through, so working out little details such as straw bale or working out detail for the front facade or window detail. So, learning that kind of stuff and how to work through it on the site in a different manner not necessarily use of computer or the software to figure it out, you kind of have to figure it out yourself on the site, so learning that process of figure things out is pretty interesting, I think that is what I learned most so far. [00:06:01-7](#)

Q. Describe significant things you have learned. [00:06:06-0](#)

A. I think personally it probably come to the detailing and how it actually work and how it actually fit together and what the best solution for the problem. Secondly, definitely materials making sure that you use the right materials in a sustainable way and also in efficient way so you not wasting it. I think we have problem with that at the site, because we are learning so much about wasting some materials may be inefficiently. But may be using the right material for the right part of the house is important. [00:06:48-0](#)

Q. what you have learn differently than other course? [00:06:55-2](#)

A. Yeah, I think it is different process, a lot of courses in my undergrad was lecturer based and you learn in classroom in one spot and its done by individually, by screen, or someone telling you, and this course compare to other courses more abstract in physical form, instead of showing a detail, you actually see the detail and touch the detail and you change the detail and work with the detail instead of someone show it to you on the slide. I need to absorb it that way. So learning in that physical touch kind of whirl around that you don't see a lot in other classes. [00:07:52-8](#)

Q. Is there any issue that you wish to learn more? [00:07:55-3](#)

A. Let see...I think I like learn more about... We started with framing (house) and everything already done, so missing out on some of that like foundation. I done foundation plan an all of that but I never work with concrete that much. May be we will get into that when do the porch, I am not sure...so that stuff already done like framing, foundation, those things I missed out that I would be interested to learn more. [00:08:34-3](#)

Q. Tell me about your self

A. Born and raise in Nebraska went to undergrad at UNO. Start my first year at UNO, It is my fifth year at grad school. Hobbies are pretty active physically, rock climbing, soccer, and out door stuff also drawing, visting, travelling, family friend and active stuff.

Q. you like architectural school? [00:01:11-1](#)

A. I do...yeah I don't think I go back if I didn't. I been interested in this all my life. I was kind of interested in orthopedic previously, but architecture is pretty solid in my life. [00:01:28-5](#)

Q. Have you participate in this type of course before? [00:01:30-5](#)

A. Yes, I think a lot of architectural courses can design-build like model, mock-up deal so deal with a lot of design-build but this first full scale design-build. [00:01:52-9](#)

Q. Why are you interested in this course? [00:01:55-7](#)

A. Because, I think you learn more actually building it. There is a lot communication lost between drawing and the actual building process, so it kind of bridging the process between the two. I think is what interest me. I also worked with a firm in Omaha that does kind of work design-build, so I kind of experience in outside the educational process. We worked hand-in-hand with the contractors so we go out there and help for a day or if he needs help, or help him build doors downstairs or workshop. So we have a lot of that communication with contractors, so I think it is important to be on at opposite end of the drawings. [00:02:46-0](#)

Q. What are things you expect to learn from this course? [00:02:50-3](#)

A. I think I want to learn, actually I can tell someone how to build but I don't know how to build it myself necessarily, the techniques of how to builds it, the order which things are built, you know the window go first, then the flooring, you know the order of events. Second, I can draw and tell someone how to build it but I cant, I never actually building it myself. So actually learn that process of building i think is what hoping to learn and have learned already. I have learned a lot. [00:03:26-7](#)



Q. Describe what do you do in this course? [00:03:32-5](#)


A. Basically we kind of take architectural drawing or thoughts, and realize it in physical form so we do a lot building construction; I have install windows, putting Tyvek, install OSB wall board, and clean-up and do a little surface grading. So a lot of different task an pretty wide spectrum of task sometimes. [00:04:16-3](#)

Q. Does it take a lot of your time? [00:04:16-3](#)





A. Yeah...I think it probably between 8-10 hours per week, I say. Sometimes more when we are a little busier I did more but it depends on my other





Appendix D: Sample Photographs Analysis-Individual Design/Build Project





Participant 1-Installation Project	Coding	Theme
 <p>The installation was built with simple string connection and laid on the floor.</p>	<ul style="list-style-type: none"> • Simple indoor installation idea. The idea of using planks as seats. Planks were scribed to give some texture and tied together with fabric string. • Sign of a novice builder. • Limited skill in using tools. • Contented with the accomplishment so far. 	<p>Limited idea.</p> <p>Satisfaction</p>
	<ul style="list-style-type: none"> • Solution is full of surprises. Design and constructed idea showed experienced craftsmanship. The use of wood and steel was nicely done • The build idea was playful and meaning full. • Expression of enjoyment and playfulness • The installation was put outdoor. • Reflex the participant's interest in outdoor environment. 	<p>Confident and unafraid to explore ideas with complex construction. Sign of seasoned builder.</p> <p>Preference</p>

Participant 4-Installation Project	Coding	Theme
	<ul style="list-style-type: none"> • The design idea was simple yet brilliant. Transforming 2x6 stud into small sticks hanged of existing trees was commendable. The sticks look like the fruits on the trees. The installation looked even better at night with shimmering lights bounces off the sticks. • Simple but sophisticated design idea. • Unobtrusive design, subtle solution. 	<p>Novice as a builder but demonstrated a great design capability. A quality of good architectural design.</p> <p>Confidence of her design ability.</p>

Appendix E: Sample Photographs Analysis-Activities on Site

Activity	Coding	Theme
	<p>Working in group for complex task</p>	<p>Team work</p>
	<p>Working in group for bigger task</p>	<p>Solving big problem together</p>
	<p>Discussion while doing</p>	<p>Team consultation</p>
	<p>Minimum of two person at one task-cutting using miter saw</p>	<p>Peer support</p>

	<p>Minimum of two person at one task-roof installation</p>	<p>Peer support</p>
	<p>Community involvement</p>	<p>Social</p>
	<p>Community involvement</p>	<p>Social</p>
	<p>Public support and exposure</p>	<p>Social</p>

	<p>First meeting on site</p>	<p>Observe the real scale</p>
	<p>Construction in progress</p>	<p>Observe the real scale</p>
	<p>The house in real scale</p>	<p>reality</p>
	<p>The house as designed by students</p>	<p>Abstract</p>

Appendix F: IRB approval



November 6, 2008

Zunaibi Abdullah
Department of Architecture
1950 J Street Lincoln, NE 68510

Miles Bryant
Department of Educational Administration
133 TEAC UNL 68588-0360

IRB Number: 2008119408 EX
Project ID: 9408
Project Title: Getting Their Hands Dirty: Hands-on Learning for Architectural Students in Design-build Course.

Dear Zunaibi:

This letter is to officially notify you of the approval of your project by the Institutional Review Board (IRB) for the Protection of Human Subjects. It is the Board's opinion that you have provided adequate safeguards for the rights and welfare of the participants in this study based on the information provided. Your proposal is in compliance with this institution's Federal Wide Assurance 00002258 and the DHHS Regulations for the Protection of Human Subjects (45 CFR 46) and has been classified as exempt.

Date of EX Review: 11/6/08

You are authorized to implement this study as of the Date of Final Approval: 11/06/2008. This approval is Valid Until: 11/05/2009.

1. The approved informed consent form has been uploaded to NUgrant (Abdullah ICF-Approved.pdf file). Please use this form to distribute to participants. If you need to make changes to the informed consent form, please submit the revised form to the IRB for review and approval prior to using it.

We wish to remind you that the principal investigator is responsible for reporting to this Board any of the following events within 48 hours of the event:

- Any serious event (including on-site and off-site adverse events, injuries, side effects, deaths, or other problems) which in the opinion of the local investigator was unanticipated, involved risk to subjects or others, and was possibly related to the research procedures;
- Any serious accidental or unintentional change to the IRB-approved protocol that involves risk or has the potential to recur;
- Any publication in the literature, safety monitoring report, interim result or other

finding that indicates an unexpected change to the risk/benefit ratio of the research;

- Any breach in confidentiality or compromise in data privacy related to the subject or others; or
- Any complaint of a subject that indicates an unanticipated risk or that cannot be resolved by the research staff.

This project should be conducted in full accordance with all applicable sections of the IRB Guidelines and you should notify the IRB immediately of any proposed changes that may affect the exempt status of your research project. You should report any unanticipated problems involving risks to the participants or others to the Board. For projects which continue beyond one year from the starting date, the IRB will request continuing review and update of the research project. Your study will be due for continuing review as indicated above. The investigator must also advise the Board when this study is finished or discontinued by completing the enclosed Protocol Final Report form and returning it to the Institutional Review Board.

If you have any questions, please contact the IRB office at 472-6965.

Sincerely,
Mario Scalora, Ph.D.
Chair for the IRB



Appendix H: Sample of Coding

Participant 1 Female Novice Hobbies: did not mention	Participant 2 Male Some experience Hobbies: rock climbing, soccer (outdoor activities)	Participant 3 Male Moderate Hobbies: building hot rod car	Participant 4 Female A little experience Hobbies: running and rock climbing (outdoors)	LEAN CODING/THEMES
Not excited about design-build. Novice builder but want to learn. Unsure of gaining experience. <i>"This first time I done design-build course. I was in the class last semester, but we did not get the chance to build anything."</i> <i>"Yeah I like to do it may be not very much. It is not like my god I so excited, but I don't hate it."</i>	Excited to learn. Have some previous experiences. Wanting to learn construction process. <i>"It is my fifth year at grad school. Hobbies are pretty active physically, rock climbing, soccer, and out door stuff also drawing, visiting, travelling, family friend and active stuff."</i> <i>"I think you learn more actually building it. There is a lot communication lost between drawing and the actual building process, so it kind of bridging the process between the two, I think is what interest me, I also worked with a firm in Omaha that does kind of work design-build."</i>	Excited to learn. Experience in hands-on hobby and construction Aspired to learn about construction. Ability to solve problem. <i>I like to seeing a project go through full tradition, like the way I came to learn is like, and how I learn seeing how they go together, and for the past four years before we go to graduate school, really architectural experience we had come through drawings and designing in 2-dimensional, not really working in 3-D field.</i>	Excited to learn Wanting to learn Has one experience in design-build. Positive about gaining experience.	Diversified previous experiences, hobbies,
Arch was second choice (first was paleontologist)	Admission of arch was second choice (first was orthopedic)		Admission of arch was second choice (first was medical profession)	Similarity of career choice
Time spent for design build-based on credit hour 10-12 hrs per week Time spent is equal to other course	8-10 hrs per week Time spent is equal to other course	20 hrs per week Other courses need more time.	5 hours per week Time spent is equal to other course	Time spent

Appendix J: Comparing Codes with all selected samples

Participant 1 Female Novice Hobbies: did not mention	Participant 2 Male Some experience Hobbies: rock climbing, soccer (active activities)	Participant 3 Male Moderate Hobbies: hot rod	Participant 4 Female A little experience Hobbies: running and rock climbing
Willing to learn but not really excited about design-build	Excited to learn	Excited to learn	Excited to learn
Wanting to learn		Excited to enroll	Wanting to learn
Novice	Has some previous experiences	Experience in hands-on hobby and construction	Has one experience in db
Admission of arch was second choice (first was paleontologist)	Admission of arch was second choice (first was orthopedic)		Admission of arch was second choice (first was medical profession)
knowledge about the course	Realization need to learn construction process	Aspired to learn about construction	
Time spent for design build-based on credit hour 10-12 hrs per week	8-10 hrs per week	20 hrs per week	5 hours per week
Time spent is equal to other course	Time spent is equal to other course	Other courses need more time.	Time spent is equal to other course
Unsure of gaining experience		Ability to solve problem	Positive about gaining experience
Describe experience in design-build as positive	Variety of constructing experiences	Team work	
Admit construction is difficult to do	Realized there is differences between drawing and actual constructions		
Learn about process of building	Detailing Efficiencies	Learn about the whole system of construction.	Witness the process of construction
Understanding the process of building			
Connection between design-build and studio	Regular classroom and process There is connection between drawings and buildings.	Both are important	
Preference of learning	Process, team work		Advocate all classes should have hands-on learning.
Realized of learning style	Realized that this course only		Does not effect learning style