ITEM: Towards an Integrated Transformational Experience Model for Design

Education

by

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ABSTRACT

Individuals' experiences, environment, and education greatly impact their entire being. Similarly, a designer is affected by these elements, which impacts how, what and why they design. In order for design education to generate designers who are more socially aware problem solvers, that education must introduce complex social matters and not just design skills. Traditionally designers learned through apprenticing a master. Most design education has moved away from this traditional model and has begun incorporating a well-rounded program of study, yet there are still more improvements to be made. This research proposes a new Integrated Transformational Experience Model, ITEM, for design education which will be rooted in sustainability, cultural integration, social embeddedness, and discipline collaboration. The designer will be introduced to new ideas and experiences from the immersion of current social issues where they will gain experience creating solutions to global problems enabling them to become catalysts of change. This research is based on interviews with industrial design students to gain insights, benefits and drawbacks of the current model of design education. This research will expand on the current model for design education, combining new ideas that will shed light on the future of design disciplines through the education and motivation of designers. The desired outcome of this study is to incorporate hands on learning through social issues in design classrooms, identify ways to educate future problem solvers, and inspire more research on this issue.

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Chapter 1

INTRODUCTION

1.1 Purpose of Study

Individuals' experiences, environment and education greatly impact their entire being. Similarly, a designer is affected by these elements, which impacts how, what and why they design. Through the current industrial design education system today, how are the students being affected? How has design education inspired designers to design? What kind of products does this design education produce? What personal meaning has this education inspired within a designer? Does design education only teach students to design flashy new objects or does it embed a passion to create design that matters?

The world is faced with many challenging problems including environmental degradation, cultural barriers, and social issues. These issues are known to be "wicked problems" which are difficult to understand let alone solve (Rittel, 1972). However, it has been brought to light that designers have an intrinsic nature to develop patterns in order to solve such problems (Cross, 1982; Levin, 1966; Douglas & Isherwood, 1979). In order for design education to generate designers who are more socially aware problem solvers, design education must introduce complex social matters and not just design skills. The purpose of this study is to take an in-depth look at industrial design education in order to improve upon it. Specifically looking at how social and global issues can affect design education, the students and hopefully the world.

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1.2 Significance and Rational

This research proposes a new Integrated Transformational Experience Model, ITEM, for design education which will be rooted in sustainability, cultural integration, social embeddedness, and disciplinary collaboration. The designer will be introduced to new ideas and experiences from the immersion of current social issues where they will gain experience creating solutions to global problems enabling them to become catalysts of change (Findeli, 2001; Amatullo, 2008). Currently educational models like ITEM do not exist. Some design curriculum address these problems, but they do not fully encompass all of the elements proposed by ITEM. There are even fewer case studies showing the research on such curriculum. Of the case studies that do exist, the models are focused on social issues touching on culture but not sustainability or discipline collaboration (Amatullo, 2008).

This study will expand the current model for design education and combine new ideas that will shed light on the future of design disciplines, the motivation of designers, and ways to educate future problem solvers. This study will incorporate hands on learning through social, cultural, sustainable and collaborative issues in the design classroom, as well as inspire more research on these aspects within design education.

1.3 Scope and Limitations

This research is a qualitative study that took place at ASU, Arizona State University. Two separate case studies were conducted. The first was the Global Resolve course during the spring semester of 2010. Global Resolve is "a social entrepreneurship program designed to enhance the educational experience for

interested and qualified ASU students by involving them in semester-long

projects that directly improve the lives of underprivileged people, and/or those in

under-developed nations throughout the world" ("Global Resolve", 2011). All four

undergraduate design students in the course participated in the study. This

included three industrial designers and one architect, two were juniors and two

were seniors. The second case study was the Innovation Space course during

the fall of 2010 and spring of 2011. The goal of Innovation Space's

transdisciplinary education studio is "to teach students how to develop products

that create market value while serving real societal needs and minimizing

impacts on the environment" ("About Innovation Space", 2011). This included

nine senior industrial designers, seven men and two women. The methods used

for research were observation and semi structured interviews (for further details

of the methodology see section 3). This approach gained insights, benefits and

drawbacks of the current model of design education and of an education that

contained elements of ITEM. Although these case studies give an excellent

overview of industrial design education at ASU, it may not be generalizable to

design education at universities across the nation and world until further

research is conducted on other campuses.

1.4 Research Questions

This research looks at design education and how ITEM could affect that

education, the students, and the production of designers as global problem

solvers as seen by the underlying research questions below (for an in-depth

rational of these research questions see section 3.4).

-How will the integration of sustainability, cultural integration, social embeddedness, and disciplinary collaboration affect the future of design education?

- How will an Integrated Transformational Education Model, ITEM, in design education affect the students/ designers?

-Will an Integrated Transformational Education Model, ITEM, in design education produce global problem solvers?

1.5 Conceptual Framework

This conceptual framework illustrates a new Integrated Transformational Experience Model (ITEM) for design education (see figure 1.0). These experiences, rooted in sustainability, cultural integration, social embeddedness, and disciplinary collaboration, will greatly affect design education and, in turn, the individual designer. By looking at these experiences collectively, new innovations and transformations on individual and global levels may be realized.
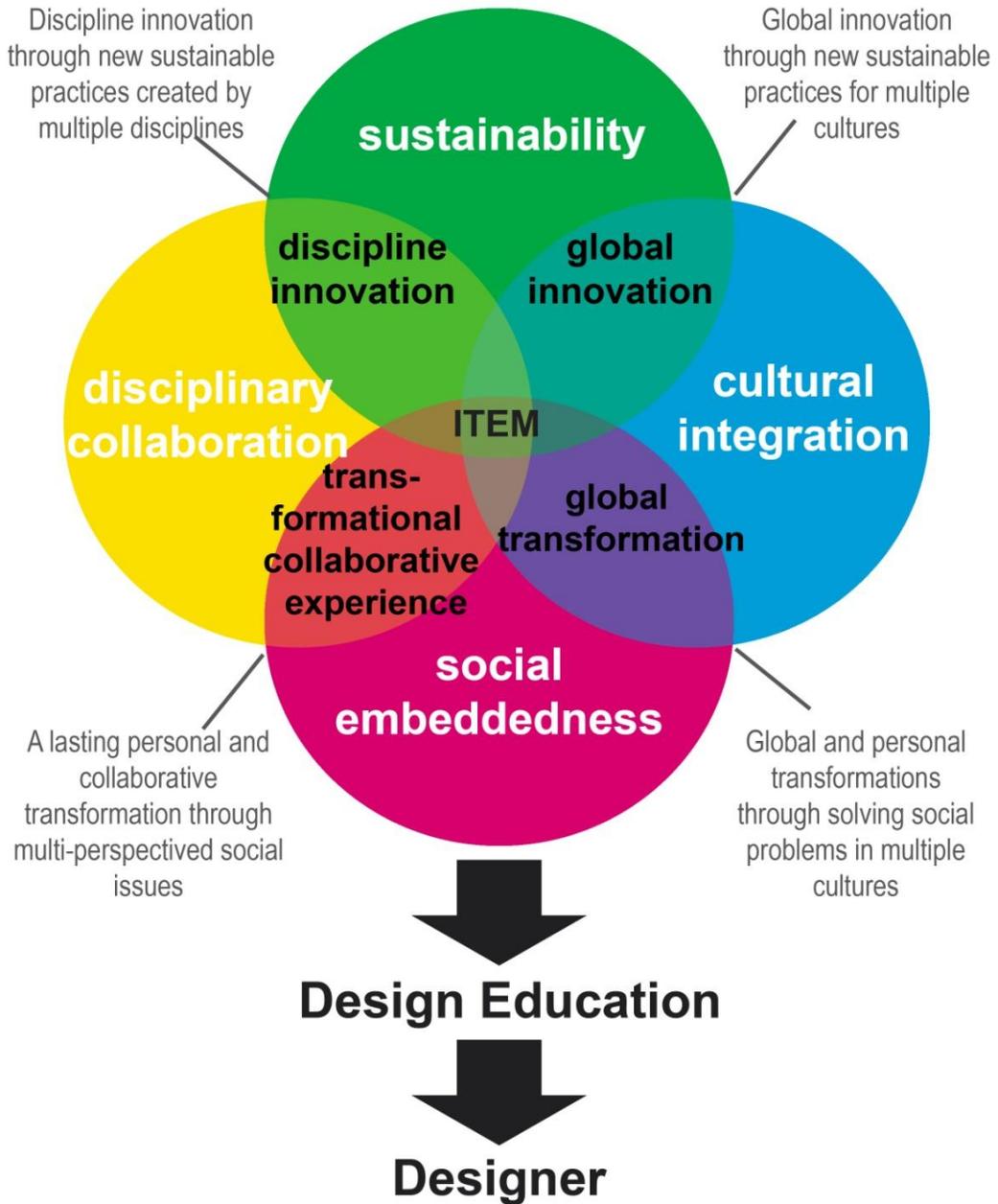
Figure 1.0 Conceptual Framework for ITEM

1.6 Definitions

Collaboration- a process of sharing knowledge and expertise by interacting with others in order to maximize the positive result of an activity and/ or expand the knowledge of the individuals collaborating (Poggenpohl, 2004)

Culture- a group of individuals who share a common set of behaviors and beliefs (O'leary, 2004)

Design Thinking- includes creative characteristics and special qualities to implement new concepts, insights, possibilities, and outcomes (Owen, 2006)

Industrial Design- the practice of creating and developing concepts and specifications that take a product, service, or system and turn it into a "preferred one" for the user

Social Embeddedness- an involvement in and contribution to society, produced through design's responsibility to the user and their needs

Sustainable Development- growth based on maintaining, supporting, and expanding environmental, economical, and social needs through qualitative improvements which is essential to relieve the extreme poverty of developing worlds and to relieve the strain of human growth on the earth and its finite resources (The Brundtland Report, 1987; Daly, 1996; Harris, 2006)

Wicked Problems- ill-defined and ill-structured problems that cannot be fully understood until solved, do not have a definitive formulation, and do not have a singular answer (Rittel, 1972; Cross, 1982)

Chapter 2

LITERATURE REVIEW

2.1 Introduction

This review of the literature will focus on design education starting with a look at the industrial design profession and how industrial designers have been educated in the past then turning to educational practices outside of design education to better grasp how students learn. Next the review of the literature will address the importance of future designers in our society with regards to their creative problem solving skills in the solving of wicked problems. The review of the literature will conclude by individually and collectively examining four areas that strongly shape designers and design education: sustainability, cultural integration, social embeddedness, and disciplinary collaboration.

2.2 Industrial Design

As stated in section 1.6, industrial design is the practice of creating and developing concepts and specifications that take a product, service, or system and turn it into a preferred one for the user. However, to be able to truly understand industrial design we must first define design. This can be a daunting task, even if you are in the profession, as design is usually known through experience and practice. Understanding design becomes even more complicated when the word becomes overused and confused between its verb and noun forms (Heskett, 2001). One of the earlier modernist definitions came from Bruce Archer who refers to design as a third area or third culture known as 'Design with a capital D'. This third area is preceded by the areas of science and art and is "the collected experience of the material culture, and the collected body of

experience, skill and understanding embodied in the arts of planning, inventing, making and doing" which leads to designerly ways of knowing (Cross, 1982) (see section 2.5.1). A few years later, Charles Eames defined design as "a method of action" and that "design depends largely on constraints." When asked what these limits of design were, he simply asked "what are the limits of problems?" From another point of view, Herbert Simon simply describes designing as taking an existing situation and turning it into a preferred one (Giard, 2009). This simple definition highlights the design process to create a better situation for the user by creating a more functional product, yet it also includes the, sometimes overlooked, functional service or system that can be improved by design but is not a tangible good.

2.2.1 Industrial Design Evolution

Although design can be traced back to early philosophers discussing art and science; industrial design, as we know it today, began during the early nineteenth century, around the time of the industrial revolution. Design came about "to absorb the shock of industrialization to make industrialized products culturally- socially, economically, symbolically, and practically- acceptable" (Findeli, 2001). Even its name, industrial design, is a result from "products manufactured by industrial processes" (Tovey, 1997). Some of these processes include manufacturing revolutions brought on by Eli Whitney's interchangeable parts, Henry Ford's assembly line, and Frederick Taylor's scientific management (Boradkar, 2010; Heskett, 1980). However, this mass production of as many products as possible began to lead to a disposable culture that didn't promote quality and longevity of materials and products. This is optimized in Victor

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Papanek's *Design for the Real World* where he states, "there are professions more harmful than industrial design, but only a very few of them." He makes his argument by describing the unsafe designs produced by industrial designers, the heap of disposed products that were yesterday's designed "wonder product," and the finite resources of the earth that industrial designers are burning through. Papanek (1971) urges that "design must become an innovative, highly creative, cross disciplinary tool responsive to the true needs of men." Since design today has become a tool that takes a situation and turns it into a preferred one for the user, a closer look at the role of the designer is necessary. Some believe that only creatively gifted people can become designers, however, everyone is a designer and has abilities to create in order to make a preferred situation for themselves. This is demonstrated by early mankind, the nomadic hunters and cavemen that designed, created, and used small tools in order to more efficiently catch and kill their food (Giard, 2009). Victor Papanek (1971) also states, "all men are designers. All that we do, almost all the time, is design, for design is basic to all human activity." Given this inclination for everyone to design, the way this raw design nature is fostered through training and education could potentially produce new responsible designers of the future.

2.3 Design Education History

The concepts of designing and making are intrinsic to human nature, however, the practices and skills of design need refining. Due to complex wicked problems, the importance of sustainability, collaboration, and greater cultural and social needs; to fully understand design's potential, one must review the past and present foci of design education and its knowledge sets.

2.3.1 Design Education's Focus on Skills

The concept of design as a trade began as a craft taught and passed down from master to apprentice. "Industrial design schools originally were situated, in most cases, within the confines of a fine arts program and strongly encouraged their students to take a hands-on approach in their educations. Curricula were often based on the acquisition of specific skills, such as woodworking, metalworking, and drafting. Given the context of both time and culture, this educational model was an appropriate one" (Giard, 1990).This method allowed the designer to produce items of a similar nature, yet lacked a critical approach and transferability of these skills to different situations and solutions. For this reason, "the traditional focus on apprenticeship and techniques shifted to focus on analysis and technology, and later to an approach emphasizing knowledge and creative thinking" (Naveiro, 2008).

2.3.2 Design Education's Focus on Science and Theory

By focusing on creative analysis joined with skills, designers became creative problem solvers, optimizing the use of their skills. As design progressed into solving problems, the artistic nature of design began to include a scientific aspect. "This is visible in an emerging transition from an arts-and-craft approach to a theory-based design. In this time of transition, the theoretical and intellectual content of design education takes on particularly great importance" (Friedman, 2005). This turn to science was seen in the education at the Bauhaus at the beginning of the twentieth century. As a pamphlet of the Bauhaus states, "instruction at the Bauhaus includes all practical and scientific areas of creative work... students are trained in a craft, as well as in drawing and painting, and

science and theory" (Findeli, 2001). This was an introduction to the educational

model of art, technology, and science. Different scales and relationships of these

three subjects were seen in the philosophy and curriculum of multiple renowned

design schools during the twentieth century (see figure 2.0). From that point on,

numerous schools educating future designer with science and theory emerged.

The importance of this move to science can be seen by Friedman (2005) as he

states, "we can determine some of the skills that designers need, but design

education can no longer be based on exercises intended to teach students how

to reproduce or improve selected objects. Instead, we must equip designers with

the intellectual tools of the knowledge economy: analytical, logical and rhetorical

tools; problem solving tools; the tools of science."
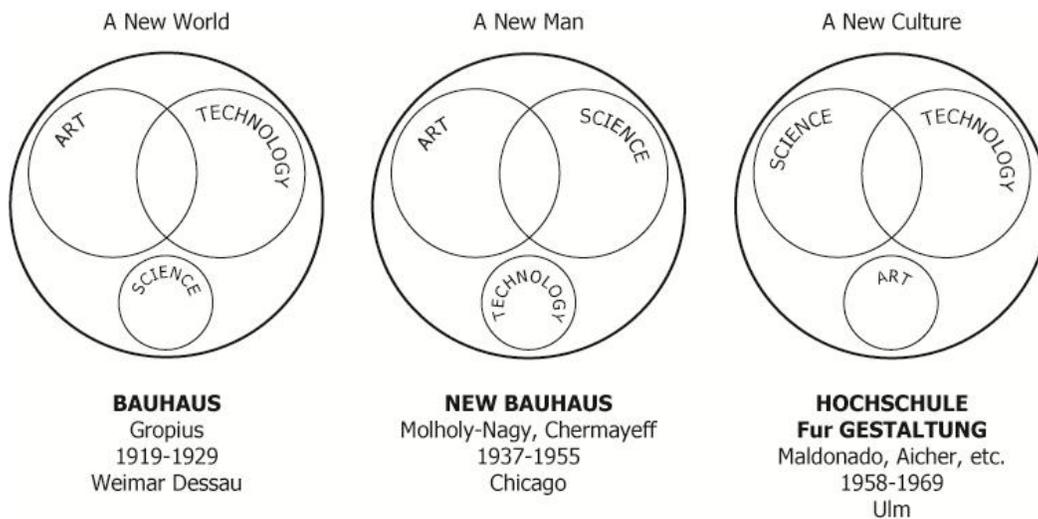
Figure 2.0   Progression of Design Education Models of Art, Technology, and

Science

2.3.3 Design Education's Curriculum and Knowledge Base

There is a wide array of curriculum choices with the types of schools

ranging from technical schools, art schools, and traditional universities. The

introduction of new technologies adds another skill that must be taught in a short time frame along with the artistic, analytical thinking, and problem solving skills. Stolterman (1994) believes the first goal of a design education should be, "to help design students to develop an intellectual capacity and to support them with the necessary theoretical tools to give them the ability to reveal hidden preconceptions and assumptions about design practice, and to help them realize that all design practice is a result of a design process and it is therefore possible to change and redesign it." This understanding of theory and process is another example that design is moving away from a simple skill based profession to one that can analyze and solve complex problems. Design education must also be moving towards a greater understanding of theory, and the schools that only teach design skills will become obsolete.

2.4 Education Models

Throughout the years, educational design models have grown from apprentice-based technical skills models to studio models that incorporate science and theory. During this same time period, educational models unrelated to design curriculum have been researched to determine how students and individuals learn. The following subsections discuss various educational models to determine how students and designers learn.

2.4.1 Technical Skills Based Models Move to Design Science and Theory Based Models

The most traditional design educational models let students act as designers on small theoretical projects while being guided by a more experienced, practicing designer. However, this leads to "design knowledge

[being] doggedly maintained as merely a form of tacit knowledge, based primarily on knowing how things work" (Levy, 1990). Friedman (1997) agrees by stating, "while traditional training can lead to tacit knowledge, it represents the virtues as well as the vices of habit. To be useful, habitual knowledge must possess critical comprehension along with behavioral roots." Friedman continues by stating, "vocational education is based on the transmission of authoritative patterns, taught by drill and memory. This is no way to educate designers who are expected to shape effective outcomes based on a genuine understanding of things and how they work." Dorst (2004) even goes as far to say that learn by doing models do not teach students to be cognitive about the design process,

"The core of design education as we know it now has traditionally been based upon 'design exercises'. It seems that most curriculum are built on the premise that you can (only?) learn designing by doing it. This 'learning by doing' is a powerful method, but it also has many disadvantages: it is very labor intensive for student and tutors, and easily involves a lot of repetitive work – which makes it pretty inefficient at times. And because of the complexity of design issues and the ill-structured nature of the student design problems, it is not even always clear what exactly is learnt by the student" (pg. 1).

This is why "the university, and in particular schools of design, should not focus solely on the training of practical skills... Design schools in a university setting should focus primarily on developing fundamental knowledge and imparting understanding of the process of analysis, synthesis, interpretation, creation, evaluation, and judgment" (Levy, 1990). This focus leads from a technical skills-

based model to an emergence of the design sciences and a scientific theory method of design education. "If designers are to approach their work as a design science, they require the background that permits them to understand complexity. This means a broad education based on problem solving and pattern building rather than a narrow education based on repetition, exercise and imitative patterning" (Friedman, 1997). The beginning of a broadening problem solving form of design education was first introduced at the Bauhaus.

2.4.2 Bauhaus Model

The Bauhaus was the first school that educated students to embrace mass production and industry instead of individual craftsmanship. The Bauhaus also pushed the principles of experience for student designers. The Bauhaus thought the student "should be equipped for the modern world in its various aspects; artistic, technical, social, economic, spiritual, so that he may function in society not as a decorator but as a vital participant." A way a student can become a "vital participant" is to be a creative problem solver tackling social issues. Bauhaus leader Walter Gropius championed the importance of well-rounded designers to be "modern artists, familiar with science and economics… to unite creative imagination with a practical knowledge of craftsmanship, and thus to develop a new sense of functional design." It is further stated that "the guiding principle of the Bauhaus was therefore the idea of creating a new unity through the welding together of many 'arts' and movements: a unity having its basis in Man himself and significant only as a living organism" (Bayer, 1938). In order to accomplish the unity of the arts and man, to produce vital participants to the community, the Bauhaus curriculum started with a preliminary course in

which students would become familiar with materials, nature, tools, representation, and design principles such as space, color, and construction. After six months in the preliminary course, students would be admitted into a specific workshop to observe. After six months to a year of observation students would be admitted to that workshop which was led by two instructors, a craftsman and an artist. While in the workshop, students would also be taught theory and intellectual matter to compliment their design experience in the workshop. After three years of instruction, students would become journeymen, and a select few would continue on to conduct research and study in the Bauhaus architecture studio. These students would practice architecture in addition to their studies and were urged to take engineering, technical material, and science classes outside of the Bauhaus.

2.4.3 Beyond the Bauhaus Model

Many schools proceeded the Bauhaus, but most of them kept similar educational models. From the New Bauhaus in Chicago to the Ulm School, these institutions utilized the art, technology, and science model; each school placing a slight variance in importance of each aspect of the model as shown in figure 2.0. Design programs in universities today use a model similar to the Bauhaus, with a focus on studio and theory courses. Findeli (2001) sums up these educational models while looking to the future of design education and touches on points that will be discussed later on. He states,

> "The general purpose of design has evolved within the Bauhaus lineage. [Figure 2.0] indicates the major themes within the three periods I have considered: "A new world," "A new 'man,' " and "A new culture." …

Somehow it was believed that if the necessary means, tools, actions, and decisions were put together, these goals could be attained. In the new perspective, however, the purpose of design must be considered as a horizon, as a guiding set of values, and as an axiological landscape to which one always must refer when taking a decision or evaluating a proposition within the design project, and not as an ideal goal to be reached in the more or less future.

What could be an adequate purpose for the coming generations? Obviously, the environmental issue should be a central concern. But the current emphasis on the degradation of our biophysical environment tends to push another degradation into the background, that of social and cultural (symbolic) environments, i.e. of the human condition. Consequently, I suggest that design could not only contribute to a sustainable natural world, but would adopt as a purpose something such as: "A balanced humankind in a balanced world," … As the question of individualistic ethics, the matter is almost too simple: some kind of moral education must be included in the design curriculum, so that the moral consciousness of every student is increased" (pg. 13-14).

2.4.4 A Model of Current Design Curriculum

At the School of Design at Carnegie Mellon University, Buchanan (2001) discusses the undergraduate curriculum which involves three stages of student development. The first stage takes place during the first year and is a time of discovery for the students. At this time the students explore methods, materials, and techniques, become aware of the cultural and social design context, and

begin learning about the different design professions. This is different than the foundation course of the Bauhaus as there is a focus on problems and projects found within the experience of the students, instead of just teaching tools, materials, and techniques. The second stage is a time of concentration and development that takes place over two years. The students deepen their understanding and skills of their design concentration, industrial or communication design, while working on actual projects to gain realistic, client-focused design experience. The third stage is the time for advanced study. The students work on a variety of special projects often working in a team setting or collaborating with other disciplines. Within these three stages there are four elements that foster the knowledge and experience essential to undergraduate education. The first element is studio experience which emphasizes creation, practice, understanding, realization, and synthesis. The second element is ideas and methods in design practice. This element exposes students to seminars and laboratory studios giving them an understanding of key ideas of contemporary design. The third element is design studies, including theory, history, and criticism. The last element is a broad scope of general education. Buchanan (2001) elaborates, "to be effective in the contemporary world, designers need a wide base of knowledge. They must be familiar with the basic concepts and methods of the natural sciences and engineering, the social and behavioral sciences, and the fine arts and humanities." Buchanan is first to admit this is not to be used as an outline in forming future design curriculum, but it shows a change from the tacit skills many designers learn to a focus on a problem solving

approach that places an importance on understanding, experience, and rhetoric. This curriculum can also be seen depicted in the diagram in figure 3.0.

	Year 1	Years 2 & 3	Year 4
	Discovery	Concentration & Development	Integration & Advanced Study
Studio Experience		Practice	
Ideas & Methods in Design Practice		Investigation	
Design Studies: History, Theory, & Criticism		Reflection	
General Education		Breadth of Understanding	
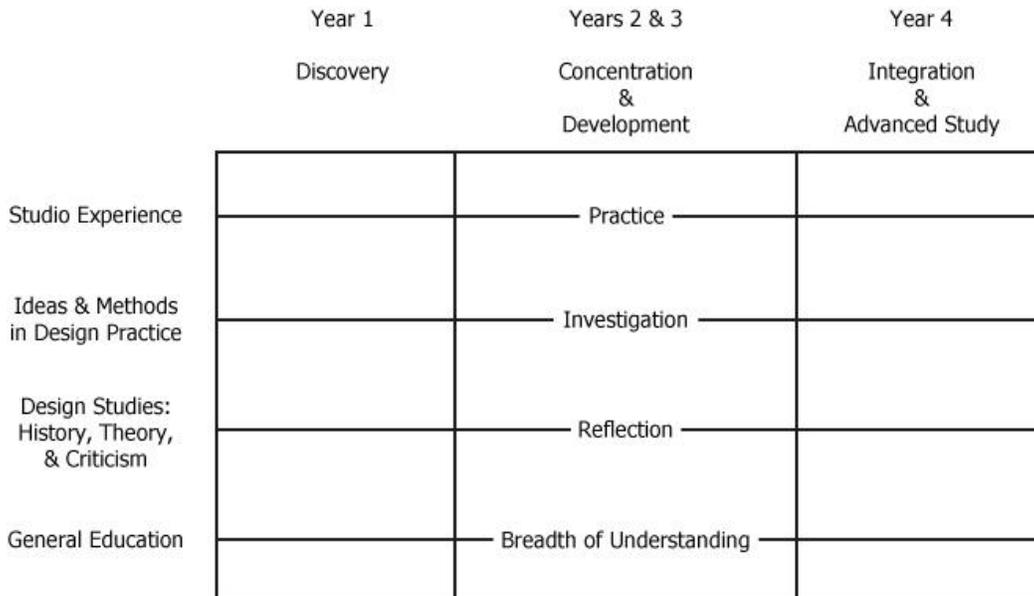
Figure 3.0   Diagram of Curriculum Taught at Carnegie Mellon's School of Design

2.4.5 Beyond Design Education Models, Towards Ways Students Learn

Learning can be defined as a change, in knowledge or understanding, in an individual through an experience (Gage, 1975). Yet, educational psychologists are still trying to explain how people learn, by creating theories of learning. A few of these theories will be looked at in order to explain how students learn. In these theories, "some believe that knowledge is a matter of internally representing the external world and is primarily acquired through experience, whereas others argue that knowledge is a matter of interpretations that learners actively construct by imposing organization on the world about them" (Driscoll, 1994). These opposing views show the continuum of epistemology. The first side being objectivism, descending from fifth century Greek philosophers, this approach to learning believes there is a singular objective reality that is

understood through experience alone. The opposite side being interpretivism, descending from Plato and Kant, where reason is the source of knowledge and reality is constructed. Falling in-between these two views is pragmatism, where knowledge is an unknown reality that must be interpreted.

Learning theories are based from what an individual knows and their interpretation of their cognition and memory. Knowledge is, "better thought of as knowing, or as a process. Through our experience in the world, we build ways of knowing, structures that determine our current understanding. And via these structures, we literally construct our knowledge dynamically as we interact with the world" (Cunningham, 1992). Ausubel's theory of meaningful reception learning is that, "meaning occurs when learners actively interpret their experience using certain internal, cognitive operations" (Driscoll, 1994). This theory states the importance of prior knowledge in order for new learning to occur. Ausubel (1963) stated that there is "memorial residue of ideational experience" which enables one to be "more functional for future learning and problem-solving occasions." Ausubel's ideas about memory and cognitive organization led into schema theories. "Schemata truly are the building blocks of cognition... the fundamental elements upon which all information processing depends" (Rumelhart, 1980). Schema theory involves a cognitive structure or organization of concepts in order for comprehension and the ability to infer solutions and solve problems due to understanding the gist of information. Schema models also depend on learning through experience. As experience and interaction grow, a better understanding of the topic at hand will grow as well. "Research on the processes of problem solving has shown that when learners

lack relevant prior knowledge, they may be forced to use general problem solving strategies rather than specific, schema-based ones" (Driscoll, 1994). This is another example that prior knowledge gained from many experiences is very beneficial for future learning and problem solving. It is also theorized that "learning must be situated in authentic tasks for knowledge to be useful and therefore used in similar situations" (Driscoll, 1994). By learning information in similar situations and environments to those where the skills and knowledge will be needed in the future, there will be better retention of the material.

In interactional theories of cognitive development the overall aim of education is to create self-propelled thinkers who create coding systems from their own experiences. The growth of cognitive development hinges on learning by discovery, where learners obtain knowledge and intelligence through discovering solutions during problem solving (Bruner, 1961; Driscoll, 1994). Looking further into development, we come to Vygotsky's ideas on teaching thinking versus content specific skills. Vygotsky (1962) states, "instruction in certain subjects [should] develop the mental faculties in general." That is to say, learning should be of a greater knowledge than just the task at hand, it should be transferable or affect many ideas and thoughts. Vygotsky (1978) also wrote, "learning is more than the acquisition of the ability to think; it is the acquisition of many specialized abilities for thinking about a variety of things." Creativity, being one of these things, is a type of thinking that falls under the principle of cognitive strategies. Gagne introduced the idea of cognitive strategies, which are many ways learners can guide their own thinking and learning. One of these ways "is learning to think creatively… that it involves originality, seeing problems

in new and insightful ways, or finding a solution to what others did not recognize as a problem" (Driscoll, 1994).

The last theory of interest is that of constructivism. Constructivists believe that "knowledge is constructed by learners as they attempt to make sense of experiences… [and is] the best construction of humankind's experience of its world" (Driscoll, 1994). What is being learned are connections due to their experiences and environment, and these connections develop and change as the learner does. The constructivists also believe that complex learning environments are needed in order for the learner to cope with complex situations. Driscoll (1994) explains this as, "experience with only simple problems can lead to such beliefs [that problems are unsolvable], whereas experience with more complicated and realistic problems can prevent such erroneous ideas." Constructivists also believe in collaboration (for the importance of collaboration in education see section 2.10.1). These learning theories incorporate different views on learning; yet, one holistic theory still does not exist. Parts and pieces of theories must be taken to represent the larger view of learning, and in this case, learning about design to become global problem solvers.

2.5 Design Thinking for Wicked Problems

As stated in section 1.6, design thinking includes creative characteristics and special qualities to implement new concepts, insights, possibilities, and outcomes (Owen, 2006). These characteristics can be used to solve wicked problems; ill-defined and ill-structured problems that cannot be fully understood until solved, do not have a definitive formulation, and do not have a singular answer (Rittel, 1972; Cross, 1982; Takamura, 2009). The following sections will

describe some of the qualities and values designers and design thinking contain, as well as, a clearer description of what wicked problems are and how designers can be better equipped to approach them.

2.5.1 Design Thinking and Intrinsic Values

Designers have their own "things to know, ways of knowing them, and ways of finding out about them" (Cross, 1982). One of these "things to know" is found in the design process itself. A study conducted by Lawson compared how scientists and architects tackle problem solving. The problem required arrangements of colored blocks to satisfy different problem needs. The scientists would systematically explore combinations of blocks in order to find the fundamental rule to the problem. On the other hand, the architects would create a series of solutions and then narrow down the solutions to find the optimal one or the "desired result." This illustrates the thinking styles of the two groups; the scientists would adopt a problem-focused result, whereas the architects would implement a solution-focused strategy. The solution-focused strategy leads to a deeper, more intimate knowledge of a problem by trying multiple solutions instead of solely focusing on the problem. Lawson repeated this experiment with younger students and found that they did not adopt either way of solving this problem. This shows that designers acquire a solution-focused strategy through their education and that they "learn, are taught, or discover, that this is the more effective way of tackling the problem" (Cross, 1982).

Another method of thinking that designers learn is the freedom to change the problem in order to create a solution. Other disciplines may spend a long time analyzing the problem and then conclude they do not have enough

information to solve it. However, designers have learned to "define, redefine and change the problem-as-given in the light of the solution that emerges from his mind" (Cross, 1982). Levin (1966) describes this as, "the designer knows (consciously or unconsciously) that some ingredient must be added to the information that he already has in order that he may arrive at a unique solution… and he uses his powers of conjecture and original thought to do so." Darke (1978) suggests that designers "find a way of reducing the variety of potential solutions to the as yet imperfectly- understood problem, to a small class of solutions that is cognitively manageable. To do this, they fix on a particular objective or small group of objectives, usually strongly valued and self-imposed, for reasons that rest on their subjective judgment." Edward de Bono portrays this as lateral thinking, "looking at an issue from a completely different perspective" (Kelley, 2005).Whether designers are changing the problem, adding new information, or looking at a problem from a new perspective they are using very powerful inductive reasoning tools which assists them in finding the best possible solution to a problem that non-designers may not be able to solve at all.

Designers have the intrinsic nature to develop codes, patterns, or 'constructive diagrams' in order to solve problems (Cross, 1982; Levin, 1966; Douglas & Isherwood, 1979). Cross (1982) states that "designers learn to think in this sketch-like form, in which the abstract patterns of user requirements are turned into the concrete patterns of an actual object." This belief that designers can cross between the "individual, organizational and social needs to physical artifacts" shows the ease they move between the different domains of abstract and concrete to find a solution (Hillier & Leaman, 1976). Designers also use their

intrinsic nature in a variety of roles in order to problem solve. Kelley describes

"ten faces of innovation" that correlate to the personas of designers. One role

being Cross-pollinators, juxtaposing unrelated concepts into unexpected

solutions, much like a designer they, "retain the childlike ability to see patterns

others don't, and to spot key differences. But they've also honed the very adult

skill of applying those subtle differences in new contexts. They often think in

metaphors, enabling them to see relationships and connections that others miss"

(Kelley, 2005). Designers use the code of language with 'metaphoric

appreciation,' where the designer moves between the domains of abstract

requirements and concrete objects by making comparisons and patterns of like

and unlike elements (Douglas & Isherwoord, 1979). Adding a metaphor to a

problem can unlock new connections and ideas about what the problem is and

how it can be solved. Metaphors provide "valuable insights into the workings of

thought and understanding" while continuously evolving as "our experience is

constantly bringing metaphoric projections to bear on the current situation. Our

experience is constantly undergoing transformation in the light of the current,

changing situation" (Coyne, 1994). Designers use their experiences and tools,

solution focused strategies, changing the problem, lateral thinking, pattern

recognition, and metaphors, to give them better understanding in solving wicked

problems.

2.5.2 Wicked Problems

Rittel first introduced the term "wicked problems" to describe second

generation planning problems. He compared wicked problems to "tame

problems" in order to give a better understanding of the complexity of wicked

problems. In Rittel's comparisons he describes eight steps, what he terms the systems approach, in solving a 'first generation' tame problem: understand the problem, gather information to understand the particular problem, analyze the information, generate solutions, assess the different solutions, implement a solution(s), test the solution(s), and finally modify the solution(s), if needed. When comparing wicked problems to the systems approach, one cannot even accomplish the first step, because a wicked problem cannot be understood until it is solved. Even describing wicked problems promotes more questions only truly answered once a wicked problem is solved. Yet solving wicked problems is difficult because there is not a right or wrong answer. Wicked problems are usually solved once they have exceeded a time limit, a money limit, or the patience of the problem solver. With wicked problems, dealing with the root problem and not solving a symptom of a larger problem is paramount. Another complication of wicked problems is that there is only one opportunity for a solution. After implementation, the problem is either solved or another wicked problem appears in its place. All wicked problems are thus unique, offering little chance at expertise in solving wicked problems (Rittel, 1972; Cross, 1982; Takamura, 2009). For this reason, it is ideal to take a collaborative approach to wicked problems, as different backgrounds may yield promising results against wicked problems (see section 2.10). Rittel (1972) describes this by stating, "for wicked problems there are no specialists. The expertise which you need in dealing with a wicked problem is usually distributed over many people." People who have a creative, analytical, solution-focused, problem-solving method, like

designers, will be more suited in approaching and solving these wicked

problems.

2.5.3 Approach to Wicked Problems

Designers' intrinsic values are well suited for approaching and solving

wicked problems. Nigel Cross (1982) states that designers and their "designerly

way of knowing," through pattern making, focusing on the solution, constructive

thinking and the ease to cross between domains, makes designers the "most

effective means of tackling the characteristically ill-defined problems." He argues

that design education develops the students' abilities in tackling wicked problems

better than the education of sciences and the humanities as design problems

more closely resemble the problems individuals need to solve on a daily basis.

Designers also tend to have knowledge in multiple domains as design does not

have a singular, specific subject matter, as Richard Buchanan (1992) states,

design is "universal in scope, because design thinking may be applied to any

area of human experience." Designers must discover the subject matter based

on the problems of a particular circumstance. By discovering the subject matter,

revising the problem, or creating a code to solve the problem, designers have a

different approach to analyzing and solving wicked problems. Victor Papanek

(1971) describes this in a similar way when he states, "designers help wield

power to change, modify, eliminate, or evolve totally new patterns." One

example of design students approaching a wicked problem is demonstrated by

the Pasadena Art Center College of Design Designmatters' Safe Agua project.

The students in this project researched the lack of clean drinking water in

developing countries. The students focused on developing new tools for storing,

using, and transporting water for families living in an area of Chile that do not have running water. However, when the students were researching in the field, they continually asked the question, "How can we best impact this area?" By being conscious of the effect of not having running water on the families instead of the lack of water in general, it shifted the students' mindset to creatively identify design opportunities that could be solved, such as products, systems, and campaigns that targeted water related needs, instead of focusing on the preconceived problem (Amatullo, 2008).

2.6 Call for a New Breed of Designer

With designers' natural ability to solve wicked problems, they should focus their practice on social issues. In order to tackle social issues, design education will need to evolve to better prepare and inspire future designers in solving wicked problems. Design education is already seen by some as "a philosophical and cultural phenomenon where the question of design learning strategy is seen as a conscious choice based on ideals and values as to what kind of society we want" (Stolterman,1994). Although a few educational institutions are beginning to introduce students to these complex issues, Margolin (2002) expresses that "how design for social need might be commissioned, supported, and implemented, little has been accomplished," especially in the way these social designers must be educated to better serve society. However, some design educators are currently working to "align research and practice with the exploration of social and humanitarian concerns and embrace the necessity to produce a new breed of designer exposed to a meaningful range of cultures and experiences" (Amatullo, 2009). This is seen in the Designmatters model, where

the educators are aware that "designers are by nature very visual, hands-on, and quick to develop high levels of empathy toward others" (Amatullo, 2008). They are employing these characteristics to shape future social designers by including social problems in the designers' education. A need for social designers is also being seen in design practice. GK VanPatter a renowned information designer has started a design collaboration entitled NextD that calls together professional designers to discuss design's future. One of the pinnacle ideas of NextD is that of a 1.0, 2.0, 3.0, 4.0 design complexity starting with 1.0 traditional design and ending with 4.0 social transformation design. In a recent dialogue VanPatter stated, "what I'd like to see more of is design education that focuses more on interdisciplinary working, collaboration, context driven design, and more socially orientated forms of designing. These are the lasting skills for designers" (Wildman, 2006). However, to solve wicked problems, designers must not only be educated through socially embedded projects, but the designers must be trained in sustainability so they do not harm the planet, in cultural integration so they design globally for all, and in disciplinary collaboration so they work with others to better solve these wicked problems.

2.7 Sustainability and Design

One global wicked problem requiring a sustainable approach is that the earth has a finite amount of resources and can only support so many living organisms, a limit rapidly approaching (Daly, 1966; Papanek, 1971; Brundtland Report, 1987). Currently, these finite resources are being used at an unsustainable rate, creating a shortage or elimination of these resources for future generations. Ravishing of these resources leads to the loss of vital

environmental ecosystems which will change the balance of the world. Due to the severity of this problem, the President's Council on Sustainable Development created fifteen principles to guide humanity's future decisions, the first being, "we must preserve and, where possible, restore the integrity of natural systems-soils, water, air, and biological diversity- which sustain both economic prosperity and life itself" (Daly, 1966). This is a goal that will only be reached if multiple disciplines work together to solve it. Scientists and technologists are needed for their insights into the environmental subject matter, but designers are needed to see the problem from different angles and creatively assign new patterns to create new sustainable solutions. As it is stated, "the vast changes required for creating a regenerative society…will require inspiration, aspiration, imagination, patience, perseverance, and no small amount of humility. They will require networks of committed people and organizations who not only learn how to see systems shaping how things work now, but also create alternatives" (Senge et al. 2008). Design is the discipline that will be able to create alternative systems through imagination and innovation. "Design must become an innovative, highly creative, cross-disciplinary tool responsive to the true needs of men. It must be more research oriented, and we must stop defiling the earth itself with poorly designed objects and structures" (Papanek, 1971).Nevertheless, sustainability is much more than just the environmental aspect; it is linked to the human aspect that includes the economy, social agenda, and culture. As stated by Findeli (2001) in Section 2.4.3, we must look beyond the ecological problems towards that of the human condition and strive to achieve "a balanced humankind in a balanced world." This is also described by Agyeman (2003) as, "it has become

increasingly apparent that the issue of environmental quality is inextricably linked to that of human equality." Harris (2003) adds upon the importance of the social aspect saying, "the social component of sustainability is not just an idealized goal, but also a necessity for achieving the economic and ecological components." In order to better understand sustainability we must look towards the social aspects, the causes, of this wicked problem.

> "Unless analyses of development begin not with the symptoms, environmental or economic instability, but with the cause, social injustice, then no development can be sustainable'. Sustainability, we argue, cannot be simply an 'environmental' concern, important though 'environmental' sustainability is. A truly sustainable society is one where wider questions of social needs and welfare, and economic opportunity, are integrally connected to environmental concerns" (Agyeman, 2003, pg. 2).

If designers are educated about the importance of sustainability, they will better understand the complexity of overlying ecological, economical, and social problems they will encounter as designers.

2.7.1 Sustainability and Design Education

It is essential that designers and students become aware of their responsibilities so they become competent to make contributions toward a sustainable society. The awareness of sustainability is a topic that has gained momentum over the past several years. The terms sustainable, green, and responsible design have begun to become incorporated into the discipline, yet there is not a strong framework for teaching the topic. Unlike the professional

counterparts of design, such as LEED, which require rigorous tests of knowledge to be certified, there are not as strong curriculum requirements for education on sustainability. Many professionals, educators, and problem solvers believe that sustainability is a vital topic for students to experience and understand in today's design curriculum. Due to the importance of sustainability, Vezzoli calls for a "redefinition of education, as a result of the influence of new technological opportunities and changed socio-cultural conditions." He continues to state that, "design activity itself needs to be redefined in order to positively and effectively contribute to the radical change required by the transition towards a sustainable society" (2003). In this redefinition, design education must broaden its scope to include important environmental, cultural, economical, social and sustainable practices which will create empathetic designers sensitive to this global problem. In this "transition towards a sustainable society," design education will need to be broadened and designers will need to be aware of their impact and responsibilities on the environment. According to Victor Papanek "design has become the most powerful tool with which man shapes his tools and environments (and, by extension, society and himself). This demands high social and moral responsibility from the designer. It also demands greater understanding of the people by those who practice design and more insight into the design process by the public" (Papanek, 1971). This development requires that design students experience sustainable practices to heighten their own responsibility, design sustainably, and in so doing inform their community of the importance of a sustainable society. Vezzoli (2003) states, there is "a whole new generation of designers [who] still needs to be educated and employed.

Designers have a crucial role to play in the radical change required to achieve a sustainable society and design educators must recognize this as a primary goal." Designers must receive education, so that they in turn can educate society. However, sustainability is not the only responsibility heightening experience designers must grasp in order to become a new breed of designer. Designers must also design to save the earth's resources while fostering a human-centered design responsibility that values all cultures.

2.8 Cultural Integration and Design

Culture and design are interrelated. A designer cannot design in isolation; they design within a specific culture. "Designers need to be mindful of the interdependence between culture and design because it might enable them to improve their concepts in responding appropriately to users' needs, wants and desires" (Moalosi, 2005). As designers need to be mindful of the culture in order to design for them, they must first learn the culture if it is different from their own. For this reason designers must experience culture integration, and become familiar with multiple cultures in order to design for them. It is also an important lesson for designers to expand their thinking on different cultures in order to become global problem solvers. In order for designers to truly innovate and be problem solvers they need to focus on people. This focus should take precedent over technology, materials, and the designer's personal agenda. Moalosi supports this by saying, "designers who focus on the intelligence of their users rather than the intelligence of their technology will produce the innovations that really matter." He pushes the role of the designer further by saying, "innovation starts with people, not with enabling technologies, and the designers' main role is to

mediate between technology and culture and to add ethics and aesthetics to

technology. In this case, designers are agents of cultural change" (2005). In any

case, for designers to become agents of change they must be empathetic to the

cultures they are designing for. If design education lets students experience

designing for multiple cultures, these students will be well-rounded, empathetic

designers who will be ready to solve global challenges.

2.8.1 Cultural Integration and Design Education

      Inclusion of multiple cultures and a global presence creates a stronger,

well-rounded design education that will enable designers to be the leaders of

change. Papanek (1971) believes that, "the main trouble with design schools

seems to be that they teach too much design and not enough about the social,

economic, and political environment in which design takes place. It is impossible

to teach anything, least of all in a system as deeply involved with man's basic

needs as we have seen design to be." However, design schools are realizing the

importance of social and cultural education, and the National Association of

Schools of Art and Design (NASAD), the accrediting agency for 240 art and

design programs in the United States, mandates that all design programs "must

strive to develop students' capacity to identify and solve problems within a

variety of physical, technological, social, and cultural contexts" (Gorman, 2004).

This type of education will develop design leaders, as Koshalek (2008) states,

> "Leadership in higher education today increasingly depends on
>
> international engagement, for institutions and individuals alike. Isolation
>
> breeds irrelevance in a global environment of ever-expanding
>
> information, inter-connectedness and flux. The multiple challenges

confronting our world—geopolitical conflicts, dwindling natural resources, urbanization, and socioeconomic inequalities—represent powerful global forces that are shaping the way we live, work, and learn. Such pressures and opportunities at an international scale are affecting higher education in significant ways, creating an unprecedented need to deliver knowledge, experience, and sophistication in a global playing field" (pg. 24).

By designing for other cultures, the students gain a better understanding of the world which puts them a step closer in being able to solve problems on a global level. The Designmatters model embraces this fact by aiming "at underlying the value of linking real-world issues with academic practices, in order to promote a deeper awareness and understanding of global context, which in turn produces more empathetic students" (Amatullo, 2008). Cultural and global awareness will create a more empathetic designer, as will the inclusion of social embeddedness in design.

2.9 Social Embeddedness and Design

Socially embedded projects have a lasting impression on designers due to their empathetic nature. Once a designer has been "engaged in satisfying work; never again will it be possible for him to engage in the kind of design directed towards 'good taste'. Having experienced this kind of work, he will forever after feel a little ashamed when" he designs purely for aesthetics (Papanek, 1971). Once designers have been involved with social problems, they want to continue to make the world a better place, one design, one problem at a time. That is why "designers have a key role to play in embracing a social agenda for engagement,

action, and intervention in response to many of the global issues confronting humanity" (Amatullo, 2008). Designers are a small group of professionals who are truly interested and in-tune with peoples' needs, making them the perfect group to address these complex social issues. However, "there can be no responsible design without a responsible designer, i.e. education should be directed to the development of an individualistic ethics" (Findeli, 2001). This is why it is vital that design education starts preparing future designers to design responsibly.

2.9.1 Social Embeddedness and Design Education

Socially embedded projects will have a great impact on design students, creating an enriching experience that may lead them to work as social designers. Another term often associated with social embeddedness is that of ethics. Buchanan discusses this in conjunction with changes that need to take place in design education by stating, "the task of education in the 'ethical' aspect of character is not to force an ideology onto the student." However, "ethical education seeks to develop each person's ability to assess the consequences of behavior, to reason about the application of principles and values in concrete situations, and offer persuasive arguments about the moral issues that one encounters in personal life or in a profession such as design" (Buchanan, 2001). This gives the students another chance to look critically at wicked situations and pinpoint the values they personally believe are worth designing for. Another way to look at it is that "the aim of design education is not only to provide social knowledge to the students, but also for them to learn how to use design techniques to express their social concerns" (Cheng, 2001). This lets students

use their design-know-how to be the tool to help them express their own principles of social and human concern. When students and universities partake in community and global engagement, "an exhilarating awareness of the leadership opportunities that arise from a focused and purposeful involvement with the deeper contexts of life is achieved" (Koshalek, 2008). In order for students to gain this awareness there needs to be, "a growing movement, within the professional design community and design schools alike, to align research and practice with the exploration of social and sustainable concerns and to find a new focus grounded in the power of design thinking for social value creation and change." That is why the Designmatters curriculum lets "students and faculty grasp the complexity of ever-changing global issues within an educational framework that is designed to provide an enriching and challenging learning experience imbued with critical content. But in addition to this, Designmatters projects also seek to develop relevant, implementable outcomes" (Amatullo, 2010).

2.9.2 Case Study of Social Engagement with Students

One such school engaged in this perspective is Pasadena's Art Center College of Design, which is involved with social projects that "partake in an educational process that goes beyond the walls of the studio and into the field." One recent project partnered with a Kenyan health clinic to deliver medical care to remote areas of Africa. This afforded "ample opportunities for designers to become fully engaged in participatory processes with the recipient communities. By the same token, such projects also establish connections and bridges between global and local concerns." After conducting field research, one student said they

"gained an amazing amount of 'ground truth,' in product design which will improve [their] ability to design for the people [they had] visited, as well as for those [they] will design for in the future. This trip was not only an inspiration to [their] way of thinking about life, but also about how much the person and their culture come into play in design" (Koshalek, 2008). Jacques Lange, the president of the International Council of Graphic Design Associations and advisor to student projects at Pasadena's Art Center College of Design Designmatters, gives human rights as an example of a social issue that can be addressed by what Cross refers to as the designerly ways of knowing noted earlier in section 2.2. "Human rights is a very complex issue and it needs to be considered with an objective yet sensitive understanding of unique social, political, and economic differences and sensitivities to vernacular constructs in different parts of the world. It is not a topic that operates on a clear black/white and right/wrong scorecard because the world does not work that way" (Amatullo, 2009). Students gave visual representation in the form of posters that included metaphoric appreciation by expressing a human rights issue and symbolic form of their own experiences. The posters were displayed at the United Nations Department Educational Scientific and Cultural Organization headquarters to give the public a chance to understand human rights issues through visual metaphors. In this process, the students learned more about human rights issues and what human rights truly meant for themselves. This type of learning creates design leaders who can solve the wicked problems of the future and bring societal change.

2.10 Disciplinary Collaboration and Design

Disciplinary collaboration with designers leads to many notable actions.

Poggenpohl (2004) identifies five patterns from interdisciplinary work,

"One, developing conceptual links using a perspective in one discipline to

modify a perspective in another discipline, two, recognizing a new level of

organization with its own processes in order to solve unresolved problems

in existing fields, three, using research techniques developed in one

discipline to elaborate a theoretical model in another, four, modifying and

extending a theoretical framework from one domain to apply to another,

and five, developing a new theoretical framework that may reconceptualize

research in separate domains as it attempts to integrate them" (pg. 153).

All of these patterns bring enrichment to the discipline of design. Multiple

viewpoints create a stronger, farther reaching discipline. On the other hand,

Swanson (1998) argues that "design is 'integrative' in that, by its lack of specific

subject matter, it has the potential to connect many disciplines." Design can

connect with other disciplines, not because of its lack of subject matter, but

because of its large inclusiveness of subject matter. Owen discusses the

strengths designers have in bringing disciplines together due to the generalist

nature of design. "There is a real need for those who can reach across disciplines

to communicate and who can bring diverse experts together in coordinated

effort" (Owen, 2006). Since design already encompasses a large body of

knowledge, it is important to look to other disciplines for their expertise, as "time

is too short to process and master all the knowledge and skill one might want to

bear on a project" (Poggenpohl, 2004). Through interdisciplinary collaboration,

designers need not be in command of all subject matter at once but rely on others knowledge to create a stronger design. Interdisciplinary work aims to achieve "cognitive and organizational innovation through evolution by variation, diversity, and combination" (Weingart, 2000). Through different collaborations, variation, and diversity of teams, innovations in design will occur. However, it should be a designer's goal to achieve a transdisciplinary level of collaboration. Transdisciplinary being the highest level of collaboration as Meeth describes it, "transdisciplinary studies start from a problem and find the related disciplines which facilitate solving it… Such studies go beyond disciplines, since they start from a problem and, using problem solving, they bring the knowledge of those disciplines which contribute to the solution" (Nordahl). Franz (2004) agrees that, "a transdisciplinary approach demands that the issue of focus be related to the world rather than to a specific discipline or even collaborative effort by several disciplines… [Transdisciplinary] is at once between the disciplines, across the disciplines, and beyond all discipline. Its goal is the understanding of the present world." This is compared to other types of collaboration such as multidisciplinary collaboration, which is usually just a juxtaposition of different disciplines, and interdisciplinary collaboration which attempts "to integrate in a coherent and harmonious curriculum several disciplines which allow to solve a particular problem" (Nordahl). These differences can be seen in figure 4.0. The desired result of collaboration is not always easily obtained, as Middleton (1967) states; "in the fullest sense, not easily achieved, the essential purpose of group practice is to link and focus the creative and critical faculties of every member of the team, not just upon one or two facets of the problem but upon every aspect at

every stage." It takes practice to creatively critique every aspect of a presented

problem. For this reason, transdisciplinary collaboration beginning in design

education will assist the presence of collaboration in professional practice.
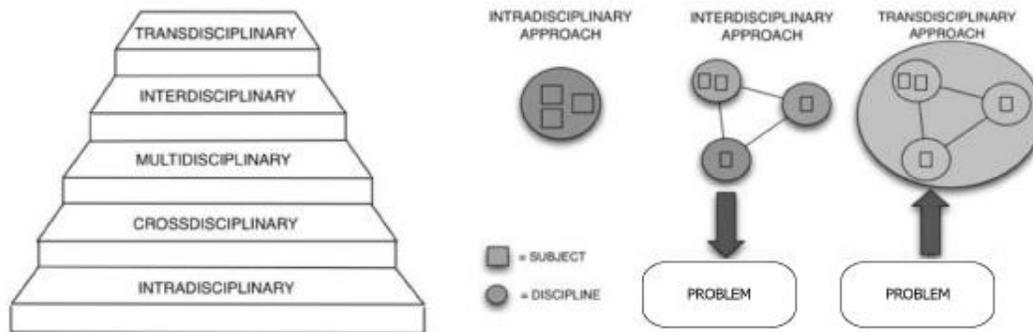
Figure 4.0   Types of Discipline Collaboration

2.10.1 Disciplinary Collaboration and Design Education

Disciplinary collaboration can increase knowledge in any system of

education; however, it is vital for design education because of the discipline's

unique abilities to improve society. Throughout history, "designers have directly

influenced the actions of individuals and communities, changed attitudes and

values, and shaped society in surprisingly fundamental ways" (Buchanan, 1989).

Design's creativity, diversity, and innate connection with the human spirit allow it

to deeply impact society. Design "is one of the fields where science and literature

meet. It can shine a light on hidden corners of sociology and history. Design's

position as conduit for and shaper of popular values can be a path between

anthropology and political science" (Swanson, 1998). Design has the ability to

affect many disciplines and areas of society, yet, design and the designer can

also be transformed. Findeli (2001) makes this point by stating, "since the

designer and the user also are involved in the process, they end up being

transformed, too, and this learning dimension should be considered as pertaining to the project." The process of collaboration is one of transformation, yet the theories behind transdisciplinary collaboration are still undefined and are only known as experienced phenomena.

Transdisciplinary collaboration is beneficial to all who are involved in it, yet it is still difficult to facilitate in an educational setting. Combining students from different disciplines to learn new outcomes presents problems for the professor or course facilitator.

"Barriers exist to building courses outside of existing structures, to team-teaching across departments, to supporting a range of teaching styles for a range of topics, and to partnering with industry in the pursuit of collaborative projects. Those faculty that have successfully overcome these barriers point to enlightened participants from within academia, design firms, and industry – enlightened in that they see the value of collaboration and the potential for new ways of teaching" (Boyarski,1998).

Although this approach is difficult, there is a reward of enlightenment for all of the participants. Some interdisciplinary programs solely combine different competences from different discipline faculty members without creating a "coherent, comprehensive, and interdisciplinary curriculum" (Nordahl). Instead, when creating new courses, the curriculum should strive to set the "boundaries for transdisciplinary courses [as] the boundaries of the problem being addressed, not the artificial boundaries of disciplines. A transdisciplinary course must involve multiple faculty members or mentors … Each course should include project or

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laboratory exercise modules through which the course material will be presented and put into practice" (Nordahl). This way students can practice solving wicked problems while being guided by multiple experts before solving such problems in the field. Currently design students are graduating from schools without being introduced to intense collaborational team work, and they are falling short of what is expected of them in the field. "There seems in fact to be a gap between what students learn in school and what they are expected to do in practice" (Naveiro, 2008). In order to bridge that gap, students must become excellent problem solvers. "A good education is one that gives you the resourcefulness to solve the problem you haven't anticipated" (Pullman, 1998). A good way to become a master problem solver is to learn from other disciplines and apply those methods while thinking critically, this is important for future designers and students of design. Owen states, "for design education, new programs must be designed that bring the best of design thinking ... New content will be necessary; new processes must be developed and taught; and new ways of working will have to be learned." He continues by saying, "it will be worth doing" (Owen, 2006). These new processes will include multiple ways of collaborating to expand the way designers think and problem solve. This process will be difficult but will bring enrichment and knowledge to designers.

2.11 Implications for Future Designers and Design Education

Sustainable, cultural, disciplinary collaboration, and humanitarian design projects will lead to a "far richer debate and exchange of ideas, often beyond the realm of design" (Amatullo, 2009). This, in and of itself, will result in a heightened transformation of the student, the designer, and the resulting impact

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they will have on society. If design is to be "ecologically responsible and socially responsive, [it] must be revolutionary and radical" (Papanek, 1971). The future of design will be revolutionary through the inclusion of sustainability, cultural integration, social embeddedness, and disciplinary collaboration. A deeper understanding of sustainability will lead to more appropriate solutions to our environmental, social, and economical issues. Adding cultural integration into design education will bring global and cultural awareness to the students, who will become more empathetic, creating stronger designs for the intended users. Through the inclusion of socially embedded projects students will become aware of important social issues, aware of their ability to solve such issues, and aware of a passion for design that helps others. By including disciplinary collaboration in design education, students will benefit from sharing their knowledge, gaining knowledge outside their field, and learning how to work with others in order to solve problems. This type of design education will give designers the much needed push to become revolutionary global problem solvers. What is considered the scope of design and design education is ever changing and growing, as humans themselves are ever evolving, the curriculum needs to be reevaluated to match the changing needs.

Chapter 3

METHODOLOGY

3.1 Introduction

This chapter discusses the methodology used in order to conduct the research for this study. Before the methods were chosen, this study started with a review of the literature in order to understand the past and present of design education. This review examined the industrial design profession and how industrial designers have been educated in the past then turned to educational practices outside of design education to better grasp how students learn. Next the review of the literature addressed the importance of future designers in our society with regards to their creative problem solving skills in the solving of wicked problems. The review concluded by individually and collectively examining four areas that strongly shape designers and design education: sustainability, cultural integration, social embeddedness, and disciplinary collaboration (see figure 1.0). Through this understanding of design education the methods and basis of this study were formed.

3.2 Methodology and Methods Used

Due to the fact that design education revolves around the students and teachers involved in it, i.e. people, qualitative research methods, and the methods of social sciences, are best suited for this study. In this case the methodology is ethnography with a grounded theory approach and the methods are participant observation and semi-structured interview, which lend well to the qualitative data of words and ideas (O'leary, 2004; Robson, 2002).

This is an ethnographic study that looked at the cultural group of design students. Ethnography can be defined as an, "exploration of a cultural group in a bid to understand, discover, describe, and interpret a way of life from the point of view of its participants" (O'leary, 2004). Ethnography's aim is to, "produce 'thick description,' which allows others to understand the culture from inside in terms that the participants themselves used to describe what is going on" (Robson, 2002). By trying to understand how design students view design education, especially looking at the connections of sustainability, discipline collaboration, social embeddedness, and cultural integration; new ways of educating students to become global problem solvers may be discovered. The approach for this study was grounded theory as, "theory that was derived from data systematically gathered and analyzed through the research process" (Strauss and Corbin, 1998). By beginning the research and collecting data through observation and interviews with the design students, theories about how the students understood, applied, and were affected by this type of design education were then generated.

The best methods for this study were participant observation and semi-structured interviews. These two methods offered the opportunity for visual, through the eyes of the observer, and verbal data to be collected (Laurel, 2003). The role of participant as observer was taken, letting the students know that data was being collected while still participating in lectures and brain storming activities to establish connections with the students. Semi-structured interviews were conducted in order to let the topics be discussed with the students in a more conversational setting (Robson, 2002). These interviews were recorded

with the students' permission (see Appendix for sample transcriptions of the interviews). These methods of observation and interviews were much more suited to the study than other qualitative methods such as document analysis. When studying a current issue such as design education, there usually are not previously gathered sources to analyze, instead one must go to the source, the current students being educated (O'leary, 2004). After the data was collected it was transcribed into word processing software so that it could be coded and easier to see patterns in the data. These patterns were also highlighted by creating charts and mapping word associations to give a better visual understanding of the data collected.

3.3 The Case Studies

A case study is, "a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence" (Yin, 1994). This study addresses the phenomenon of design education and looks to observations and interviews as the evidence within the confines of two separate studio courses. Case studies are often used in education to highlight or support a new educational theory. Professor Amatullo (2011, 2008) often uses case studies to address the changing curriculum at the Pasadena Art Center College of Design.

3.3.1 Global Resolve Case Study

This case study was conducted in the spring of 2010 at Arizona State University. It took an in depth look at the IND494 course entitled Global Resolve. This course was chosen for the initial case study due to its nature of discipline collaboration while focusing on social, cultural, and sustainable ideas. Global

Resolve included designers, engineers and business students coming together to propose solutions for global issues effecting developing countries. There was not a sampling strategy as all four of the undergraduate design students participated in the study, this included three industrial designers and one architect student, two were men and two were women. Throughout the semester observations were conducted and at the end of the semester each student was interviewed. The interviews were transcribed and coded to gather insights into the study. This was a pilot study to solidify the research to be undertaken in the second case study.

3.3.2 Innovation Space Case Study

This case study was conducted in the fall of 2010 through the spring of 2011 at Arizona State University. The subject matter was the IND464 course known as Innovation Space. This is a yearlong studio course that lets the students work in teams of four, an industrial designer, a graphic designer, an engineer, and a business student, to create a business plan and product that meets a specific user need in an innovative sustainable empathetic way. Each student must apply to be accepted into this studio course. For the industrial design students this course replaced their fourth year studio. This course was chosen for the case study due to the emphasis on discipline collaboration, social, and sustainable measures, as well as the national recognition of the success of this studio, the students, and the products that have come out of the course. There was not a sampling strategy as all nine teams were observed and each industrial designer was contacted for an interview, however, due to student scheduling issues one student was not able to give an interview. These industrial

design students were all in their senior year and included seven men and two women. The interviews were transcribed and coded to gather insights into the study.

3.4 Research Questions

-How will the integration of sustainability, cultural integration, social embeddedness, and disciplinary collaboration affect the future of design education?

The rational for this question is based on the notion that many design educators and practicing designers are calling for a change in design education. Friedman and Levi set forth the idea to better equip students with knowledge and tools, such as the ones that would be gained through the integration of sustainability, disciplinary collaboration, social embeddedness, and cultural integration (refer to Section 2.3.2). Findeli calls for a curriculum that must support a "balanced humankind" (refer to Section 2.4.3). Margolin, Amatullo, and VanPatter call for a new breed of designer based on a design education rooted in social issues (see Section 2.6 and 2.9.1). Vezzoli and Papanek ask for a redefinition of design education based on sustainable practices (see Section 2.7.1). Koshalek and Papanek state that stronger design educations are ones that include global and cultural perspective (see section 2.8.1). Boyarski demands a development of true disciplinary collaboration within design education (see section 2. 10.1). By looking at these aspects individually and collectively in the case studies, we will begin to shed light on the possibilities of these aspects integrated into design education.

- How will an Integrated Transformational Education Model, ITEM, in design education affect the students/ designers?

This question is important to answer because looking at the rational for the previously stated question; one begins to understand the possibilities of this educational model on the future of design education. As a product of that design education, students will be greatly affected by this model. In fact, Papanek believes once designers have had a taste of responsible design they will be greatly changed (1971). Amatullo and Koshalek describe the heightening transforming experiences students experienced through socially embedded projects in Section 2.9.1. By interviewing students in the case studies we will begin to see how they feel about a similar design educational model.

-Will an Integrated Transformational Education Model, ITEM, in design education produce global problem solvers?

The rational for this research question is that design thinking is key to solving ill-structured wicked problems, as discussed by Owen and Cross (see Section 2.5 and 2.5.3). Subsequently if ITEM can produce stronger designers capable of design thinking, then this design education model would be better suited for producing global problem solvers.

Chapter 4

RESULTS OF DATA ANALYSIS

4.1 Introduction

This chapter brings to light the ideas and opinions of the students
interviewed in the two case studies. These ideas are the foundation of student
perception of ITEM, the Integrated Transformational Educational Model (see
figure 1.0). Each case study includes an analysis of the four components of
ITEM, including sustainability, cultural integration, social embeddedness, and
interdisciplinary collaboration.

4.2 Global Resolve Case Study

This course was chosen for the initial case study due to its nature of
discipline collaboration while focusing on social, cultural, and sustainable ideas.
Global Resolve included designers, engineers, business, and sustainability
students coming together to propose solutions for global issues effecting
developing countries. All four undergraduate design students were interviewed
and the next sections highlight their ideas about the course and design education
as it pertains to ITEM.

4.2.1 Sustainability, Design Education and Student Perception

This course opened up the student's eyes to a new appreciation for
sustainability in design. The students' previous education had only looked at the
environmental aspects of sustainability. They were told it was important to not
use up the earth's natural resources, to reuse and recycle as much as possible,
however, they never realized how important sustainability truly was until they
saw how much of an impact there was on the social and economical aspects of a

developing country such as Ghana. One student stated that the cultural and economic difference,

> Makes me reevaluate what is important in the product. Here [The United States] we may not care how much plastic goes into it, or how long it takes to make, or if it is made of carbon fiber or that kind of thing, or how long it will last you, but for there [Ghana] it needs to be made out of cheap materials that will last a long while. It just changes the whole priorities. (interview # 3)

Although the student had many times questioned the amount of materials to use in designing products for other classes, he had never seen it as being as important of a decision until this course. Another student describes it in great detail by saying,

> You don't want to design a ten dollar water bottle when you could design a three dollar water bottle that will serve the same function and be just as aesthetically pleasing, to give the same service to the user and all that. So I think the main difference is, just it's not, there's not an option to have any kind of frivolous extra. You really have to think about what is essential here and the essential part is all you get because you are working with people who cannot afford the essentials much less anything extra. So I think design is really looking at long term effects of design of a product because with most of them, the sustainability is a concern when you are designing for people in the U.S., but maybe the long term social implications of a product or service in the U.S. may not be as extreme as in a place where you're introducing something totally new.

That's one of the things we've been looking at all semester is, what are

the unintended consequences of your product or service in the

developing world? (interview # 2)

An example of an unintended consequence discussed in the Global Resolve class

was bringing an inexpensive lamp to Ghana. This could be seen as an

improvement of the way of life for poorer citizens who would now have access to

light in the evening time, but could this force the women in the village to

continue working in the evening instead of having family time? The idea that the

students are looking at unintended consequences for the people and place they

are designing for shows great growth in understanding the totality of

sustainability (including cultural, social and economic). A designer must not only

weigh the consequences of using the earth's resources, but the consequences of

what that product will do to the people/ culture and the economy they are

designing for.

4.2.2 Cultural Integration, Design Education and Student Perception

Through the idea of cultural integration, students had a chance to

experience new things and new ideas in a real way. Students expressed that this

class had "really opened up my eyes to different parts of the world that I have

never experienced before," and that this project, "seems a lot more real, it's not

just…[that] theoretically people would want this. It's actually going out there and

talking about it." All of the students described a change in their design

philosophy or direction because of this course. Some students discussed going

into a philanthropic design field to continue designing for developing countries,

others just had broadened their views on what may be important in design. For example one student stated,

> It kind of changes my ideas of what is important in the world.... It might be fun to just work for Nike and make the next athletic shoes but maybe there is a greater benefit to making shoes that are affordable. (interview # 3)

Another student discussed how design has become more "impactful because you have to take into consideration these individuals, their lifestyle and their culture and the value they have in life and it's not necessarily they want this, this person is going to have to decide if they want to buy food for the next day or buy our product… it's a more emotional approach." Another student excitedly states, "it would be great to design something that changes the world for the better." Along with obtaining ideas of how to better design for the developing world the students also learned how to research and gain insights on other cultures to be able to design for the rest of the world. A student said, "I think that working with Ghana I've learned more as far as making products available to the greater majority of the population of the world."

4.2.3 Social Embeddedness, Design Education and Student Perception

The social embedded nature of this course allowed students to design products that would truly impact others' lives. This experience affected the students in profound ways. One student tried to explain how this course was the first in his education to include this social aspect and how that influenced his design career. "Nothing has come close on the social aspect… I kind of feel like I've fallen into… I've known what I wanted to do for a long time and now I am

kind of like … I can do that, and I think I am doing that because of this class."

Later in the interview the student stated, "[this class has] influenced the direction I will be going in for the rest of my life." Other students discussed how being more involved in social aspects helped them design more suitable products for the users. One student discussed how they had "found some way to empower those individuals, in a way, I looked at the social approach because I am not satisfying a want I am satisfying a need." Another student saw how a more suitably designed product influenced the user and themselves as a designer.

> I see the impact; I can impact an individual's life or expand and improve their quality of life. And I think the social work is a lot more effective, especially from a passion standpoint. I mean I really feel like I did something at the end of the day. I actually did something, I helped someone and they may wake up tomorrow and change something for someone else. (interview # 4)

Social embedded design projects and the design courses that include them appear to foster a passion ultimately resulting in improved educational experiences. As one student stated,

> This is probably my favorite class I have taken at ASU by far, but because it gives you the opportunity to make the class what you want it to be… In this class you get to design a product that changes lives… So if you take it upon yourself to really make that happen, you have the opportunity to do so much more. And it's not just a class; this is a life changing experience. (interview # 4)

4.2.4 Disciplinary Collaboration, Design Education and Student Perception

Interdisciplinary collaboration can be very rewarding, but it still leads to frustration within students. In the beginning of the semester students were excited about working with other disciplines and creating something together. "I was hoping to be able to work with students in other majors, to be able to work on a project where I can use my skills in product design to help create something." Others expressed the reward of gaining knowledge from the students of different disciplines. "I really like working in a group with people who are not all different designers because they have a lot more knowledge about things I have no clue about." Another student stated, "I like working in teams, I like to be able to understand different aspects of business and engineering. So I was hoping to learn a lot about those things." Some students realized key differences between designers and other disciplines by working in the group. For example, during brainstorming sessions a student noted, "it seemed as though my ideas were big and goofy... like big picture crazy there is no way we can do that, ideas that we could then funnel down. Other people's ideas seemed like they were more focused." Even with the benefits of gaining knowledge and the designer using their knowledge to support the team and create a product, frustrations from group members, communication, and work load still existed. One student chocked up these frustrations to a learning experience and said at least,

> In an interview I can sit there and talk about the challenges that I had with group projects, such as this, but that is pretty positive to say I was working with a group in India for a semester on a sewer treatment plan

opposed to I worked by myself on a really expensive widget for… a niche

market in the U.S. (interview # 2)

The student continued by saying, "for me that's way more valuable," which in

other words means that despite the frustrations, collaborating with other

disciplines is understood to be beneficial and is valued by students.

4.2.5 Conclusions from Global Resolve Case Study

The Global Resolve case study was very important in guiding the direction

of this research. Going into this course the research was focused solely on the

idea that social embeddedness and humanitarian aspects of design would greatly

impact design education and the designer in a profound way. This was true;

however, this case study showed that social embeddedness was not the only

aspect that profoundly changed the students. There is also an importance of

sustainability, cultural integration, and working in interdisciplinary teams, with

each of these aspects intertwined and overlapping to create a more holistic

change in design education. These ideas led to the conceptual framework,

research questions, and the continuation of the research in the following case

study. Having a deeper understanding of the research, the Innovation Space

case study was conducted with more specific ideas of how design education was

being influenced by these four aspects: sustainability, cultural integration, social

embeddedness, and disciplinary collaboration.

4.3 Innovation Space Case Study

Innovation Space is a yearlong studio course where the students worked

in teams of four, an industrial designer, a graphic designer, an engineer, and a

business student, to create a business plan and product that meets a specific

user need in an innovative sustainable empathetic way. This course was chosen for the case study due to the emphasis on discipline collaboration, social and sustainable measures, as well as the fact that the industrial designers had to apply for the studio and choose it over the traditional fourth year studio course. The next sections depict the design students' ideas about design education, this specific course, and ITEM. At the end of each section a word association map visually supports the students' ideas about the individual component.

4.3.1 Sustainability, Design Education and Student Perception

By interviewing the students, it was realized that they had very different views on what sustainability was and different frustrations of how sustainability was taught to them. Most of the confusion seemed to be stemming from the fact that many sustainable ideas were pushed on them which only included the environmental aspects. By trying to incorporate and truly understand the social and economical impacts they came up with understandings of sustainability that were more personal to them. One student described this by saying,

> To me, sustainability is sustainability of human life, not just survival but living, not at the expense of destroying the world, but the focus should be the quality of life. A product that promotes that is sustainability. I don't like that sustainability has come to mean degrading the quality of life for the sake of an unknown. I have taken a lot of issue with that because it has been pushed and forced down our throats every year, that this is what will happen unless you do this there is nothing you can do about it. The problem I take with that is that human life and human

creativity has created and produced these lives and wonderful abilities

because there was human life and the ability to do it. (interview # 3)

This student was very passionate about the social importance, humanity, not

being overlooked for the environmental aspects, which seemed to be at the

forefront of sustainability education until this class. Another student also

mentioned the importance of the social aspect when they said,

Sustainability is not just about the environmental impact. It's about

sustainable equity and all these things have to work together. Just

looking at the environmental side is throwing off the balance; we have to

keep everything balanced including the social aspect. (interview # 2)

Some students saw sustainability as a life changing principle and were frustrated

that others talking about it did not practice it.

What sustainability means to me is more than what people hash it out to

be. You have to practice what you preach. I've completely changed my

whole way of life by recycling, riding my bike, and living close to where I

work. Sustainability is something you have to live not just talk about.

(interview # 2)

Another student describes this in a way that tries to look at the whole of

sustainability stating,

To me it is the ability to continue on a path without creating or making

impacts that negatively affect people, places, and things. The sustainable

philosophy is: what am I going to do today to make the world a better

place? The bigger picture, is taking it from a material definition to

thinking about the intended and unintended consequences of every

action. Unfortunately, sustainability is becoming an overused word that

no one truly understands or believes in. To me sustainability has gone

from something that was just material to an idea that is almost

metaphysical. (interview # 1)

These students have truly incorporated sustainability into their life and design

philosophy, but they are frustrated by others' understandings and practices of

sustainability which are rooted in how sustainability has previously been taught.

This is also expressed by a student saying sustainability "is an important part,

but it hasn't been that critical to my education, maybe if it was incorporated

better it would be different." By educating students on a more well-rounded view

of sustainability some of these frustrations could be eliminated.

Despite the frustrations regarding sustainability, students did still learn

valuable insights into design because of their sustainable education. One student

placed a high value of sustainability in the understanding of design processes in

general, stating without sustainability,

The way design is going none of us would have a chance. If we didn't

know how to implement anything and we didn't understand what our

product goes through in the life cycle and how sustainability is involved in

all of that and where it can be effective, I don't think we would really

have a grasp of what is going on. (interview # 8)

A different student had similar ideas stating that sustainability has, "put new

issues on the map for me, and I can actually provide solutions to answers for

these new issues." Another student sees sustainability as a welcome challenge.

I think what is exciting, is when you look at sustainability as a new

challenge to prove our value as designers. My philosophy on sustainability

and design is that it is our mission to make things better for the world,

both from an ecological and functional standpoint. (interview # 6)

Sustainability even helped build the general knowledge of the students, as one

stated, "[sustainability] increased my resolve and helped me broaden my

understanding. The social sustainability has been as critical as any part of it."

Even the students who didn't fully agree with the ideas of sustainability found

reasons it was important to their education.

I wouldn't say it was critical, but it was beneficial just because it got me

to do my own research and formulate my own understanding. If it wasn't

for learning about sustainability, I don't think I would have an

appreciation or understanding, so not only would I not be able to speak

the language but I wouldn't be able to debate it. (interview # 3)

However, in the end students, despite frustrations, saw their education of

sustainability as beneficial. One stated, "I do think these two things

[sustainability and culture], especially together, will give a lot of experiences and

benefit to designers." Sustainability benefited the students by helping them

better understand the design process, by changing the way they practiced design

and by opening up their eyes to global and social issues.

Figure   5.0 Sustainability Word Association Map

4.3.2 Cultural Integration, Design Education and Student Perception

Cultural integration is an important part of students' design education. A student showed the importance of learning from other cultures by saying, "it has been one of the most valuable parts of my education. I've learned more being immersed in different cultures then I have from any one teacher or course." For designers learning from other cultures has two major benefits. The first benefit helps designers grow as a person. One student explains this by saying,

Just interacting with many different kinds of people makes you a more
well-rounded person, especially when you have the social implications
that you have to be conscious of everything you do. Having a larger
social outlook is definitely what leads to personal growth. (interview # 5)

Another student agreed learning about other cultures "taught me to be open and that every experience helps you grow as a person." Yet another student explained the importance of cultures by saying,

Before this education I never had imagined designing for other cultures, or Third World cultures. It has opened my eyes to a lot of things. And now I realize that a majority of design is for developing worlds or improving products, or even systems, for social needs. The more you are exposed to other cultures and other experiences, you become more well-rounded in your understanding and how you design. (interview # 4)

The second benefit helps designers know how to design for their users. One student plainly puts it, "if you don't understand the culture, you can't help the people." A different student states, "I think it's important to find out the entire social, economical, environmental landscape of whoever your user is, that you really understand all the different variables that affect their life, short term and long term." Another student states,

As designers I think it is important to travel internationally because our designs are going to have more global implications. It would be great if every design student, and really every designer, could travel outside their country to see the different mentality of people from other cultures. And just to be aware of other cultures, I feel more equipped for future design endeavors. (interview # 6)

These students all agree that being exposed to other cultures helped them grow as a person and as a designer. They also believe that cultural integration is an important part of their design education and hope that future design students will get the chance to be immersed in different cultures.

Figure 6.0   Cultural Integration Word Association Map

4.3.3 Social Embeddedness, Design Education and Student Perception

Students found socially embedded projects to be personally

transformational and help better equip them for the future. After one student

agreed that socially embedded projects better equipped him for the future he

elaborated, "if it is not socially equitable or solve a problem it doesn't really

matter. I think what separates art from design is the ability of the designer to

address real problems and needs in products." This was further elaborated by

another student who said,

> When you get to know your user and watch their reaction to a prototype,
>
> how excited they get about something so little that can change their life,
>
> really inspires you as a designer to design meaningful things. For me,
>
> that's super beneficial and I love that. (interview # 8)

Socially embedded projects not only help others, but it gives designers and students passion and purpose.

Seeing the rewards for doing good can make people want to design for good. It can make you question if your focus is in the right place. Actually solving problems and helping people is where your focus should be. And by going through that process it will make you enjoy that work more or at least be aware that humanitarian work is an option. If you're not focused on helping people, what are you doing but just filling the landfills with garbage? (interview # 5)

Being introduced to socially embedded projects in their education changed the student's entire outlook and design philosophy. One student said that this socially embedded project is,

Something that has definitely changed my view and has driven how I've designed the product that we have. That personal connection and passion has led me to this life that has totally altered and changed the way I design, leading to an end result, which is a much better product. (interview # 3)

Another student admitted,

Before this class I just wanted to be a product stylists, I just wanted to make pretty flashy objects, I knew there was another side to design but I didn't really care. Now, I am much more aware and concerned of our social issues. And these issues have affected my design philosophy. (interview # 6)

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Yet another student said, "the way I think about misfortune is completely different. It feels good to do things that are socially responsible." By introducing socially embedded projects to students during their education they look at designing completely differently, they are more aware of suffering, of design consequences, and of how they can make a difference through design.

Figure 7.0   Social Embeddedness Word Association Map

4.3.4 Disciplinary Collaboration, Design Education and Student Perception

Students learn many lessons from working in interdisciplinary teams. One student said the most important aspect of this class was the "collaborativeness, being able to work with all the different disciplines, and being able to push myself to work on something that I may not have chosen." Another student benefited from learning team communication, stating that,

> When you work in a team, what you're working on is what they are
>
> working on, and it has to work. It made me understand how to

communicate better with people in different disciplines, relate better, know what they go through and what I go through. I think in that sense I'll be able to be more comfortable in the work place and communicate with other people. (interview # 8)

Being able to bring communication skills into future endeavors gave students confidence to work with other disciplines outside of the classroom. "I feel better equipped because the world is becoming more and more interdisciplinary, the lines between design, engineering, and business are blurring." Another student elaborated that,

The power to bridge the gap between designers and engineers, people usually at odds in the industry, was very powerful. This happened this semester because of soft skills I picked up and grew because of Innovation Space. That is one reason I am so excited I did this program, because these skills and this growth are powerful tools that aren't as prevalent in most designers. (interview # 6)

Again a student praised the learning outcome of working with other disciplines stating, "in Innovation Space we had the opportunity to work with other disciplines, and I learned how each of the people approached the problem. Understanding their focuses has been one of the better learning experiences." One student made an interesting point about working with others in order to 'change the world'; they stated "we [designers] cannot do it on our own. We should try to understand as much as possible, but not do as much as possible." Even in situations where students were frustrated by their teams, they still felt that they learned from the experience. "Our team started off on a bumpy road,

which was good, we were able to work through our issues early and figure out a team dynamic that could work for all of us." Overall, students appreciated the interdisciplinary teams. They compared it to other studios where they only worked with other designers saying, "in the other studio the only teamwork done is between designers who all think alike, and there is no one there to challenge your preconceived notions." By working in interdisciplinary teams ideas were challenged, communication was learned, knowledge was gathered, and in the end better products were conceived.

Figure 8.0   Disciplinary Collaboration Word Association Map

4.3.5 Conclusions from Innovation Space Case Study

Through interviews with the students of Innovation Space the importance of a design education involving ITEM, including sustainability, cultural integration, social embeddedness, and disciplinary collaboration has indicated stronger, more well-rounded, and passionate designers come out of the program. Students indicated the value of an ITEM education stating,

I know that our profession ten years from now will be vastly different. So

having these four things integrated into education will allow students to

cope with the change, these four things will always help me find some

place in the world, knowing that twenty years from now, Photoshop

rendering skills will be irrelevant, but having these four skills will give me

those tangible values. (interview # 6)

As other design skills become less relevant the ideas behind ITEM will still give

designers value, a value that is rooted in knowledge and experience that cannot

be compensated by artistic skill alone. Students hope that others get the chance

to experience a design education based off of ITEM stating,

I hope students do get these four things in their education...I think that is

a responsibility of a responsible research based program. You need to

foster the idea of good design and what is truly important. In education

you should be taught how to design, what to design, and why to design.

(interview # 5)

When the students were asked to rank the importance of the individual

components of ITEM they ranked social embeddedness the highest out of the

four components (see Figure 9.0), however, many students found it very difficult

to rank these components as they strongly believed these four components were

so intricately woven that it is hard to contemplate, nevertheless rank, the

components individually.
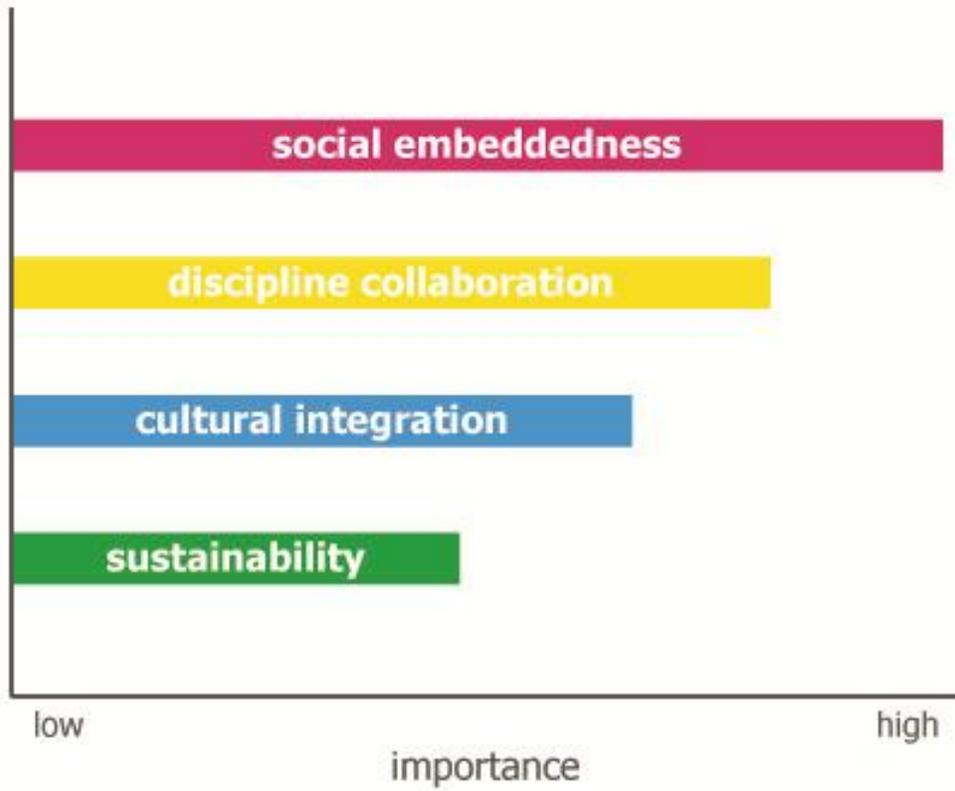
Figure 9.0 Ranking of Individual ITEM Components

Chapter 5

DISCUSSION AND CONCLUSION

5.1 Introduction

This chapter discusses the results of the data analysis within the context of the previous research on this subject matter presented in the literature review. The discussion will offer explanations of the research questions, pose future implications from this research, and convey the overall impact and conclusion of this study.

5.2 Discussion of Results

In regards to ITEM, the Integrated Transformational Educational Model, and the research gathered by the two case studies, let's address the first two research questions together. The first research question is: *How will the integration of sustainability, cultural integration, social embeddedness, and disciplinary collaboration affect the future of design education?* The second research question is: *How will an Integrated Transformational Education Model, ITEM, in design education affect the students/ designers?* The reason for discussing these two questions together is that they are exponentially linked. One cannot discuss the changes of design education without considering the changes in the students of that education due to the fact that as design education is improved so are the students.

As indicated in the findings of this study, by creating an ITEM-based design education system, that includes sustainability, cultural integration, social embeddedness, and disciplinary collaboration, designers will greatly be improved to become stronger, more well-rounded, and passionate. These students will

have true value; a value that is rooted in knowledge and experience that cannot

be gained from an education only rooted in artistic skill (see section 4.3.5). The

importance of knowledge and value is supported by Levy and Freidman who

believe that design education should focus on knowledge, complexity, and

problem solving skills (see section 2.4.1). What better way to gain this

knowledge then by solving wicked problems that involve the overlapping

complexities of sustainability, collaboration, with social and cultural issues?

Students participating in a design education focused on ITEM would be

considered a 'vital participant' by Gropius and Bauhaus standards since they

would be tackling social issues (see section 2.4.2). Considering educations'

general goal of producing knowledgeable students, we find Gage and

Cunningham defining learning and knowledge as a process based on experiences

which construct one's understanding (see section 2.4.5). Through these two case

studies, students have experienced firsthand working with environmental, social,

and cultural issues while collaborating with other disciplines, thus constructing

their own views on design, problem solving, and the world around them. The

students express the knowledge they received from these courses by saying,

"this is a life changing experience," and, "it has been one of the most valuable

parts of my education." Stolterman sees design education as a choice of what

type of society we want (see section 2.6). This is confirmed by a student in the

case study who said, "I really think we design the world we're in." By designing

our world or choosing our society through design education, why not choose a

more holistic society by educating designers with an ITEM education focusing on

problem solving? The student continued by saying, "if designers can't change the

world, I am not sure who can. So we are going to have to make that push and keep going in that direction, it could take a long time but it needs to be done." ITEM also falls in line with Amatullo's ideas of a "necessity to produce a new breed of designer exposed to a meaningful range of cultures and experiences" (see section 2.6). As ITEM is an experience model, each aspect is about fostering meaningful experiences. Each student mentioned the course was an experience that taught them about design, the world, and themselves. One student tried to describe the difference between learning and experiencing these aspects by saying, "I think it's more about the experiences of these things then learning about them. These are things that can't be learned from someone telling you how it is; you have to experience it for yourself." The knowledge and experiences gained through a design education focusing on ITEM are aligned with what these past educators are calling for, so now let's individually discuss ITEM's aspects to see how it will affect design education and the students.

The first aspect of ITEM is sustainability. Findeli believes in a model similar to ITEM which depicts students having a balanced education by not only looking at sustainability but at the social and cultural aspects in turn producing students with a moral consciousness (see section 2.4.3). This is agreed upon by students from the Innovation Space case study who declared, "sustainability is sustainability of human life," and, "sustainability is not just about the environmental impact. It's about sustainable equity and all these things have to work together. Just looking at the environmental side is throwing off the balance; we have to keep everything balanced including the social aspect" (see section 4.3.1). Agreeing with Findeli and the students is Agyeman who also

believes that the environment is strongly linked to human equality and that sustainability must consider economic opportunity and social needs (see section 2.7). Vezzoli has strong convictions that when it comes to achieving a sustainable society, designers have a vital role which must be addressed in design education (see section 2.7.1). This was also seen in the case studies when the students called out for a new approach to learning sustainability that must include more than just the environmental aspects and must be presented in a new way. This is seen here as a student states, "[sustainability] is an important part, but it hasn't been that critical to my education, maybe if it was incorporated better it would be different." Overall, learning sustainability including environmental, economical, and social issues will broaden students understanding of design and the world, giving them more opportunities to change the world.

The second aspect to discuss is cultural integration. Moalosi states, "designers are agents of cultural change" (see section 2.8). Yet to be an agent of cultural change designers must be educated in cultures other than their own. One student stated, "just to be aware of other cultures, I feel more equipped for future design endeavors." This awareness of culture is what will help them become an agent of cultural change. Another student thinks that, "designers, to be that global change, need to have more social science research skills, and be able to know what the social implications of our solutions are." In order to understand 'social implications' one must be aware of the culture. Amatullo thinks that a deeper awareness of other cultures produces students who are more empathetic (see section 2.8.1). A student agrees saying that when

designers truly consider their user in their culture it becomes "a more emotional approach." By including cultural integration into design education the students will have a deeper awareness and understanding of others' needs, leading to better design outcomes, empathetic designers, and a chance for true global change.

The third aspect of ITEM is social embeddedness. Papanek believes that once designers have worked on socially embedded projects, they won't be able to just design for aesthetics (see section 2.9). Multiple students came into these courses with aspirations to be aesthetic designers and now they see there is so much more to designing for those in need.

> Before this class I just wanted to be a product stylists, I just wanted to make pretty flashy objects, I knew there was another side to design but I didn't really care. Now, I am much more aware and concerned of our social issues. And these issues have affected my design philosophy. (interview # 2)

Another student expressed how this course, because of the social aspect has, "influenced the direction I will be going in for the rest of my life." Yet another student said,

> Seeing the rewards for doing good can make people want to design for good. It can make you question if your focus is in the right place. Actually solving problems and helping people is where your focus should be. And by going through that process it will make you enjoy that work more or at least be aware that humanitarian work is an option. (interview # 5)

Buchanan believes that social embedded education rests on teaching ethics in a way that does not force an ideology but develops the students reasoning of values within situations and the ability to assess consequences of their actions (see section 2.9.1). One student addressed this by discussing personal growth and how it must be,

> Learned not forced. Making those opportunities to learn it is essential in the education, but to say it is this path, or this particular way, or this process, is entirely inappropriate because then you are limited and forced down a track, which stops you from asking questions and seeing problems with that track. (interview # 3)

Cheng points out that "the aim of design education is not only to provide social knowledge to the students, but also for them to learn how to use design techniques to express their social concerns" (2001). This student has learned to create products to address real social concerns and because of that he states,

> I can impact an individual's life or expand and improve their quality of life. And I think the social work is a lot more effective, especially from a passion standpoint. I mean I really feel like I did something at the end of the day. I actually did something, I helped someone and they may wake up tomorrow and change something for someone else. (Global Resolve interview #4)

By including social embeddedness in design education, more socially responsible designers will emerge from the program which will in turn impact everyone being designed for.

The last aspect to address is that of disciplinary collaboration. Owen and Swanson discusses the strengths designers have in bringing disciplines together due to their ability to 'reach across disciplines' to bring experts together through communication and popular values (see section 2.10). A student found this ability and stated, "working with these other disciplines and seeing things through their eyes has definitely helped me understand how to speak their language." Middleton argues that transdisciplinary collaboration is not easy to achieve as it does not just include teams working together but coming together at every aspect of a problem (see section 2.10). While some students found working in teams to be challenging they still "learned how each of the people approached the problem. Understanding their [the other disciplines] focuses has been one of the better learning experiences." Poggenpohl addresses that, "time is too short to process and master all the knowledge and skill one might want to bear on a project" (2004). A student had a similar idea when they elaborated that, "we [designers] cannot do it on our own. We should try to understand as much as possible, but not do as much as possible." Naveiro points out that there is a gap between design practice and what is taught in school due to the fact most students cannot or have not had an opportunity to collaborate with other disciplines (see section 2.10.1). One student said that working with others helped them, "understand how to communicate better with people in different disciplines, relate better, and know what they go through and what I go through. I think in that sense I'll be able to be more comfortable in the work place and communicate with other people." Another student pointed out that, "the power to bridge the gap between designers and engineers, people usually at odds in

the industry, was very powerful… these skills and this growth are powerful tools that aren't as prevalent in most designers." By being introduced to discipline collaboration in design education students have the opportunity to learn from these disciplines, make better designs by using others' knowledge, practice communicating, and to be better prepared for working with others in industry.

The third and final research question to discuss is: *Will an Integrated Transformational Education Model, ITEM, in design education produce global problem solvers?*

In order to answer this research question one must understand what types of global problems need to be addressed. Rittel discusses such global problems as wicked problems. One complication of wicked problems is that there is only one opportunity for a solution. After implementation, the problem is either solved or another wicked problem appears in its place (see section 2.5.2). That is why a student described that designers must,

> Have the knowledge and the ability to problem solve. You need to be able to step back and look for the true problem and not just the symptoms of the problem. Because designers know a little bit about a lot, it helps us see the bigger picture. That is why being well-rounded is so important. Being a good problem solver, being able to understand the problem, being able to talk to people, and being able to synthesize all of that information to turn it into a holistic solution would be our biggest skill set and asset as designers. (interview # 5)

Nigel Cross agrees stating that designers and their "designerly ways of knowing," through pattern making, focusing on the solution, constructive thinking and the

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ease to cross between domains, makes designers well equipped to tackle such wicked problems (see section 2.5.3). Designers have also learned to "define, redefine and change the problem-as-given in the light of the solution that emerges from his mind" (Cross, 1982). One student similarly describes this saying one must, "define the problem or there is nothing to solve, nothing to understand, nothing to research, there is nothing. So designers have to have the ability to define a problem, and from there all the other bits and pieces come along." One student said a critical aspect of design education was that, "you have to explore and try different ideas and approaches in order to consider more aspects of problems." Another student began to incorporate the ideas behind ITEM when it comes to problem solving saying,

> Everyone faces problems, and as designers we want to tackle, or solve, those problems. The more experiences you have, good or bad, are all going to affect your design philosophy, your choices, and the way you think… Once people start having more experiences you can see that there design and their approach has completely changed. (interview # 2)

These experiences are the ones found in ITEM, experiencing practicing sustainability, being immersed in other cultures, working on socially embedded projects, and collaborating with other disciplines. Another student said, "because of the skills I learned through this education I feel like I am ready to contribute and equipped to actually do something." Based on these students experience and their responses, it is clear that a design education focused on ITEM will help produce global problem solvers.

5.3 Discussion of Future Implications

Based on the findings of this research there are some direct outcomes to be applied to design education. First, sustainability must be taught in a way that includes the social and economical aspects along with the environmental. It must be taught in a way that allows the students to make it more personal, more important, to them. This will give the students a chance to be a true advocate of sustainability, to truly understand, instead of just using the word and becoming fed up with it. Secondly, students should be given the opportunity to be immersed in other cultures. They should not have such a rigid schedule or program that it inhibits them from studying abroad. The students should not be told they will lose their place in an industrial design program if they choose to study in another country for a year. Also, all design studios should focus on the user, and the user's culture, when designing for them. Over are the days of designing any 'cool looking' gadget that does not have an intended user. Next, studios should participate in socially embedded projects which can improve the lives of the user, broadened the student's awareness of the world, impact the students design philosophy, and give student work meaning and passion. From the study not one negative thing was said about socially embedded projects. Furthermore, despite collaboration difficulties it should continue to be found in design education to create stronger, more diverse students. Interdisciplinary collaboration will continue to challenge students, give them knowledge, and teach communication skills. Lastly, it should be understood that ITEM is a set of guidelines. Specific detailed curriculum cannot be prescribed for the design classroom as design problems will always be changing. No two studios will result

in the exact outcomes. However, when turning the principles of ITEM into curriculum, one should be aware of the challenges they may face. First, it is very difficult to create effective, meaningful disciplinary collaboration in design studios. As discussed in section 2.10 one must first look at the problem that is being addressed and then determine the disciplines needed to solve such a problem. With the problem trying to be solved changing with every successive studio it would be challenging to know which disciplines should be enrolling in the course to solve such a problem. Therefore other disciplines may not always be aware of the studio opportunity during enrollment unless effective marketing of the class has been done. Even if the studio course gains all the disciplines needed, problems may arise with the group members or the facilitation of the course. Another possible challenge of implementing the ITEM framework is that there must be extensive effort on the part of the professor to be able to continually, effectively execute the social embeddedness and cultural factors of the course. The project itself should be centered on a socially embedded issue and the culture that it effects, to do this effectively semester after semester requires the professor to do extra research and use personal or professional contacts. Despite these potential challenges in facilitation, these case studies support the findings that students learn more from a design education rooted in sustainability, cultural integration, social embeddedness, and disciplinary collaboration.

Future research and case studies would be valuable to get a larger cross-section of design students' ideas about this educational model. Studio courses founded on the ideas of ITEM should be established. Then those students who

participated in such courses should be researched, observed, and interviewed to learn about the outcome of such courses according to the student's perception. Future studies could also focus on the role of the professor. This study focused on the perception of the students and what should be taught to future designers. However, as briefly stated in this section, professors will have some challenges of their own in implementing the ITEM framework. It would be interesting to gain the professors' ideas of ITEM since they will have to strongly support it in order to do the extra work in implementing it. When studying the professors' role in an ITEM education, one may also begin to look at how ITEM could change the school's curriculum and how that will affect the professors, the students, and possibly the accreditation of the school. It would also be valuable for future studies to look at ITEM in non-design education. Looking at the disciplines starting to collaborate with design, for example, the sciences, engineering and business, to determine how ITEM could affect their educational systems. Could experiences with social embeddedness change business students perception of success? Could an immersion in another culture bring new ideas to a scientist? Could sustainability help engineers come up with holistic ideas to create regenerative societies? Could an emphasis on discipline collaboration intertwine different disciplines in a way that leads to a brighter future? How would this model and these experiences affect other students? As design is not the only discipline trying to solve problems, and ITEM has shown to be very beneficial to the problem-solving nature of design education, it stands to reason that other disciplines could benefit from this model.

5.4 Conclusion

This study has indicated that ITEM is a very impactful model for design education. It has provided evidence that an education rooted in the ITEM principles of sustainability, cultural integration, social embeddedness, and disciplinary collaboration will create designers who are global problem solvers. This study has reminded educators of the importance of teaching sustainability in a more holistic way, including environmental, social, and economical issues. It has also shown the importance of immersing students in other cultures in order for students to gain a deeper awareness and understanding of others' needs; leading them to attain stronger design outcomes, become more empathetic designers, and have a greater ability to achieve global change. This study has shown that introducing socially embedded projects has been personally transformational for the students, giving them the opportunity to help others while making them more passionate and experienced designers. It has also shown that including discipline collaboration in design education will give students the opportunity to learn from these disciplines, make better designs by using others' knowledge, practice communicating, and to be better prepared for working with others in industry. Once design programs implement the ideas behind ITEM, it will be exciting to see the profession of industrial design take a step into the future by creating well-rounded, stronger, empathetic designers to tackle global problems. It will also be exciting to see what accomplishments the students of this study, and the first wave of students to pass through an ITEM education, will contribute to society. In the end, through future research

conducted in this study, an ITEM-based design education will be influential on

the next generations of designers and problem solvers as they continue to work

on the world's wicked problems and their impact on communities globally.

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APPENDIX A

GLOBAL RESOLVE INTERVIEW QUESTIONS

1.	What was the reason you signed up for this class?

2.	What did you hope to gain from this course?

3.	In the future do you plan to participate in design projects that have a global impact?

4.	Have you taken other classes that have let you use your creativity and talents to help others?

5.	Do you think this class will more greatly impact you, or the ones you are designing for?

6.	Do you think this course will more greatly benefit your education or your personal design principles and practices?

7.	How were you paired with the country you are designing for?

8.	What did you know about this country before you started this class?

9.	How did you research this culture in order to better design for them?

10.	Can you transfer these research skills to other design projects?

11.	Did you learn these research skills during this project or in a prior class or project?

12.	Do you plan to visit this country?

13.	Do you plan on actually creating the product and business you designed for this course?

14.	Did you do any specific activities or exercises to inspire ideas for the design you created?

15.	How is designing for a developing country different than designing for your peers/ a client/ an American?

16. Is there any specific knowledge you have gained from this class that you plan to use in future design classes or as a professional designer?

17. Would you consider going into a philanthropic design field?

18. Are you interested in long term design work for developing countries?

19. Do you consider yourself an empathetic designer?

20. Do you want to design in a way that changes the world?

21. Would you consider this class an inspiration to your design career?

22. Did you learn any new design skills in this class?

23. Can you use these design skills, found in this class, in your other design projects?

24. Would you recommend this course to a friend?

25. Do you think you would have learned as much, or more, in a similar class that brought multidisciplinary students together but focused on design and profit in the U.S.?

26. How did you and your teammates brainstorm ideas for the design solution?

27. Was there a difference in the way your teammates brainstormed compared to you?

28. How did you get your ideas across to your teammates? Words, sketches, pictures, diagrams, models, etc.?

29. How does this course rank in the following categories compared to other studio/ project based classes you have taken? (high, above average, average, below average, poor)

    -research   -creativity

-inspiration	-sense of need
-programming skills	-brainstorming
-knowledge	-deliverables/ final product
-design implementation	-group work
-ideas	-collaboration
-ethics	-sustainability
-future endeavors	-process
-methods	-transferability of ideas
-empathy	-portfolio work

30.   What classes would you rank higher than this one in some of the

previously mentioned categories?

31.   Is there anything else about this course you would like to share with me?

APPENDIX B

SAMPLE GLOBAL RESOLVE INTERVIEW TRANSCRIPTION

Note: This is a sample of how students responded to the questions. In order to conceal the student's identities these answers come from all of the interviews and were randomly selected for each question.

1.   What was the reason you signed up for this class?

Um…Let's see, I first signed up for the class because, one of the main reasons I came to school here is because I was interested in designing things for people who are not so advantaged, my background is building second homes for people for ten years at a ski resort. Like five million dollars, second and third homes for people who are incredibly wealthy and will probably never live there. So, I kind of came here thinking, ah I should be, I have some talents, I can put it somewhere besides resort lifestyle. So that's why I signed up for the class.

2.   What did you hope to gain from this course?

I guess just experience and how/ what you are supposed to look at when you are developing um a business for the developing country verses you know a regular business, plus I am not a business major, so learning from them and the other disciplines as well about how you develop a business together and all the factors that you look into. That was kind of the main thing I was looking to gain from it and as a whole I guess the example of how you can do it and implant it.

3.   In the future do you plan to participate in design projects that have a global impact?

Yes. Yes I definitely think so, the way I am looking at it now, before this class I just saw it as an opportunity to learn things but now I see it as an impact thing. And that I can change someone's lives through a small product or I can

improve someone's day and how happy they are with like their cell phone or their shoes. So I see the impact, I can impact an individual's life our death or expand and improve their quality of life or something like that on a smaller scale. And I think the social work is a lot more effective and especially from a passion standpoint. I mean I really feel like I did something at the end of the day. I actually did something, I helped someone and they may wake up tomorrow and change something for someone else.

4.   Have you taken other classes that have let you use your creativity and talents to help others?

Um… As far as classes…I don't, um, well nothing pops out like that so um not in college probably. And I think that is the other thing that is cool about this class because architecture you have so many required classes, you know, so through your designs you can like focus on doing that but they are theoretical. So ya I would say that no, this is the first class that I have been actually able to like, besides studios and stuff which are implemented. So not in school, no. All the work I have done in this kind of stuff has been out of school stuff. That's why this class is so exciting. I was so excited about this class when I heard about it.

5.   Do you think this class will more greatly impact you, or the ones you are designing for?

Definitely me. Ya I mean we really haven't… we're in the process of designing right now so we will see. Hopefully, the end goal would be way more than me. I was just describing the impact of the potential impact of our product being billions of people, but we will see.

6.   Do you think this course will more greatly benefit your education or your

       personal design principles and practices?

       Personal design principles and practices by far. This class, I wouldn't even

consider this, well it's definitely a class but I look at it more as an opportunity to

be enlightened. It's like a… ya, an opportunity to open your eyes up to

everything in the world. I could honestly say about ninety-five percent of the

students at this university would have no idea about the problems we are looking

at. And it is ridiculous because this class is twenty people or so and given the

resources we definitely could obtain like our scholastic knowledge and access to

mentors and such we could implement these projects, maybe on a small scale

but the outcome and impact of that is tremendous.

7.   How were you paired with the country you are designing for?

       I am actually on an Akor team; I am not on a Ghana team. We … ah … it

was a pretty haphazard way of going about it. They just assigned, randomly

chose, there was a limited number of graduate students in the class and a

limited number of engineers in the class and originally what they were trying to

do was have an engineer and grad student on every team and then hopefully

have a designer on every team but there wasn't enough designers, there are

only four people in design in the class. So I think the way they came about

choosing the teams was pretty random and they gave the teams the option of

being a Ghana team or an India team and my team members were very

interested in the Akor challenge. I was more interested in Ghana because I knew

I was headed to Ghana but I thought it would be a good experience since I am

going to be working in Ghana, to get some experience outside, like I could say I

have worked on a project that has to do with India opposed to just Africa projects.

8.   What did you know about this country before you started this class?

Absolutely nothing, nothing at all.

9.   How did you research this culture in order to better design for them?

We did a lot of research mostly on the internet, obviously you can't do much besides the internet on the other side of the world, but the… we started with the team from Terri University over there, a team of four people from Terri University on our team. Their initial research on this slum and then more research on from the Delhi job board water organization and so it's a, it's the job board website has a bunch of statistics governmental statistics on it. Um lots of NGO's have worked in this field so there are a lot of people doing similar work. Not using the same technology we are but doing similar work and you know addressing the scale of the problem you know. So the problem is well researched, it's not a very obscure thing so it was not hard to find a lot of information on it, definitely hard whittling it down and trying to figure out what facts are most compelling that are going to get people's attention. You know when you say there's four million people without a toilet it doesn't make much sense but I am just trying to design this info graphic on like what that means like if we take like this unique… I don't know I am trying to build the slides right now, having a little difficulty trying to get the impact, the social impact out there without, you know, brow beating people, you know, with multiple facts and figures, you know.

10.   Can you transfer these research skills to other design projects?

Ya, I think so. I mean, you know, that has been my source for research since I got to school. I don't know, you know, I wish we had time and funds to go over and do other forms of research, but I mean google is our modern day research tool I think, you know. I don't know of another way to get it done really.

11.   Do you plan to visit this country?

I wish I could go, I can't afford it. I was actually considering two days ago buying a ticket on my credit card but then I thought it is an investment of three thousand dollars out of my own pocket which would not be a smart investment but I figured it would be worth it. I have a really deep passion to make this project succeed.

12.   Do you plan on actually creating the product and business you designed for this course?

I would love to see this happen. It's ah… you know, to be quite honest, it is a huge, huge project and it seems ridiculous but basically the India team really wanted to do this. They had a doctor over there that said this is really a pilot project in India but has used this same technology with the same school they are going to. They had a pilot project in a different slum and they thought it would be a good scalable technology, so they kind of went with that without really knowing a huge amount about it. Literally, I mean I would love to see it happen but there are some gaping holes (chuckle). Honestly, you know, without a million dollar seed money, I don't see how you could come up with, you know, setting up one or two plants and operating capitol and getting it implemented. But if we win the competition, than you know, maybe that is a possibility because the

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competition would involve going to India for ten days, a week, two weeks, something like that, and then coming back to the university in Minnesota and working with the Akor group there to try and hammer out the details and come up with a solid business plan that we could pitch to venture capitalists and social capitalists, people who invest in social businesses.

13. How is designing for a developing country different than designing for your peers/ a client/ an American?

It's very different because you're dealing with someone who will actually be able to change their entire life with this product instead of it just changing an aspect of their life. And also it really, really makes me see the fact that these individuals live in a poverty stricken area and yet they still find value in design. When I first approached the problem I thought to myself, we just need to design something that works which is basically the concept for engineering, however, when we got deeper into the problem the individuals actually want cool stuff just like we do and that's the biggest differences the biggest step for me because I didn't know that. And that was my fault thinking they live in a village in a rural poverty stricken area I just want something but it is not like that, they like the branding and cool design things. And on top of that impactful because you have to take into consideration these individuals, their lifestyle and their culture and the value they have in life and it's not necessarily they want this, this person is going to have to decide if they want to buy food for the next day or buy our product. When in America it's oh I am going to buy this and then I am not going to have my favorite lunch or something, like I am going to get my favorite pair of

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shoes today but I am not going to buy, you know, something I like the next day.
So you know… it's a lot more, it's a more emotional approach.

14. Is there any specific knowledge you have gained from this class that you
plan to use in future design classes or as a professional designer?

Manufacturing… top of the list. Designing simply. Designing simply by far
because that's the biggest problem I see in design now. I mean design
competitions, and everyone can have their own opinions about this, but you
want to design something cool you better make sure it's simple. Concepts are
great but I almost feel like it is a waste of time. I am a realist, I like getting
things done and I it's too often that people design concepts and sometimes their
awesome, unique and creative but it's not always possible and it is a waste of
resources. I think it's cool that companies try to develop the next concept car
and stuff like that but it's sometimes especially with the economy right now, it's
a waste of time, there is no point to it, there is no market for it. And recycling,
that's huge. If we could figure out how to use waste products that would be
huge, and people are definitely taking that into consideration but I think it has to
do with the curriculum.

15. Would you consider going into a philanthropic design field?

Yes, if I could um survive on that income type of thing. I mean I really
like volunteering, I don't do it a lot but um with graduating I am going to have to
make my own income and such.

16. Are you interested in long term design work for developing countries?

Yes.

17. Do you consider yourself an empathetic designer?

Hmmm… I would like to say yes but I don't know enough to really say yes I am an empathetic designer. It's definitely a goal.

18.   Do you want to design in a way that changes the world?

Doesn't everybody? Ya I mean it would be great to design something that changes the world for the better.

19.   Would you consider this class an inspiration to your design career?

Yes, it has really opened up my eyes to different parts of the world that I have never experienced before, um even though the class really wasn't what I was expecting.

20.   Did you learn any new design skills in this class?

I mean really the design tools would be the… we did gain some tools I think for looking at the process of design and that upfront like tools for thinking about social implication, environmental implication and … I don't know if that's, it's kind of hard to say that's a design tool or is that a research tool. When does research stop and design begin? It's kind of… I think the tools for this class were right on the edge. I mean I haven't learned to draw better because of this class, I mean I have done drawings for this class but I haven't really. I have learned a little bit more about you know building presentations and those are design tools but kind of you know…

21.   Can you use these design skills, found in this class, in your other design projects?

Ah yes and no. No because the skills I learned in this class are all about designing for the bottom of the pyramid. Um… so that would be kind of

counterproductive in designing for America because it is all based on wants.

That's why yes and no, it really depends on the project.

22.   Would you recommend this course to a friend?

I definitely would with a huge disclaimer that if you don't put your all into this then don't sign up. This is the kind of class where there is a ridiculous amount of opportunity especially with the faculty involved.

23.   Do you think you would have learned as much, or more, in a similar class that brought multidisciplinary students together but focused on design and profit in the U.S.?

It would have been different, you know, it would have been totally different. Like the senior project in industrial design or innovation space is basically what it would be and I would guarantee you that they would come away from their class with a totally different idea of what they are doing and what we had done this semester which I didn't join the class where… that why I joined this class to learn about design in underdeveloped countries.

24.   How did you and your teammates brainstorm ideas for the design solution?

We did a… mind mapping and um a bunch of whiteboard work, you know, and a kind of broke it down and looked at the value chain of water, you know, and all the players of water in this slum since that is where we are focusing. So we took the value network of people and then the chain of water, where the water comes from- where the water goes, and then did mind mapping to try to find the most urgent areas of those things that needed help and also did

mind mapping once we found those areas on what can we do, what can we use as solutions to those needs.

25.   Was there a difference in the way your teammates brainstormed compared to you?

Very different. I am very much a visual person and I like to throw out there way out there ideas and then bring them back in. Um working with the finance majors and stuff they are just very straight lined, step by step, and I don't know. It's just very different but it works out though.

26.   How did you get your ideas across to your teammates? Words, sketches, pictures, diagrams, models, etc.?

I have a much easier time describing what I am thinking with pictures than words so I would try to describe it to them but I would ultimately just end up drawing it out or using a computer and creating a visual that way.

27.   How does this course rank in the following categories compared to other studio/ project based classes you have taken? (high, above average, average, below average, poor)

-research	5	-creativity	4
-inspiration	5	-sense of need	5
-programming skills	4	-brainstorming	3
-knowledge	4-5	-deliverables/ final product	
-design implementation	1	-group work	4
-ideas	4	-collaboration	4
-ethics	5	-sustainability	4
-future endeavors	5	-process	4

| -methods | 2.5 | -transferability of ideas | 4 |
| -empathy | 4 | -portfolio work | 2 |

28.   What classes would you rank higher than this one in some of the previously mentioned categories?

This is probably my favorite class I have taken at ASU by far, but because it gives you the opportunity to make the class what you want it to be. Like the studio, we were given an assignment to design a power tool for example, you may have the chance to design a screwdriver or a chainsaw, it is going to take a lot more time to design the chainsaw because it is larger. In this class you get to design a product that changes lives, I mean we could have designed a light bulb that is connected to a battery, it's not viable at all or we could design something that works really well. So if you take it upon yourself to really make that happen, you have the opportunity to do so much more. And it's not just the class; this is a life changing experience. So um ya that is what I like about it, it gives you the chance to make the most of it.

29.   Is there anything else about this course you would like to share with me?

You know there's… I mean… I feel like it's a really positive course and it's in growing pains. It was on the ground floor last year. I've been excited to be a part of it. It's definitely the whole Akara challenge; it has been a total nightmare. Like literally on some level I feel like it's influenced the direction I will be going in for the rest of my life. But on some level I feel like I have wasted more time on this class than any class so far at ASU, and it has frustrated me more because I mean we… it's multifaceted both sides, there are four people in India and there are four people here and that's hard to deal with… but not that hard, we Skype

and we email, the problem is they are not involved in a class like we are, it's just an extracurricular activity to them, they have no faculty advisor. And no one at Akara even knew that there faculty advisor had left the project. So the people running the whole thing didn't even know there was a problem, we're saying we haven't heard anything but they have thirty five teams when last year they had three teams. So that's, I don't know how many universities, maybe ten universities in the U.S. and India they are trying to communicate with, and I don't know… I feel totally cheated on some level by that, literally seeing what people are able to do on the Africa challenges and the projects they are working on compared to what we are doing I feel like I totally got screwed. I really wish I had been on an Africa team, and I shouldn't feel that way, you know. Wow, I should be really grateful I was on this India team and learned about India instead of having a bad taste in my mouth. It's unfortunate that this is the case. I mean I am really grateful to be part of it. My life will probably never be the same because I am taking this class. So in a year that will far outweigh the pain I have about this class and the institution of the GIE. It's not like… I mean … I talked to this guy all last year a senior from industrial design and I talked to him about it and he was saying the exact same things I am saying right now but he wasn't involved in the Akara challenge. You know, it was about Africa, they had a group member who wouldn't cooperate, didn't really work, you know, and that's just the way it goes, you know, but it didn't have to go so extremely weird, I didn't think… there could have been some steps taken maybe a month into the semester and say ok this isn't working right lets figure out what the problem is opposed to lets wait two months into the semester… I mean like we two-thirds

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through this semester we changed completely. We had been working on one thing and the group over there said no we are not doing that we are doing this, so we had two-thirds of the semesters worth of work done and then all of a sudden we changed ideas, you know, I have a huge folder of research not relative at all to anything we are doing now. You know, I am looking up numbers on the internet this morning so I can build the final presentation slides, so I know what the scope of the problem is, you know, that is a little crazy. That should have been oh ya we know exactly what this costs before we decide on the technology… And exactly in an interview I can sit there and talk about the challenges that I had with group projects such as this working, but that is pretty positive to say I was working with a group in India for a semester on a sewer treatment plan opposed to I worked by myself on a really expensive widget for, you know, a niche market in the U.S. For me that's way more valuable than… so I don't know.

APPENDIX C

INNOVATION SPACE INTERVIEW QUESTIONS

1. Briefly tell me about your team's project.

2. Do you think you learned more taking innovation space versus what you would have learned in the fourth year studio?

   a. Why is that?...because of the multi-disciplinary teams? The scope of the project?

3. What was the most important aspect of this class for you?

4. After experiencing working in multi-disciplinary teams, do you feel better equipped to tackle real-world problems?

5. Did working in multidisciplinary teams affect or change your personal design philosophy (the way you view and practice design)?

6. Do you think working on socially embedded projects (projects that help others) better equips you to tackle real-world problems?

7. Do you learn more from designing a product for yourself or others?

8. When designing for others do you find it important to research them? Their background, experiences, culture?

Culture- a group of individuals who share a common set of behaviors and beliefs

9. In your education did you have the opportunity to learn from other cultures?

   a. Did you get the chance to fully immerse yourself in a different culture?

   b. What did you gain from that experience?

   c. Would you consider this a critical experience of your education?

   d. Do you think learning about other cultures improved/ enhanced your design philosophy?

10.   What does sustainability mean to you?

11.   Did learning sustainable measures change your design philosophy?

12.   Do you think learning about sustainability was a critical aspect of your

education?

     a.   Why was it so critical?

13.   Do you think designers can lead a global transformation (change the

world)?

     a.   What skills does a designer need to lead a global transformation?

     b.   Did you learn or enhance any of these skills in Innovation Space?

14.   What can lead to discipline innovation in design (what can push the

design industry forward)?

     a.   Is it important that design education foster discipline innovation?

15.   How can designers lead global innovation (how can design push the

world forward)?

     a.   What skills must designers possess to help lead and create global

innovations?

16.   Can a personal transformational experience affect your design

philosophy?

     a.   What experiences do you consider personally transformational

(what experiences have had a huge impact on you)?

     b.   Do you think socially embedded projects (projects focusing on

helping others) are personally transformational?

     c.   Do you find learning new skills transformational?

17. Do you think that learning about sustainability and being integrated with other cultures is an education that could lead to global innovations through design?

18. Do you think learning from other disciplines while working on socially embedded projects (projects that help others) led to personal growth?

19. Do you think personal growth is as important as learning tangible tools like design software and building craft?

20. In order of importance in design education, please rank these four things:

    -learning how to help others

    -learning about cultures

    -learning about sustainability

    -learning how to work in multidisciplinary teams

21. Do you think a design education that incorporates these four things: multiple disciplines, sustainability, social embeddedness and cultural integration, would benefit future designers?

22. Think of your favorite project from school, maybe the project that taught you the most, or meant the most to you for some reason. What was the project?

    a. Did it help others?

    b. Was it sustainable?

    c. Did you have to research the users?

    d. Did you work with others or have input or critiques from others?

23. Out of your entire education, what would you say was the most critical aspect? What should future designers be taught?

24. Do you think it is important for education to help design students find/

build a personal design philosophy and not just technical skills?

APPENDIX D

SAMPLE INNOVATION SPACE INTERVIEW TRANSCRIPTION

Note: This is a sample of how students responded to the questions. In order to conceal the student's identities these answers come from all of the interviews and were randomly selected for each question.

1.   Briefly tell me about your team's project.

Our project is related to finding biomarkers, finding biomarkers in the blood and trying to apply that to a project. Through all the research we've come down to a whole system of products. We have an arm band called Mii Go Fit which can take blood pressure and it makes simple readings and relay them directly on to a screen which is on the band, but it also links to an at home device that can take blood and saliva samples which can track your T-cell count if you had HIV, or cancer looking for if you had a recurrence and stuff like that. So it links to this at home device which gives you more information and can do more testing, and that links to your doctor, so it is all tele-medicine based so you'll be able to communicate with your doctor or if something spikes these devices will let you know and that can let your doctor know. Through web cam you can communicate with your doctor and decide to come to the office rather than you having to guess or let it be. So it makes you more proactive.

2.   Do you think you learned more taking innovation space versus what you would have learned in the fourth year studio?

Absolutely. I was actually just talking about this with my dad yesterday and also with one of my classmates. I think what has set innovation space apart from the regular senior studio is interdisciplinary collaboration. In the other studio the only teamwork done is between designers who all think alike, and

there is no one there to challenge your preconceived notions. Whereas in innovation space you may have an idea that from a design and engineering standpoint is great, but the business student will come in and say 'where is the profit?' Or 'how can I make this a good product on the market?' So with innovation space I don't think it has been so much the content, as it has enabled me to collaborate with others.

3.   What was the most important aspect of this class for you?

Learning how to collaborate, being able to work with the graphic designer, engineer, and business student. Learning how the physical components become our product and learning more about manufacturing was very interesting.

4.   After experiencing working in multi-disciplinary teams, do you feel better equipped to tackle real-world problems?

Most definitely.

5.   Did working in multidisciplinary teams affect or change your personal design philosophy (the way you view and practice design)?

Yes, definitely. Prior to this year, I had a strong traditional view of industrial design. I was content being the stylist, but having gone through an interdisciplinary program, my view on design still includes the traditional design skills, but the term designer is more broad and our job is to merge intricate environments into elegant solutions. As industrial designers, our job is to take all those requirements and synthesize them into one elegant, well conceived solution. That is where we will be able to add value to companies.

6. Do you think working on socially embedded projects (projects that help others) better equips you to tackle real-world problems?

Absolutely, no doubt about that. I think that human nature has created and produced a standard of living for everybody that has increased. I think this social responsible aspect of it is something I want to do for two reasons: one, in this case the diabetes impacts me emotionally and I want to take care of that and make life easier on my wife, my kid, and myself. Second, doing something or designing something that is desired because it is a necessity if something that is stable, it's a good job, good money; it's something that somebody really needs. It's good for people and is good for my bank account.

7. Do you learn more from designing a product for yourself or others?

Definitely for others. Designing for others not only helps others but it also helps us re-evaluate what our own concerns are.

8. When designing for others do you find it important to research them? Their background, experiences, culture?

Culture- a group of individuals who share a common set of behaviors and beliefs

Yes definitely. I think that is most important part of the design process. I also think you can have the most impact because of the research stage. The research is really what focuses a product in a way to be successful.

9. In your education did you have the opportunity to learn from other cultures?

a. Did you get the chance to fully immerse yourself in a different culture?

I think so. Being able to go over to Ghana was an immersion in a completely different culture. It has been one of the most valuable parts of my education. I've learned more being immersed in different cultures then I have from any one teacher or course.

b.   Would you consider this a critical experience of your education?

Most definitely. My focus was very narrow before I took classes outside of the design school. Taking global resolve broadened my scope and really enriched my experience.

c.   Do you think learning about other cultures improved/ enhanced your design philosophy?

Yes definitely. It is enhanced for sure, and I would consider it improved. I feel like I have a more focused direction and I am a much more valuable designer as a result of it.

d.   Do you think learning about other cultures improved/ enhanced your design philosophy?

Yes, my design philosophy has definitely changed. I've become more aware of things.

10.   What does sustainability mean to you?

What sustainability means to me is the ability to continue on a path without creating or making impacts that negatively affect people, places, and things. The sustainable philosophy is, what am I going to do today to make the world a better place. The bigger picture, because of my work with global resolve, is taking it from a material definition to thinking about the intended and unintended consequences of every action. Unfortunately, sustainability is

becoming an overused word that no one truly understands or believes in. To me sustainability has gone from something that was just material to an idea that is almost metaphysical.

11. Did learning sustainable measures change your design philosophy?

Yes. I think what is exciting, is when you look at sustainability as a new challenge to prove our value as designers. My philosophy on sustainability and design is that it is our mission to make things better for the world, both from an ecological and functional standpoint. So to me, learning about sustainability, in order to be a kick ass designer, you need to improve function but also make it sustainable and profitable.

12. Do you think learning about sustainability was a critical aspect of your education?

I think it was important, it would be hard not to be aware of these issues, but the specific classes we took didn't prepare me too much to practice sustainability. It is an important part, but it hasn't been that critical to my education, maybe if it was incorporated better it would be different. I am excited for biomimicry, to see how that will play out in design.

13. Do you think designers can lead a global transformation (change the world)?

Yes I do. It's a little cliché but I really think we design the world were in. All of us do, so if designers can't change the world, I am not sure who can. So we are going to have to make that push and keep going in that direction, it could take a long time but it needs to be done.

a. What skills does a designer need to lead a global transformation?

We have to have the ability to sell our ideas. Designers, to be that global change, have to be able to sell their ideas. They have to convince non-designers of the value of their ideas. We need to have more social science research skills, and be able to know what the social implications of our solutions are. We still have to be able to sketch. I think visuals will always be a part of our toolbox, and if our toolbox decays, our value decays, our ability to convince decays, and then the value of our ideas decay. The ability to speak, the ability to do solid research and back it up, the ability to sketch or visualized our ideas, and then I think, a little bit similar to social science research, we have to be able to quantify and prove the validity of our concepts. I have noticed in design school, at the end of the semester, we are not really held to a feasibility bar. So we have to be able to prove our ideas if we are going to enact on this change.

b.   Did you learn or enhance any of these skills in Innovation Space?

Yes, definitely. Doing research completely changed my design, which was a product of an innovation space experience.

14.   What can lead to discipline innovation in design (what can push the design industry forward)?

I think these new movements, like the biomimicry movement, that is so different and so new, that is bringing in the biologists, and the whole science community. We are starting to cross discipline with disciplines that we hadn't before, and I think things like that excite us and get us going. It's a big push, we have to stay conscience so we don't go too far with it and then look back and

wonder if we were being effective. New things like this gets design going in the right direction but we have to stay conscious of where we are going.

a. Do you think this is important for design education in the future?

Yes, I think big time. I love that biomimicry is being implemented into many classes. I also think we should explore other avenues and start thinking outside of the box. It's going to be crucial if we want to be ahead and if we really want to do this global change.

15. Can a personal transformational experience affect your design philosophy?

Yes definitely. You see people in studio wanting to work on certain projects because it affects them or they're passionate about it. I think the really harsh, terrible experiences sometimes foster the best ideas. We all want to have a solution to our problems. Everyone faces problems, and as designers we want to tackle, or solve, those problems. The more experiences you have, good or bad, are all going to affect your design philosophy, your choices, and the way you think.

a. Do you think socially embedded projects (projects focusing on helping others) are personally transformational?

Yes. I think also when you get to know your user and watch their reaction to a prototype, how excited they get about something so little that can change their life, really inspires you as a designer to design meaningful things. For me, that's super beneficial and I love that.

b. Do you find learning new skills transformational?

Yes, I think they can change everything about your design. In sophomore year, when we learn computer aided design, it flipped our world upside down, and we loved it.

16. Do you think that learning about sustainability and being integrated with other cultures is an education that could lead to global innovations through design?

Yes, but again I think it's more about the experiences of these things then learning about them. These are things that can't be learned from someone telling you how it is; you have to experience it for yourself in order to design for them.

17. Do you think learning from other disciplines while working on socially embedded projects (projects that help others) led to personal growth?

Yes definitely. Just interacting with many different kinds of people makes you a more well-rounded person, especially when you have the social implications that you have to be conscious of everything you do. Having a larger social outlook is definitely what leads to personal growth.

18. Do you think personal growth is as important as learning tangible tools like design software and building craft?

I think that personal growth is more important than those tangible tools because, for the most part, those skills can be learned by anybody. It is that personal growth that teaches you how to use those tools. It's that personal passion and desire to become an expert in one of these areas. The tools mean nothing without the personal understanding and growth to use them.

19. In order of importance in design education, please rank these four things:

1 -learning how to help others

3 -learning about cultures

4 -learning about sustainability

2 -learning how to work in multidisciplinary teams

20. Do you think a design education that incorporates these four things: multiple disciplines, sustainability, social embeddedness and cultural integration, would benefit future designers?

Yes, absolutely. Those things completely change our entire approach of design

21. Think of your favorite project from school, maybe the project that taught you the most, or meant the most to you for some reason. What was the project?

I would say it's this innovation space project.

22. Out of your entire education, what would you say was the most critical aspect? What should future designers be taught?

The idea that you are not designing for yourself is important. Being open to suggestions is also very important. Design is a process, analyze and identify the user's needs, don't project your ideas onto a product. Design for others and not yourself.

23. Do you think it is important for education to help design students find/ build a personal design philosophy and not just technical skills?

I think so. I think that is a responsibility of a responsible research based program. You need to foster the idea of good design and what is truly important. In education you should be taught how to design, what to design, and why to design.