DISSERTATION

KUWAITI ENGINEERS' PERSPECTIVES OF THE ENGINEERING SENIOR DESIGN (CAPSTONE) COURSE AS RELATED TO THEIR PROFESSIONAL EXPERIENCES

Submitted by

Abdullah AlSagheer

School of Education

In partial fulfillment of the requirements

For the Degree of Doctor of Philosophy

Colorado State University

Fort Collins, Colorado

Fall 2010

COLORADO STATE UNIVERSITY

August 30, 2010

WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY ABDULLAH ALSAGHEER ENTITLED KUWAITI ENGINEERS' PERSPECTIVES OF THE ENGINEERING SENIOR DESIGN (CAPSTONE) COURSE AS RELATED TO THEIR PROFESSIONAL EXPERIENCES BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

Committee on Graduate Work

_____
Sharon K. Anderson

_____
James H. Banning

_____
Yashwant K. Malaiya

_____
Advisor: Donald G. Quick

_____
Interim Director: Jean Lehmann

ABSTRACT OF DISSERTATION

KUWAITI ENGINEERS' PERSPECTIVES OF THE ENGINEERING SENIOR DESIGN (CAPSTONE) COURSE AS RELATED TO THEIR PROFESSIONAL EXPERIENCES

This study looks into transfer of learning and its application in the actual employment of engineering students after graduation. At Kuwait University, a capstone course is being offered that aims to ensure that students amalgamate all kinds of engineering skills to apply to their work. Within a basic interpretive, qualitative study-design methodology, I interviewed 12 engineers who have recently experienced the senior design course at Kuwait University and are presently working in industry. From the analysis, four basic themes emerged that further delineate the focus of the entire study. The themes are 1) need for the capstone course, 2) applicability of and problems with the capstone course, 3) industry problems with training, and 4) students' attitudes toward the capstone course.

The study concludes that participants are not transferring engineering skills; rather, they are transferring all types of instructions they have been given during their course of study at the university. A frequent statement is that the capstone course should be improved and specifically that it is necessary to improve upon the timing, schedule, teachers' behavior, contents, and format. The study concludes that Kuwaiti engineers on the whole face problems with time management and management support.

The study includes some implications for Kuwait University and recommendations that can provide significant support for the development of the Senior Design (Capstone) Course. For examples: the project must be divided into phases to ensure timely completion of deliverables. In order to motivate students for hard work and to achieve true transfer of learning, Kuwait University is required to communicate with certain organizations to place its students at their research centers for capstone projects. All universities, including Kuwait University, should hire faculty specifically to run the capstone course.

In conclusion, the study includes some suggestions for further research studies focused on issues related to the Senior Design (Capstone) Course. Future researchers should focus on developing the project-based course in earlier stages of students' educational program by investigating more about the relationship between student achievement and the market demand.

Abdullah AlSagheer
School of Education
Colorado State University
Fort Collins, CO 80523
Fall 2010

DEDICATION

First, I want to gratefully thank Almighty Allah for all blessings. Without my mother Najat AlRefai and my father Mohammad AlSagheer's support, I could not finish this long journey and I could not achieve my dreams. They support me financially and emotionally. They deserve the greatest thanks. Also, I would like to thank my sister, Areej, for her support. She felt every moment during my journey. Moreover, I have to thank my brothers, Nawaf and Fawaz. I have to say thank you all for your powerful support. At the end, I would like to dedicate this to all of my family members, including my nieces, Sadan, Lateefa, and Aseel and my only nephew, Mohammad. Thank you for everything. Thank you for helping me to accomplish my dream. I am proud of having all of your support.

ACKNOWLEDGMENTS

I would like to thank my advisor, Dr. Don Quick, Assistant Professor, for his great guidance and for his help. I think without his advice I could not have reached this point and finished the journey of both my degrees. He showed me the way of how to be a leader and take the decision to complete both my degrees. He is a real friend. In my culture, the friend should be with you in the good and bad times. I really appreciate his support. He is the mentor for my decisions.

Also, I would like to thank my methodologist, Dr James Banning, Professor, for his support. He is one of the best professors that I have had. He usually thinks in a constructive way. He helped me a lot by directing me to improve my skills for how to collect data. I really learned a lot from him. I have to say that when I started the program as an engineer, I thought that I should go with the quantitative research method. Then I changed my mind to go with the qualitative research method for my dissertation. I think that I learned a lot; it was a new challenge and experience to me. I really enjoyed the qualitative research method because of Jim.

Dr. Sharon Anderson, Associate Professor, was the first person I met in the School of Education. She is one of the best professors that I have had. I enjoyed her classes. She played a great role in framing my leadership skills. I learned a lot from her to be more professional and ethical leader. I really appreciate her support. She also played a main role in my dissertation.

Moreover, I have to thank Dr. Yashwant K. Malaiya, Professor in the Computer Science Department, for his guidance. He was willing to support my dissertation because he knew that there is a real need to investigate such a topic. I learned a lot from him as a technical expert. Moreover, he always showed me the path to follow. I really appreciate his support and effort.

Last but not least, I would like to thank all my friends and colleagues who helped me and supported me all the time. I think I could not have reached this point without your support. Thank you for everything. Your support was the power for me to achieve my goal.

Thank you all.

CONTENTS

CHAPTER 1: INTRODUCTION

"Tell me and I forget. Teach me and I remember. Involve me and I learn."

Benjamin Franklin

It was my sixth week in internship with a few of my classmates after having completed one of my senior engineering courses. We used to study together, and we have experienced the same courses and same teachers. Part of our senior design course of the previous semester was to learn how to operate different measuring instruments. However, all of us, including me, did not know how to operate the instruments accurately. This realization was a bit shocking for our mentor because this was something we were supposed to know. This situation opened up a door in my mind about the real effectiveness of the senior design course in engineering. It also focused me on thinking, "Is the senior design course adding any value? What are the problems in the senior design course that hinder students from fully implementing the skills they learn in it?" This thought brought forth my idea to explore the senior design course: its usability and its capacity to enable students to transfer their learning so they can apply the skills they learn in the course to their professional life.

Transfer of learning is probably one of the most effective methods for acquiring knowledge, skills, and understanding. One way to think of transfer of learning is that it is the application of skills learned in one context to another area or context. It also is the study of the dependency of human conduct and learning on prior experience. Transfer of learning has become a central issue for many educational theorists. The question of what

methods in fact help individuals to transfer learning from one context to another has continued to gain attention since the concept was introduced (Koch, 2004). Various theorists have discussed different perspectives in this context in their attempts to find the best methods for successful transfer of learning. And in fact the topic is even broader because effective methods of learning transfer may differ for every type of study. In other words, it is possible that one method that works in one discipline may not be applicable in other disciplines. For instance, theoretical models are likely to help students understand behavioral models, whereas one expects that practical studies may be more useful in medicine and biology. Because of the wide variability in transfer-of-learning approaches and methods among the various disciplines, we cannot safely make generalizations about the transfer of learning (Kirwan & Birchall, 2006).

Almost every engineering program has a capstone project or senior design course in which students recap their entire program of study. In general, the senior design course includes practical application of the cumulative theoretical knowledge and learning students have acquired during their coursework. For instance, the capstone course being offered by the United States Air Force Academy challenges students to transform their technical designs into a comprehensive construction project plan that considers the site, the construction issues, and the local community (Jenkins, Pocock, Zuraski, Meade, Mitchell, & Farrington, 2002). Similarly, the capstone course at Kuwait University requires students to actually build a new engineering concept by developing a unique procedure (Savsar & Allahverdi, 2008). The current study focuses specifically on discovering the value of the engineering senior design course as a method for transferring students' learning to their real-life engineering work. I will assess this relationship by

investigating the utility of the engineering senior design course to graduates' work in the industry.

Background

A study of the literature in the field presents a broader point of view on transfer of learning. There are numerous studies available that deal with a variety of related issues. To formulate the proposal for this study, I have studied a wide range of literature. To develop a premise for discussion, we can use the study of Haskell (2001), who asserted that transfer of learning includes all types of instruction only if the transfer of learning, or the stated benefits of learning, can be achieved.

An examination of the literature particularly from an engineering studies perspective suggests that transfer of learning is critical in engineering courses. All the various engineering fields, such as software engineering, civil engineering, mechanical engineering, and others depend on the application of knowledge that engineers have acquired during their formal studies. The core strength of engineering disciplines is their capacity to enable students to transform their initial knowledge into advanced knowledge. As the literature suggests, frequent communication between faculty and students, as well as students' personal growth and the enhancement of their learning to include interpersonal and interorganizational behavior, increase this potential.

Another school of thought is reflected in Holton's (1996) assertion that training methods adopted in engineering courses are ineffective. He claims that engineering programs cater to cognitive learning, but that job training is not sufficient. Endorsing this same view, he also stated that transfer of learning works only when the original and transfer situations are similar.

Literature pertaining to transfer-of-learning theories and methods reflects a constant tension between which of the methods available are most effective in helping students to apply the skills they have learned in one course to another course. The wide range of literature focused on the transfer of learning has generally clarified the objective of learning transfer and its benefits; the present literature, however, is most focused on finding the best available method.

Looking at this topic from the perspective of our target audience—i.e., students in the engineering senior design (capstone) course, the current literature presents broader viewpoints on the applicability of methods one learns as a student to actual industrial work. Jiusto and Dibiasio (2006), Fentiman and Demel (1995), Mahendran (1995), Maskell (1999), and Turner (2001) have focused more on the overall course of study during the students' engineering program; whereas Scott (2004) has focused on the application of the senior design course as an emergent issue. There is a wide variety of literature that argues in particular the fact that the senior design course helps students. However, this issue has not yet been explored in the context of Kuwait, and specifically not from the perspective of Kuwait University in particular. This proposed study will attempt to explore the value and usefulness of the senior design course in the industrial work of Kuwaiti engineers who are graduates of Kuwait University.

In Kuwait, the senior design course is similar to such courses offered around the world. The course is designed on the principles of the Accreditation Board for Engineering and Technology (ABET), which imply the establishment of objectives and criteria, synthesis, analysis, construction, testing, and evaluation. The course is an attempt to expose students to creative design and synthesis in a number of industrial and system

engineering areas. The course is structured as different phases that include the selection of a topic of study, development of problem area definitions, formation of groups, and communication for solving the problems. The course is being evaluated using a number of criteria, including but not limited to written reports, presentations, meetings, team evaluation, and adherence to deadlines (Savsar & Allahverdi, 2008).

However, the senior design (capstone) course at Kuwait University looks like an independent-study course. Groups of students register for the course under the supervision of a faculty member. The students work independently with the faculty member by selecting a topic, collecting data, and designing their project. At the end of the semester, the College of Engineering makes an exhibition of all senior design projects for all the disciplines.

If I analyze my experience in my internship and the senior design course, I realize that I observed many gaps in the students' skills. Students who had already passed through the senior design evaluation were unable to perform in the actual industry. This fact specifically provoked my question about the usability of the senior design course. The most important issue was whether students should complete this course because in some cases it seemed unable to prepare them for practical life. It was a sheer matter of concern about whether or not the senior design course prepares the students for actual industrial life. For this reason, I chose the issue as my core study topic and formalized the study to discover the facts.

Statement of the Research Problem

Transfer of learning though the capstone course has remained the center of attention for a number of theorists; however, it is a difficult area to understand.

Theoretically, senior design/capstone study courses are designed to help the student in practical life; however, actually knowing the extent of the courses' applicability in industrial work appears to be quite difficult. Except by directly communicating with students and asking their experiences, it is a difficult, although not unique, phenomenon to observe. Studies such as those of Haskell (2000) and Ellis (1965) have been conducted in this regard, and universities have always had a desire to improve in this area. The literature has covered the aforementioned problem extensively, whereas this proposed study will discuss the specifically identified area.

This present study is significant because it attempts to determine whether the capstone course helps in the transfer of learning and enables students to apply skills they have attained during their academic life in the actual industrial scenario. Finding this out is important from all perspectives, including those of students, faculties, and engineering institutes because application of this knowledge will help to improve the methods used for transfer of learning.

Without a strong focus on the transfer of learning, the role of educational institutes and teachers is blurred. In my opinion, until we reach the point at which students attain maximum use from what has been taught in class, the value of the educational program is significantly limited. It is a great matter of concern to know whether the senior design course is fulfilling its objective of enabling students to transfer their knowledge. This is in a way a cost-benefit analysis of the senior design course because the course should be offered only if its benefits exceed its cost. As previously stated, the problem has already been explored in the literature, but primarily from the point of view of teachers. For example, Kunda (1992) investigated the same issue from

the perspective of teachers and from third parties. But the perspective of students remains unknown. I will use Kunda's findings to develop a basis for the proposed study and explore the topic from the perspective of the students. In addition, I will assess in the proposed study how former students evaluate their senior design course experiences in the context of their respective engineering environments.

I anticipate that the evaluation of the capstone study courses and their respective application to the engineering industry in Kuwait will help students and faculty on a large scale. Knowing the gaps in Kuwait's current study program and its limited ability to prepare students for actual industrial challenges, I foresee that this research is likely to improve the transfer-of-learning methods adopted in the future in the senior design course. The insight of students is an extremely useful tool in designing future courses of study, including the senior design course. This study will also generate additional knowledge for the engineering industry. The industry in general and employing companies in particular will develop confidence that graduates coming from a background that includes the senior design course are more skilled, need less training, and are more comfortable in general with engineering tools and methods and their application.

By observing via the literature the general conditions of the engineering industry and the approaches to transfer of learning in Kuwait, I will formulate the study questions in terms of the applicability of the engineering senior design course to transfer of learning in Kuwait University.

Research Questions

The main research question that guided this basic interpretive qualitative study is *What is the meaning of the students' experiences in the senior design course with respect to the course's applicability to their experiences in the industry?* The research sub-questions that I pursued are:

- What do students gain during the senior design course that is helpful in their actual work in engineering?
- What is the value of the senior design course to the working engineer?
- What senior design course method helps the most?
- What do the participants suggest as ways of improving the transfer of learning from the senior design course to the field of work?

Researcher's Perspective

As a Kuwaiti young man in elementary school, I was dreaming of pursuing my doctorate degree from the United States of America. At the high-school level, I was studying hard to get a high grade point average (GPA). I got 4.00 out of 4.00. It was a really great GPA for getting a scholarship from the Ministry of Higher Education of the State of Kuwait. I had chosen to study computer engineering. After having spent all the years from 1999 to 2007 at California State University Long Beach (CSULB), I got my undergraduate degrees (and double major) of Bachelor of Science in Computer Engineering and Bachelor of Science in Electrical Engineering. Also, I earned my post-graduate degree of Master of Science in Electrical Engineering from CSULB. However, nothing could stop me from achieving my goal. I started my Doctor of Philosophy in Electrical Engineering at Colorado State University. I had recognized that most of the

engineering professors did not have the skills for teaching. Even though they are experts in their fields, that doesn't mean that they know how to teach. I also recognized that there is a high demand for reforming engineering education. As a result, I decided to change my major to Education and Human Resource Studies and specialize in Interdisciplinary Studies. I decided to make changes in one of the most important phases in an engineering student's education: The capstone course is where the students are to apply and implement what they have learned in their entire engineering course of study. I will do my best to improve the engineering education field and to start a new era in reforming engineering education.

I have selected this topic because it relates to my personal experiences. During my internship period, I found a significant gap between the practical skills engineers require and the engineering skills being taught at the university. In my perspective, the senior design course was ineffective in terms of its usability in industry. I also felt that the universities incur higher cost on these courses, which may be an unnecessary burden for them if the courses are not fulfilling their objectives. I also had worked in close liaison with teachers in my capacity as an assistant, and I believed that the university would recognize my suggestions as worthy.

For this reason, I decided to take the step toward analyzing the effectiveness of this course. The input on which to base this analysis must be derived from the experiences of students, which is a difficult task. Everyone has a different understanding and perspective of the senior design course, and one course may not be equally beneficial for all. In this context, I faced a dilemma about how I would generalize the study.

During my internship, what I observed established my frame of mind about the specific conclusion I might draw from such a study. Although qualitative studies usually do not have a hypothesis, I had a view in my mind that capstone courses are not doing what they are intended to do. This was based on my observation during the internship, where most of the students failed to properly implement the contents of the capstone course. This hypothesis can also be called a bias because I had a belief that analysis would result in the conclusion that capstone courses are ineffective.

To eliminate this bias, I decided to rely on a combination of observation, experience, and literature. Amalgamating all three aspects has brought significant balance to the ideas presented in my research and will provide me with an opportunity to compare my biases to the other perspectives from the literature and the students' input.

As noted previously, in my perspective this study is important because capstone courses are expensive for the university and time consuming for students. Universities hire external people to evaluate courses and to manage specific advisory boards and members for the purpose of guiding students in all respects. At the same time, students usually spend a complete semester in this course. And if the course does provide the intended benefits, then all of the students' time and the university's investment represent a loss.

CHAPTER 2: REVIEW OF THE LITERATURE

A review of the literature, which contributes to an understanding of the effectiveness of transfer-of-learning theory and the importance of the senior design capstone courses in different environments and cultures, provided the conceptual framework for this study. The study will help to describe the goals and perceived outcomes of transfer-of-learning principles applied in different settings and situations. In the study, I assess teachers' and instructors' perceptions of knowledge, skills, and attitudes toward teacher-preparation programs in different cultures, including Kuwait; and I compare these aspects in Kuwaiti culture with those of Western cultures. In addition, I describe and analyze the perceived knowledge, skills, and attitudes of teachers and students in different conditions and states of transfer-of-learning processes. Finally, I analyze the impact of these factors by observing the effectiveness of students participating in the senior design capstone courses and by discussing different aspects of engineering transfer-of-learning principles.

A discussion of the Kuwaiti transfer-of-learning process and the differences between that process and the Western process brings together much information. This study will help the educational decision makers in Kuwait and other countries; it will support their teacher-preparation programs and decision-making processes regarding what is needed to make those programs and various workshops more effective.

I have divided the literature of this study into two main sections. The first section pertains to the transfer of learning and its various aspects in information technology (IT)

and engineering. This section emphasizes Kuwait's transfer-of-learning process and the differences between this and the Western process. The second section provides a discussion of the senior design capstone courses; this discussion specifically emphasizes those courses within the College of Engineering at Kuwait University. Both sections combine to offer clear and concise themes that are concerned with the basic research questions in this study. I relate several research report findings and recommendations on studies to make sense of the whole literature review.

Transfer of Learning

Cree and Macaulay (2001) have defined transfer of learning as the ultimate aim of teaching; however, achieving this goal is regarded as one of teaching's most formidable challenges. In the educational field, transfer of learning is regarded as a cornerstone: From the different levels of elementary, secondary, vocational, and industrial training, to higher education, we learn in different milieus and frameworks, and we apply and recognize that learning to different situations. We can call this process transfer of learning, "the very meaning of learning itself" (Haskell, 2000, p. 3).

Transfer of learning has been defined as "putting into practice the skills, knowledge, and attitudes that were gained through learning intervention on [*sic*] either the classroom or on job training in a specific working environment" (Rambau, 2005, p. 18).

Similarly, Ellis (1965) also highlighted the meaning of transfer of learning: "Experience or performance on one task influences performance on some subsequent task." The transfer of learning makes certain that the knowledge and skills that one acquires during a learning intervention are then applied successfully on the job.

Educators, learners, and employers often face difficulties ensuring that the learning in the classroom will have a broader effect in the workplace. The focus here is on adult learners in different contexts, such as professional and vocational. The objective of the transfer-of-learning concept is that providing multifaceted perspectives about education, psychology, management, and other fields will enhance and deepen students' understanding in their fields. Therefore, we can regard transfer of learning as a "pervading concept that is intrinsically linked to the way we lead our lives everyday" (Leberman, McDonald, & Doyle, 2006, p. 1).

Various factors affect the transfer of learning. "First, some initial acquisition of knowledge is necessary for transfer"; and second, the "context also plays a pivotal role in the transfer. If the knowledge learned is too tightly bound to the context in which it was learned, transfer to superficially different contexts will be reduced significantly" (Mestre, 2002, p. 27).

Benefits of Transfer of Learning

Transfer of learning plays an important role in improving people's ability to learn new skills more proficiently because of their prior practice on a series of related tasks. This capability helps them to acquire new views on a topic by seeing different approaches to a task, which strengthens their understanding of the topic.

> For example, practicing to drive a variety of cars provides experience with different stimulus situations and makes new learning easier. Another example is that greater learning occurs not by rereading the same text, but by reading another text on the same subject matter. (Transfer of Learning, 2009, para. 12)

Governmental agencies and private-sector companies, as well as schools and other associations, have become greatly interested in the evaluation and assessment of transfer of knowledge from training and development programs. One of the greatest

benefits of transfer of learning is the practice that individuals implement in their work after they have received particular training in specific fields. Transfer of learning enhances the training in any area or in any workshop. According to Enos, Kehrhahn, and Bell (2003), "New perspectives are offered on the interrelationship between informal learning and transfer of learning, the role of metacognition and self-regulation in informal learning, and the influence of informal learning in the development of managerial proficiency" (p. 369).

Haskell (2001) proposed a general theory of transfer that requires 11 learning and instructional principles in order for significant transfer and learning to occur. These basic principles indicate that transfer undergirds all aspects of learning, thinking, problem solving, and memory. In addition, the transfer of learning plays a pervasive and central role in our daily lives and fulfills the demands of the No Child Left Behind Act (Haskell 2001). When the transfer is effective, teachers and students will be better prepared to meet the demands and challenges of state standards, benchmarks, and grade-level expectations.

Different Aspects of Transfer of Learning in Engineering

As noted, the transfer of learning usually occurs when learners use what they have learned in different situations and conditions. We can observe different aspects of transfer of learning in engineering universities, electrical companies, and in workshops, among other instances. For example,

> If the chip designers at Intel could not transfer in their prior learning to facilitate the design of new chips, Intel would be too inefficient to keep up with its competitors. At the same time, if the chip designers did not go beyond their prior knowledge, there would be no innovative product designs. (Schwartz, Verma, & Martin, 2008, p. 481)

Therefore, understanding the relationship of transfer of learning to conceptual change may help in creating conditions that foster innovation.

When one considers the knowledge work and the teamwork involved in the field of consulting engineering, one often notices that the teamwork is characterized by the pressures within the environment. The production of knowledge and learning coexists with and is embedded in continual political processes of negotiation about the content of the work, as well as in the frames around the work (Kunda, 1992).

Consulting engineering companies play a central role in knowledge production in the construction sector. These companies are often described as knowledge-intensive business service firms. The different companies cope with the dynamics of their projects by balancing various tensions around project teamwork. They therefore are continually doing "analyses [of] whether knowledge management initiatives might enhance knowledge production in and across projects, thereby promoting organizational knowledge production rather than single project production" (Koch, 2004, p. 278). Project learning in engineering consulting companies is reflected through various means and is clearly limited by the logic of the single-project economy.

In engineering workshops, enrollment and training are regarded as important ways of developing knowledge resources. These knowledge resources come from the style of the learning transfer, which further enhances efforts to make the company an attractive place to work, encourages employees to stay with the firm, and builds up the employees' loyalty.

Some researchers have suggested that there is now enough significant data that shows positive results in personal growth and improved interpersonal and

intraorganizational behaviors for scholars to endorse experiential learning in the form of human-relations training as a means of inducing desired organizational changes (Rodenbaugh, 2001). The extent to which this training will prove to be fruitful comes from the area of knowledge management, but its value is not uncontested since some managers and employees feel they mostly learn by participating in direct project work. We can consider the knowledge-sharing behavior as a primary effort toward realizing success in engineering companies and workshops.

Accessibility and Usability Issues

The ability to transfer knowledge learned in one environment in order to improve performance in a different environment is a hallmark of human intelligence. “Insights into human transfer [of] learning help us to design computer-based agents that can better adapt to new environments without the need for substantial reprogramming” (Cook Holder & Youngblood, 2007, Abstract).

In earlier times, different classical methods for teaching engineering relied on the limited interactions between faculty members and undergraduate students that usually occurred in relatively large classes. However, much improvement has been made in the past decade to create university research centers of excellence in science and engineering that are focused on a particular area of technology or basic science.

> Instead of expecting the teaching faculty to generate exciting practical ideas for a relatively large group of senior students, the center encourages local industry to propose potential design projects to be pursued by teams consisting of engineers, students, and faculty members. (Ozaturk, 1995, p. 127)

Workshops also play an important part in the learning-transfer process. Transferring learning and giving the training its final impact is a basic theme of workshops. In most engineering workshops, the learners develop and expand strong links

between their course experiences and their everyday world in different ways. They learn how to arrange and organize their reviews; to integrate appraisal, feedback, and action plans; and, finally, to evaluate these components in their programs. The Mudd Design Workshops (Dym, Sheppard, & Wesner, 2001) have played a positive role in transfer-of-learning principles by providing useful insight, advice, and information to educators about how they might think about the future of design and design-related computing, and about the roles of organized centers (of design and related focuses) in engineering education.

Some of the basic themes of the Mudd Design Workshops are to

- Identify the key themes and learning brought out during the entire workshop; and to include culture, values, and the notion of intent in the academic program.
- Include assessment and continuous improvement in the program.
- Focus on projects and experiential design learning: Participants must design projects.
- Address grading and learning in new ways. (p. 295)

This set of themes represents a synthesis of individual workshop presentations and countless hallway discussions. It also focuses on learning rather than teaching, and coaching rather than teaching, as the methodology of the educator.

Theoretical Framework

Holton (1996) stated that one cause of failure to transfer training is that training design rarely provides for transfer of learning. That is, cognitive learning may well occur, but program participants may not have an opportunity to practice the training in a job

context or may not be taught how to apply their knowledge on the job. So the training itself can have a direct influence on the transfer of that training. The two primary viewpoints that describe the conditions necessary for transfer are the identical elements and the principles theories (Yamnill & McLean, 2001).

Identical elements theory. We can trace one view of learning transfer to the theory of identical elements that Thorndike and Woodworth (1901) proposed. This theory presumed that transfer will occur in situations in which identical elements exist in both the original and transfer situations. The degree and types of transfer that occur will be determined by the similarity of the two situations (Smith, 1991). Applying this theory to the engineering transfer-of-learning context, we can assume that if the task is identical in both the training and transfer settings in the workshops, trainees are simply practicing the final task during training and there should be high positive transfer.

Principles theory: Haskell's theoretical framework for achieving general transfer. To resolve past and current failures of transfer of learning in the classroom, which he believed was due predominantly to a perceived insufficient theoretical base, Haskell (2001) enumerated 11 learning and instructional principles in his theoretical framework for achieving general transfer. These learning and instructional principles, which shall be discussed individually in future studies, are as follows:

1. First Principle of Transfer: Primary Knowledge Base
2. Second Principle of Transfer: Peripheral Knowledge
3. Third Principle of Transfer: History of Transfer Area(s)
4. Fourth Principle of Transfer: Motivation
5. Fifth Principle of Transfer: Nature and Function of Transfer

6. Sixth Principle of Transfer: Orientation to Think and Encode in Transfer Terms
7. Seventh Principle of Transfer: Cultures of Transfer
8. Eighth Principle of Transfer: The Theory Underlying the Transfer Area
9. Ninth Principle of Transfer: Drill and Practice
10. Tenth Principle of Transfer: Incubation Time
11. Eleventh Principle of Transfer: Reading and Observing Exemplary Works of Transfer

These principles can help teachers make an effective plan to enhance students' learning behavior.

Transfer of Learning in Kuwait

Kuwaiti-based transfer-of-learning data shows that the applied education and training programs in Kuwait have been in place for more than fifty years, basically since the start of the oil exploration. In early 1972, the State of Kuwait established the Department of Technical and Vocational Education as a centralized body to supervise and coordinate the training work in these different centers (Alkhezzi, 2002). Different companies that were associated with the production and exportation of oil identified the necessity of training programs and workshops to adequately transfer learning to their trainees.

Brief History of Transfer-of-Learning Efforts in Kuwait

Kuwait's history of education and transfer of learning began slowly and developed steadily. In its final report to the president of the University of Kuwait in 1980, the planning panel for the College of Education at the University of Kuwait emphasized

the importance of programs aimed at preparing student teachers and recommended the following:

- A whole semester should be dedicated for student teaching, and this semester must be in the first semester of the final year.
- The College of Education should appoint supervisors who are experienced and well qualified to supervise student teachers.
- An Office for Student Teachers should be established to facilitate planning and organization to improve the quality of student teachers. This office also should provide any supervision that is needed for successful implementation. (Bufarsan, 2000, p. 16)

Others observed that incubation time in any transfer-of-learning process plays a significant role and can be considered as a requirement for expertise and significant transfer to occur. Such incubation time is time away from learners' conscious attempts to identify similarities or analogies, and it provides new insights or approaches at the subconscious levels (Calais, 2006).

The Ministry of Education launched the Kuwait Intermediate School Information Technology Project (KISITP) in 1994 (AlMahboub, 2000). The basic goal of this project was to transfer the advancements in IT to the students and train them properly. Colleges, universities, and academies considered computer technology training a basic part of the education. Different companies also gave proper training and workshops to the trainees.

In Kuwait's narration of transfer-of-learning efforts, the use of recent technology has played a major role. The increasing role of technology has raised the expectations of designers of instruction. Traditional instructional environments in Kuwait have changed

to a great extent to meet the milieu of cultural demands from a worldwide society. Research Bandar (2000) conducted revealed teachers' concerns toward the adoption of IT and uncovered their perceptions about the implementation process. With this data, policymakers in Kuwait thus will be able to understand teachers' concerns, perceptions, and attitudes toward the implementation of the IT curriculum. Identifying teachers' concerns also could help policymakers design appropriate interventions to resolve the concerns of teachers toward the adoption of the IT curriculum.

Similarly, in the engineering design of courses for transfer of learning, group teaching was found to be more effective than individual teaching in helping recipients understand multiple dimensions of a source's collective knowledge and in creating bridge networks. Group learning was found to be more effective than individual learning for helping trainees integrate their learning and then re-embed it within their local context. Research Zhao, Anand, and Mitchell (2004) conducted showed that among four teaching-learning configurations, group teaching-group learning is the most effective transfer strategy for transferring collective knowledge. Individual teaching-individual learning transfers collective knowledge poorly, but this combination can lay a foundation for more complex teaching-learning combinations.

Comparison of Transfer-of-Learning: Kuwait and Western Countries

For clarity, I have grouped some of the differences in transfer-of-learning strategies between Kuwait and Western countries according to cultural, language, gender, and technological influences. I have included religion and educational differences within the discussion of cultural variations. Further differences are evident in the capstone course infrastructure in different countries.

Cultural influences. Kuwait is an Arabic-speaking, Islamic constitutional emirate located on the Arabian (also Persian) Gulf in southwestern Asia. British rule continued there for decades, until 1961, when Kuwait gained its independence. With the discovery of oil, Kuwait's economy leapt quickly from one of dependence on limited sea trade to one of the world's richest in gross national product per capita (Bazna & Reid, 2000) Several changes in the intellectual and cultural life in Kuwait rapidly followed. A strong Western culture replaced the old traditional tribal culture. However, these new circumstances nurtured a strong basic conflict between tradition and modernity, a change in ethical and moral standards, and an imbalance between material achievements and spiritual values.

The heavy impact of Western thought and institutions, whose influence is commonly dated from the beginning of the nineteenth century, after Napoleon's invasion of Egypt in 1798, is shaping modern Islam in its church-state dimension (Hardon, 2003). The introduction of the Western educational system into the Islamic world is a major element that has brought tension and heterogeneity within the very matrix of Islamic society. This introduction, in addition to the constant contact between many Muslim scholars and students within educational institutions in the Western world itself, has brought to the center of the stage the crucial question of the relationship between the immutable principles of Islam and the philosophy, the methods, and the contents of Western educational systems. As Andrew (2005) states, the two contending educational systems have created in the Muslim world today a chasm between the Western-educated minority and the majority, which on both the popular and intellectual level is rooted in traditional Islam. There are still many philosophical differences between America and

Kuwait in many other areas. To some degree, there is a crisis in the Muslim educational system as it attempts to incorporate the ideas of modernity and post-modernity, with its scientific influence upon education. To traditional Muslims, the ethical implication of the scientific mode of thought is a sensitive issue. Some traditionalists believe that moral science is guided by no moral values but by naked materialism and arrogance. Furthermore, knowledge divorced from faith is not only partial knowledge but can even be described as a kind of new ignorance.

Language. We also can clearly see the differences in education between the Western world and the Islamic world in the case of the different courses that are taught in the Islamic countries like Kuwait. Some of the major differences arise due to different languages in both cultures. Andrew (1995), in relation to this, pointed out that the Kuwaiti students face a difficulty in learning the English language that becomes a big hurdle in the learning process. Kuwaiti students' academic difficulties appear to be related to their lack of language proficiency and possibly the diglossia factor. The Greek linguist and demoticist Jean first coined the term *diglossie* (French). The Arabist William Marçais used the term in 1930 to describe the linguistic situation in Arabic-speaking countries (Knowledgerush, 2009).

According to Elinor (2005), Arabic native-speaking children are born into a unique linguistic context called *diglossia* (Ferguson, 1959). In this context, children grow up speaking a Spoken Arabic Vernacular (SAV), which is an exclusively spoken language, but later learn to read another linguistically related form, Modern Standard Arabic (MSA). Therefore, more advanced courses in writing and reading in English should be made available to enhance the bilingualism in the country (Ferguson, 1959).

Gender. The differences between the learning-transfer processes of the Arab countries and the West are mainly due to the cultural and gender differences. Culture plays a major role in every country; therefore, observations are that, in Kuwait, gender differences exist that create an additional significant hurdle to the transfer-of-learning processes when compared with Western countries. For example, Cicchelli and Baecher (1985), who investigated the concerns of 78 teachers (47 in a high school, 7 in a junior high school, and 24 in an elementary school) toward using microcomputers in the classroom, found that males scored considerably higher than females on consequence concerns, elementary female teachers indicated high awareness concerns, and elementary males scored significantly higher than females at the consequence stage. This research data showed that to some extent gender bias influences Kuwait culture.

Bander (2000) conducted a descriptive and relational study to identify concerns that teachers experienced when they were implementing the IT curriculum in Kuwait middle schools. Bander designed the study to investigate the relationships between teacher stages of concern and factors such as gender and experience, and to look for developmental stages of concern. The Multivariate Analysis of Variance (MANOVA) (Carey, 1998) indicated significant mean differences between females and males on the management and refocusing stages, which also points toward gender discrimination in the learning process.

Technology. Differences also exist in computerized learning environments (CLEs) between the Western countries and Arab countries like Kuwait. In Kuwait University, despite the obvious advantage of CLEs, certain problems need to be resolved. Among these problems are the misuse of technology and the theoretical bases for the

design of these CLEs. Concerning the theoretical bases, three schools of thought have been in wide use: behaviorism, cognitive psychology, and constructivism (Abdelraheem, 2003). However, many current approaches to CLEs adopt the traditional instructional design models in which learning is viewed as an information-delivery process coupled with practice of procedures. To be more effective, CLEs must carefully address suitable support for the learner.

Compared to Kuwait, modern instructional design models in Western countries such as the United States have been introduced that have become real technologies and that provide systematic and research-based advice, guidelines, and even prescriptions for the design and development of learning environments. Elen (2004) found that by accomplishing the mission of implementing an instructional design model, one can fulfill the requirement of scientific rigor in well-directed engineering research. In this model, however, the study of instructional design anchor points (IDAPs) plays a key role. Elen presents electronic learning environments as a recent version of an IDAP.

The issue of ethnic differences between Kuwait and Western countries is highlighted mainly when we look at a comparison of the barriers that affect or prevent e-learning in companies as an integral part of their workforce's training and learning processes in Kuwait. The e-learning implementation models we find in Kuwait and in the practice of Western companies are also different in many research studies. For example, human resource managers as well as IT managers in charge of the e-learning of 11 of the largest companies in Kuwait carried out primary data collection through the use of semi-structured questionnaires (Ali & Mensch, 2008).

The research results showed that the key implementation barriers in Kuwait are

1. Lack of management support;
2. Language barriers;
3. IT problems; and
4. Workload and lack of time.

Of these barriers, two are common to Western countries (technology problems and lack of time). The remaining two (lack of management support and language barriers) are specific to Kuwait. Regarding the comparison between the two implementation models, the key finding was that organizations in Kuwait did not follow the usual e-learning development cycle (plan–design–integrate–improve) (Ali & Mensch, 2008).

This research showed that organizations in Kuwait largely ignore the planning, designing, and improving stages, with the emphasis resting almost completely on integrating the e-learning tools and processes within the rest of the organization. The problem of e-learning implementation in Kuwait is not so much one of knowing what the barriers are, but one of knowing what the appropriate management processes should be for companies to achieve business success. Therefore, a proper development plan for e-learning in Kuwait should be created to fit the current business environment there.

Capstone design course infrastructure. Some other differences in the Kuwaiti transfer-of-learning process and that process in Western countries are also evident if we study the infrastructure of the capstone courses, discussed in more detail in the second section of this chapter. Educators use capstone courses widely in teaching information technology to expose students to realistic, work-like situations, although in a controlled environment. The value of the experiences the students engage in, and the skills and

knowledge they develop are not questioned because they are accepted as a beneficial precursor to professional work (Smith, 1991). The pedagogical methods educators use to deliver capstone courses vary across academic program, institution, country, and culture.

Transfer of Learning Recap

After having conducted the detailed analysis of the literature and having discussed the important features of the transfer-of-learning process, I can summarize that transfer of learning is a complicated and complex process that involves much tact and skill to provide the necessary training to the learners in a specific environment. To successfully teach the higher-education engineering courses, one must skillfully formulate teams and use advanced technologies. To carry out the transfer process properly, one should establish a large number of workshops in order to train and educate the learners to successfully meet the highest standard of education.

It is also pragmatic that, in transfer-of-learning processes, culture plays a major role because it identifies the different values and principles of the students and the teachers. I have observed that the transfer-of-learning process in Kuwait is different from the West as a result of the different implementation models, the language distinctions, and diversity. Although the technology has contributed much to the advancement in the criteria for successful learning transfer, in Arab countries such as Kuwait much improvement, development, and expansion is needed to meet the standard of Western countries such as the United States, which are moving forward using the latest technological tools and models of training and instruction.

Senior Capstone Design Courses

The senior-level, capstone-design integration courses challenge students to transform their technical designs into a comprehensive construction project plan that considers the site, the construction issues, and the local community (Jenkins et al., 2002). Such a course is primarily a construction-management course. Students enter the course bringing with them at least one of the previously described design projects they have completed in other civil-engineering courses.

Development and Structure of Capstone Design Courses

Capstone courses that civil engineering departments offer are generally simulation-type courses. Coordinating a capstone design course involves a significantly greater amount of time than that required for a regular engineering course. Educators develop and structure capstone courses according to the different projects that they provide to the learners. Learning starts with the identification of simple problems and continues with the application of increasingly complex ideas and sophisticated skills to increasingly complicated problems.

Capstone courses provided an experience of advanced design to engineering students, especially in the projects of applied engineering. In 1994, capstone design comprised the educational practices in this field. Howe and Wilbarger (2006) investigated and found that the capstone course increased the mutual cooperation among students of different departments and thus reduced the feeling of individuality among those students. Not only this, but the course also opened the doors to cross-disciplinary collaboration.

Earlier, Mulopo and Fowler (2006) found that the traditional method of teaching was not an effective one. Thus, most of the students failed in achieving the educational

program's desired goals. Learning and proper application of design procedures made the capstone course highly successful and contributed to increasing the students' mutual understanding and team-based skills.

Dutson, Todd, Magleby, and Sorensen (1997) indicated that numerous changes have occurred in the engineering educational system that have led to an increased utilization of class projects for the purpose of teaching engineering design. Thus, with the incorporation of standard practices, this course has gained huge popularity. The main motive behind the proliferation of capstone design courses is an endeavor to influence the ABET requirements and also to support analytical learning.

Fentiman and Demel (1995) noted that students in capstone courses are instructed to organize the design process, speak clearly, and properly develop the context of the design. Engineering design courses extend a splendid opportunity for students to formulate the skills that are based on writing and presentation. Fentiman and Demel (1995, p. 331) emphasized that "the purpose of having students produce written and oral reports is to give them an opportunity to learn to produce effective reports." And not only this, but with the incorporation of this technique, teachers need to put less effort into giving instructions and, in turn, students can produce the utmost quality of documentation and presentations related to the project.

Raju and Sankar (1999) indicated that capstone courses concentrate on cross-disciplinary education along with real-world problems, which assists the students in vicariously understanding the situations inside the classroom that they might in fact come across in the near future. This combination reduces the gap between theory and practice.

Pros and Cons of Senior Design Courses

Senior design courses are of much importance and value, especially to the teacher-education institutions that have a capstone course for student teachers in the final semester before they exit the program. Such courses are helpful because they often attempt to prepare pre-service teachers to enter the immediate job market. Other versions of a course like this are often used to focus on problem-solving issues. Fallon and Brown (2002) believed that capstone courses help to cross the bridge from student mentality to teacher professionalism. Capstone courses guide learners to seek understanding rather than just find a solution to the problem.

Stephen, Jan, and Michael (2008) discussed the usefulness of capstone programs in assessing the quality of undergraduate education in the United States. The authors claimed that the capstone course provided a venue for assessing how successfully the major has been in helping students attain the overall educational goals. They also explained that college departments use capstone courses to assess their majors in a variety of ways, ranging from rudimentary to rigorous. However, the best practice involved an in-depth analysis of the projects to know their quality and to use that evidence to make curricular improvements.

Some of the disadvantages and drawbacks of capstone courses are also evident when they fail to provide the necessary foundation for entry-level engineering positions in the public and private sectors, or for advanced studies, by not incorporating a thorough instruction in the engineering sciences and design. Such limited programs do not provide an integrated experience for graduates to develop the skills for responsible teamwork, effective communication, and lifelong learning necessary to prepare them for successful

careers (Christoforou, Al-Ansary, & Yigit 2004). In addition to this, these courses do not provide the broad education necessary for responsible citizenship, including an understanding of ethical and professional responsibility, and the impact of engineering solutions on society and the environment.

Andrew and Clifford (2003) have suggested some other drawbacks of the capstone design course, in which, as with any new or redesign of courses, there are usually obstacles to overcome and areas to improve upon. With alteration of the course, students were required to perform more tasks, put in more time in design, and spend more time on campus in labs applying the tools that they had learned to use in their prior coursework. Initially the students were reluctant, especially when they compared their experiences with those of their previous counterparts, in comparison to whom they had to face several problems and difficulties. Further, a second main category of problems was faculty related: The faculty department had to devise a way to obtain funding to provide small stipends to each faculty member involved in this course.

Capstone Courses and Teaching Methodology

Capstone courses incorporate a specific teaching methodology that may involve the formulation of teams, use of different learning techniques, and finally implementation of the capstone courses through various programs. According to Felder (1988), it is accurate to say that learning and teaching styles serve as a key for engineering courses and should be given due importance.

Teams

Dutson et al. (1997) explored changes that were made in the capstone course. Here, the main emphasis was on the formulation of the team, which is usually done on

the basis of aspects such as level of concentration in the project, academic strength, personality, nationality, gender, and experience at work. With the aid of a questionnaire, the coach/instructor can gain insight about the students' interests, desires, and experience.

Turner (2001) noticed that teams of students who are often provided with a faculty advisor as their teacher is an effective method. "Mathematical problems have an exact right answer" is typical of the student approach to the discipline. This attitude is reinforced by traditional calculus courses. The more experienced perspective of the faculty advisor can help to temper such an "either/or" approach that typically excludes other ideas and possibilities. Because of the time and performance penalties, traditional methods courses cannot usually cover state-of-the-art methods. This, in turn, makes it harder to deal with practical problems. The traditional method of teaching doesn't involve an effective design for learning and team processes.

Taylor, Magleby, Todd, and Parkinson (2001) recognized that capstone courses could be made effective by deriving a shift in the role of a traditional lecturer to an entirely new coaching role. Success in the engineering team could also result from an intense focus on team efforts and individual team interviews. To increase the effectiveness in the teaching methodology, various universities introduced the Teamed Internships Program (TIP) and Advanced Technological Education (ATE). These projects stimulated and inspired teamwork and communication skills for technicians and engineering students, and also led to the development of the instructional materials. Last but not least, these approaches developed cooperation with other industries.

According to Todd, Magleby, Sorensen, Swan, and Anthony (1995), the capstone course under mechanical engineering comprised the projects that necessitated either the

design or both aspects, such as design and manufacturing, which were linked to the project's solution.

Paretti (2008) indicated that the instructor in engineering capstone courses acted as a project manager who was supposed to provide lectures and assignments; conduct workshops; and offer project design, management, collaboration, and communication. In addition, he was also involved with upgrading the quality of students' work. A benefit of using case studies included the situational learning involved; the case studies also helped to reduce the barriers that students otherwise associated with fulfilling the project expectations when they encountered conflicts. Along with these variations in the instructor's role, different learning styles were also adopted, such as situational learning, which, according to Suh, Couchman, Park, and Hasan (2003), provided a foundation for better learning to the students based on communication and activity theory:

> [Situational learning] investigates human interaction with others through an activity, which is a basic unit of analysis for understanding human behavior. Activity theorists have argued that human activity is not an isolated entity (Bannon, 1997). Rather it has the structure composed of three basic elements: a subject, an object, and a tool. (p. 2)

Effective Learning Techniques

From the above discussion, it is clear that the team formulation in capstone courses is highly valuable. Further, as suggested earlier, it is also necessary to understand the significance of learning techniques. This is so because the application of the appropriate learning styles can make the capstone courses more effective.

Active learning. Active learning is usually considered as part of an instructional method that encompasses students in the process of learning. In other words, active learning necessitates that students perform significant activities of learning. This style also combines the activities of traditional learning, such as homework. The fundamentals

of the active learning process are the activities of students and their involvement in the process of studying (Prince, 2004).

Collaborative learning. Collaborative learning refers to the instructional method in which students carry out their work together in groups, directed toward a common goal (Prince, 2004). This approach is in contrast to active learning in that the focus of the effort is on the group rather than the individual.

Cooperative learning. Cooperative learning defines the structured form of work carried out in groups. This learning model integrates five major tenets that include individual responsibility, mutual interdependence, face-to-face promotive interaction (e.g., students sharing oral explanations of how to solve problems, discussing the nature of the concepts being learned, and connecting their present learning with past knowledge), suitable practice of interpersonal skills, and standard self-assessment related to functioning within the team (Prince, 2004).

Problem-based learning. Problem-based learning, often denoted as PBL, serves as an instructional method. With PBL, at the commencement of the instruction cycle, problems are brought in and are used to suggest the context for the learning process. This learning style also incorporates noteworthy amounts of self-directed learning (Prince, 2004).

Jiusto and Dibiasio (2006) noticed that a traditional academic structure doesn't encourage learning that is self-directed. They found that experiential interdisciplinary project programs, also known as global studies programs, enhanced students' willingness toward self-directed learning (SDL). In this context, Mahendran (1995) noticed that students best understood the theories of civil engineering when emphasis was on its

practical application. The simple methodology of “teaching” led to reduced motivation among the students. In contrast, practical design projects contributed greatly to their development of skills.

Maskell (1999) observed that engineering education (especially in Australia) must give consideration to the altering environment so that the development of future engineering graduates could effectively contribute to the development of society and also could face the pressures at the local, national, and international levels. Therefore, teaching techniques should be directed toward students, problem-solving, and SDL skills.

Implementing Capstone Courses

It is important to keep various aspects in mind while implementing the design and structure of capstone courses. Implementation is important because merely designing the capstone course cannot serve the ultimate goal of learning until and unless the course is implemented effectively. Following are important guidelines to consider, focused in particular on practicing engineers, when implementing a capstone course.

Practicing engineers. Howe and Wilbarger (2006) observed that to practice engineering, it is necessary to be aware and capable of implementing the process of design. A capstone design course provided engineering students with a culminating experience of designing applied to engineering projects. This course placed great emphasis on the development of professional skills. To make the practice of engineering effective, it is necessary that the curriculum include a focus on creativity—on open-ended problem and design methodology. The capstone course was designed to prepare the students for meeting the requirements of the industry, in which the need for creative thinking and problem solving is always present.

According to Fentiman and Demel (1995), at the beginning of the design process, students were required to formulate an agenda for their projects. Students were also encouraged to make an oral presentation. Following is a description of the eight factors that are crucial for the presentation of design processes:

1. Laboratory notebook
2. Design schedule
3. Purchases
4. Progress reports
5. Final report
6. Data presentation
7. Oral presentations
8. Visual aids for presentations

Turner (2001) noticed that projects derived from practical situations served as a high-level package. For instance, MATLAB (an interactive program for numerical computation and data visualization used extensively by control engineers for analysis and design; Mellon, 1997) was capable of overcoming the difficulty linked with students' learning of scientific programming. Similarly, Croissant, Ogden, and Ogden (2000) pointed out that some projects were helpful in creating clear demarcations between the roles of engineers and technicians. The projects helped in the overall development of engineers and differentiated them from technician students. For example, engineering students were concerned with the planning and optimization of equipment, while technicians were supposed to perform the experiments (separation) and chemical analysis.

According to Raju and Sankar (1999), in order to effectively practice engineering, one should identify teaching related to the domain-specific knowledge as the most important purpose of an undergraduate engineering education. In this context, the literature strongly supported engineering capstone courses because they are very helpful in keeping students abreast of the current dynamic situations, and they also increase students' interest level. Other literature related to effective engineering education focused on the role and responsibilities of the coach.

Role and responsibilities of a coach. Scott (2004) noticed that there are many issues related to the incorporation of a capstone course in the engineering education curriculum, and only the effective planning and proper guidance by a coach can overcome these barriers. Some of the challenges include

- Overcoming the wide barriers related to language
- Religion
- Values
- Manners
- Ethnocentrism

The only solution through which such issues can be mitigated includes an emphasis on aspects such as working in teams, developing clarity about goals, and stimulating team-building exercises. All these methods help the students to solve complicated problems in an effective manner.

Howe and Wilbarger (2006) explored the idea that coaches must adopt an adaptive and friendly attitude toward students to promote the learning environment. To be effective coaches, they should act as facilitators. In turn, Taylor et al. (2001) pointed

out that, as facilitators, coaches should guide the team in the aspects of the team and design process. Coaches should support team building and behave in a supportive manner. They should act as mentors by providing adequate support to the team. To be effective mentors, they also should be aware of the latest trends and happenings and should be helpful to students.

Todd et al. (1995) indicated that coaches/faculty members must take the responsibility for every individual student, project, or team. The two major areas in which development is required in engineering education are those of teamwork and those that involve the industry in students' education. The case-study approach requires instructors to generate assignments that confirm design activity. They should also vigorously utilize these assignments to keep these case studies in the forefront and endorse such support. Last but not least, they should support and appraise the engineering projects.

Without the proper assistance of the coach, it is quite impossible for students to achieve success in a capstone course. Fentiman and Demel (1995) noted that the coach, as a learner and facilitator, must try to assist the students in understanding the various concepts so that they can freely ask questions and acquire new knowledge. Felder (1988) explained that students should have opportunities to perform something extra, apart from transcribing notes. And the coach should emphasize activities related to brainstorming.

Other research emphasized that it is essential for the coach to focus in the future on developing an interdisciplinary team-teaching environment. It should be noted that the students need to receive appreciation throughout the course, especially within the experimental environment of computational science. It is also necessary for the coach to motivate the students (Turner, 2001, p. 83).

Success Factors of Capstone Courses

According to Howe and Wilbarger (2006), one can judge the success of capstone courses on the basis of factors such as learning and proper application of design procedures, mutual understanding, and team-based skills. In this concern, Dutson et al. (1997) noticed that the entire structure of a capstone course depends mostly on the level at which the course is enforced. For example, the capstone courses developed by departments of civil engineering are broadly simulation-based courses.

Todd et al. (1995) pointed out that most departments' focus leans toward the organization of team-oriented projects instead of individual student projects. To support this, Fentiman and Demel (1995) observed that success from the capstone courses can be achieved only if the students are ready to recognize that visual aids serve only as aids—they do not substitute for a superior presentation. Litzinger, Wise, and Lee (2005) pointed out that problem-based learning assisted in developing self-directed learning among students, and, therefore, students also supported the incorporation of problem-based learning courses. Qualters, Sheahan, Mason, Navick, and Dixon (2008) explored the need to incorporate a feedback system to establish in first-year engineering students (FYES) an understanding of their learning and retention of knowledge.

Taylor et al. (2001) noted that success within the engineering team can also be derived from the intense focus on team efforts and individual team interviews (the coach should act as a shield between the external reviewers and customers). With the incorporation of the capstone course, students reported and evidenced the greatest development in their teamwork, communication skills, and technical skills. Croissant et al. (2000) pointed out that the capstone course provided an opportunity to implement the

principles of the scientific and technical courses that reinforced the significance of the academic course. In this concern, Felder (1988) noted that it is also necessary to establish the balance between problem-solving and fundamental learning. And computer-based techniques should be used in a way that is effective.

Senior Design Capstone Engineering Courses at Kuwait University

Kuwait University was established in October 1966, 5 years after Kuwait became an independent state. The university began with the Colleges of Science, Arts, and Education, and a women's college, with 418 students on the roll and 31 faculty members (Wiki Symbian Developer Network, 2008). The capstone design courses usually include topics that are related to new technologies available in the market. For example, the topics offered include mobile computing, location-based services, and mobile databases.

Since the fall of 1994, the civil engineering program at Kuwait University has included a senior-level capstone design course in its curriculum structure. While the inclusion of this single course is an essential ingredient of a program that trains competent design-oriented engineers, it nonetheless falls short of achieving this goal due to a variety of factors (Bandar 2000). For example, some of these factors might include

1. An abundance of technologies and standards
2. Inadequate technologies and integration between technologies
3. Inconsistent implementation of standards
4. Differences in end user platforms (Ali & Mensch, 2008)

The objective of the capstone design course was to integrate different undergraduate content areas and courses that were related to the humanities, social science, IT, and engineering (Noble, 1998).

Kuwait University also introduced a capstone design course within the construction-management specialty program in the civil-engineering curriculum. The course experience was designed to be similar to what students might expect in real life, in which an actual construction project would be chosen as a case study for the course (Al-Tabtabai 2000). In this capstone course, teams carry out the project work, with students acting as construction managers on each phase of a construction project cycle.

Jervis and Hartley (2005) pointed out that capstone courses that prepare students for transition to the working world promote the coherence and relevance of general education; therefore, these courses also promote the connections between general education and the academic major. They fostered integration and synthesis within the academic major, and they explicitly and intentionally develop important student skills, competencies, and perspectives that are tacitly or incidentally developed in the college curriculum. The courses improve seniors' career preparation and pre-professional development—that is, the courses facilitate their transition from the academic to the professional world.

Kuwait University has implemented a Five Year Action Plan (2005–2010) (Kuwait University College of Engineering and Petroleum, 2009) that involves the following most important actions of the recent capstone courses designed for the engineering department:

- Involve licensed engineers (USA) with excellent experience in design from local industries in the capstone projects (one or two lectures, as required).
- Present the student capstone projects in international exhibitions.

- Encourage faculty to publish papers from the capstone design projects.

(Kuwait University College of Engineering and Petroleum, 2009)

At present, Kuwait University is offering a multidimensional capstone course covering a wide academic and practical range. The course carries a prerequisites requirement, which ensures that students have already completed 130 credit hours in engineering study and have already gone through planning, design, and control courses. The capstone course at Kuwait University's College of Engineering and Petroleum is being designed under the guidance of ABET, which specifies that the course fulfill the needs for both theoretical and practical knowledge. The structure of the capstone course being offered is similar to a standardized approach to selection of a topic; formation of groups; appointment of advisor; incorporation of group meetings; and stringent evaluation of multiple criteria, including presentation, written excellence, and demonstration of practical knowledge (Savsar & Allahverdi, 2008).

Differences Between the Capstone Courses in Western Countries and Kuwait

Many differences are evident between the capstone courses offered in Western and Arab countries. The Department of Civil and Environmental Engineering at the United States Air Force Academy has developed a senior-level capstone integration experience that blends technical aspects of engineering design with construction and realistic issues of modern society. Technical designs that students have completed before they take the capstone course form the basis of their capstone design experience. The students review the technical design and prepare the project for construction by incorporating engineering standards and considering realistic issues. The Academy has instituted a course that integrates these previously completed technical designs with less-

technical engineering management concepts into a comprehensive course to complete the students' undergraduate engineering experience. The department's Construction Practices Division teaches this capstone course, called Construction Management and Administration, during the students' last semester before graduation (Todd et al., 1995).

In contrast, at the course level in Kuwait University, instructors individually performed the initial assessment. The main assessment tool they use is the Instructor Class Evaluation Form. This form reports the grade distribution as well as the assessment of program outcomes served by the course. The instructors evaluated student performance relative to what is normally expected from them at their level according to the following scale:

1. Students' performance was very weak.
2. Students' performance was unsatisfactory.
3. Students' performance was barely acceptable.
4. Students' performance met expectations.
5. Students' performance exceeded expectations. (Christoforou, Al-Ansary, & Yigit, 2004)

In comparison to Kuwait University, the University of Oklahoma utilizes a project that weaves a common, 4-year design theme throughout the curriculum. Students individually complete segments of a common-theme design project throughout their work in several courses. Individual students accumulate the parts and turn them in as their portfolios in the capstone course. They do no further work on this integrated project as part of the capstone course (Jenkins et al., 2002).

Some differences also arise in the context of drawbacks observed in the capstone courses Kuwait University's engineering department offers. For example, some capstone courses that had been introduced earlier at Kuwait University were found to have drawbacks that resulted in the determination they were not helpful courses. This was the outcome because design is a total incremental experience that involves many techniques and skills, and that requires practice and teamwork. Thus, it was not possible to squeeze design into one course within one final semester—engineering students would not be exposed to design challenges until it was too late. Statistics, which show that the attrition rate at the College of Engineering at Kuwait University is an astonishingly high 55% or higher, seem to support the fact that these problems were significant. And this rate exceeds, but is still close to, most U.S. institutions (Al-Duaij, 1997).

Kartam (1998) identified the need to incorporate design concepts into the civil engineering curriculum from the freshman through the senior years. Kartam indicated that the existence of a single requirement for a senior-level capstone design course, which is implemented in most engineering programs per ABET's basic requirements, does not fulfill the goal of preparing design-oriented, creative engineers. Instead, the introduction of design concepts to freshman and sophomore students would help to attract and retain engineering students. This outcome is expected because these students will experience how interesting and challenging engineering disciplines can be, how to apply theoretical principles and equations to practical experience, and, most importantly, how engineering can make them think.

According to students who have left engineering programs, the high attrition rate in engineering programs is the result of many factors, but most importantly their

frustration with the boring and impractical material in freshman and sophomore courses. Thus, the introduction of design concepts to freshman and sophomore students would help attract and retain engineering students (Ercolano, 1996). Also noted is that in order to retain students' attraction and motivation toward these courses, several different designs must be introduced to the freshmen and sophomores.

Capstone courses also vary from institution to institution and from culture to culture. For example, the universities located in the United Kingdom offer students real-world experience in solving engineering problems. These programs are usually close-ended programs. In contrast, quite a number of other programs combine both industrially or community-based projects with those that are instituted internally. However, Kuwait offers primarily open-ended programs. In the more senior-level courses, the programs progressively relax these constraints as students tackle more open-ended problems and have to research their own design data.

Similarly, in North America, to better prepare engineering students for their work in industry, many schools throughout the country offer senior project or capstone-type courses. A significant reason for adding these types of courses has been ABET's emphasis on providing an open-ended course with an accumulated background of curricular components (Todd et al., 1995). As noted previously, unlike traditional engineering courses, capstone courses are usually designed to provide senior-standing engineering students with experience solving "real world," open-ended problems.

In their research, Gregson and Little (1998) found that a continuity of design experience that is without junior-year design experience requires students to 'jump' from closed-ended, well-circumscribed design tasks in their sophomore year straight into open-

ended, poorly defined projects in their senior year, with the added problem of having nearly a two-year hiatus in design. This arrangement results in the following problems:

1. Students are tremendously insecure, feeling that they have been 'tossed in at the deep end' in the senior-year capstone course because their design experience does not include simpler, open-ended design projects.
2. Students have very limited opportunities to develop concept-identification skills, knowledge-acquisition skills, and judgment because they are exposed to open-ended design only at the senior level.
3. Industry-initiated capstone courses offer little opportunity for students to compare their design methodologies with those of others working on similar problems.
4. Capstone project evaluation is frequently inconsistent because design projects are not usually assessed by a common panel of assessors. This is particularly true of industry-initiated projects.
5. The validity of teamwork experience in capstone courses has been questioned because groups are composed of peers. (Gregson & Little, 1998, p. 1)

Designing the majority of the courses in close-ended programs to enhance quality and excellence in the students' work can resolve these problems.

Conclusion

On the whole, we can conclude that transfer of learning is a unique phenomenon that plays an important part in students' learning process. The effectiveness of the capstone course design also depends on the mode of the learning transfer. For example, according to the literature, students who are well trained by their instructors and teachers

show much progress in their courses when compared to those students whose instructors do not properly guide them.

A number of factors decide the contents of the capstone courses in a specific country. These factors include, among others, the academic framework of the specific country, and its culture, languages, and educational standards. The design of capstone courses also differs by each country's culture, norms, and traditions. For example, there is a different model and paradigm for capstone courses in Kuwait University than for those in other, Western countries. We have also observed that to some extent the role of gender can contribute to the differences between the capstone courses of Kuwait and the United States.

It has also been observed that senior design capstone courses play a key role in universities and training workshops because they train the learners to become skilled professionals. Improving the institution's engineering programs through these capstone courses is one of the basic goals of the courses. For example, the College of Engineering and Petroleum at Kuwait University, in line with its efforts to improve and maintain the quality of the engineering education its programs offer, has established a continuous assessment process based on the new ABET engineering criteria.

On the basis of an overall analysis of the sources cited, we can also infer that each source offers different findings and recommendations for capstone projects and the role of coaches and instructors. The selection of project sponsors should be performed in a keen manner because the sponsor decides the future of a particular project. To realize a balance between the various activities of a project, it is crucial to follow the stated benchmarks in a standardized manner. Apart from this, it is also essential to attain a

match between the key players and components of the project—e.g., the coach of the project, the sponsor liaison, and the expected outcomes for the particular project. To realize the stated outcomes for these projects, it is necessary to avoid any tendency that seems to be a hurdle to overcome in meeting the chief requirements of the project.

Of importance is the article by Paretti (2008), which is based on an in-depth study of the communication skills and role of the instructor in capstone projects. According to Paretti, the instructor's credentials and skills forms the basis by which we can assume the accuracy and preciseness of the data used in the article. Apart from this, the article discussed the guidelines for developing metacognitive communication skills. In this context, the main task for instructors is to develop meaningful assignments and projects for their students. According to Dutson et al. (1997), the instructor should develop some evaluation rubrics to measure students' performance in a realistic and practical way, which will further nurture the competent communication and academic skills among them.

This present study is significant because it attempts to find whether the capstone course helps in transfer of learning and enables students to apply the skills they have acquired during their academic life in the actual industrial setting. Finding the answer to this question is important from all perspectives, including those of students, faculties, and engineering institutes because that information will help educators to improve their transfer-of-learning methods. A very important observation I made during the literature analysis is that almost all the studies were focused on finding the best method for transferring learning through the use of the capstone course. However, the usability and effectiveness of the capstone course in terms of its acceptability and "reject-ability" has

not been questioned. All studies have reflected a strong focus on finding the best method for teaching the capstone course; however, its basic presence has not been questioned widely. In the present literature, I found no breakthrough study that focused on the worthiness of the capstone course. In this context, there appears to be a specific gap within the literature about this basic issue regarding the capstone course. The intention of the present study is to address that issue by inculcating student's experiences, my personal observation, and evidence from the existing literature.

CHAPTER 3: METHODOLOGY

The main research question that guided this basic interpretive qualitative study is *What is the meaning of the students' experiences in the senior design course with respect to the course's applicability to their experiences in the industry?* The research sub-questions that I pursued are

- What do students gain during the senior design course that is helpful in their actual work in engineering?
- What is the value of the senior design course to the working engineer?
- What senior design course method helps the most?
- What do the participants suggest as ways to improve the transfer of learning from the senior design course to the field of work?

Research Methodology

Looking at this issue from the theoretical perspective of Cresswell (1998), we find that, for such an inquiry, the basic interpretive study design can surely help me as the researcher to answer these research questions. To meet the requirements of open communication and sharing of experiences in a relatively informal environment, the interview technique is more suited to this study. In a basic interpretive study that uses the interview method, interviews can be used in a variety of contexts; however, researchers typically use this combination to gain insight into people's personal experiences. Thus, this method is associated with comprehending how participants perceive and understand a specific situation. In communicating their understanding, the participants act naturally

and describe their experiences in how they handled the situation. Also, compared to other techniques such as the group interview, the individual interview does not allow participants to change their opinion because of external influence (Rhinas, 2006).

A basic interpretive study is a valid method for assessing the responses to questions such as those that are the focus of this study. As Creswell (1998) suggested, one can investigate qualitative research from a philosophical and theoretical stance; however, this study's design for investigating a particular phenomenon must be valid. If one wants to understand a phenomenon and opts to explain the phenomenon, the best available options are the case study, ethnography, the basic interpretive study, and the narrative study. Merriam (2002) supported Cresswell's idea and asserts that the basic interpretive qualitative research design is the simplest method, the easiest to understand, and accurate for the stated purpose. This type of study is more applicable when a researcher wants to acquire a sense of, and understand the meaning people have constructed about their world and their experiences.

Patton (1985) has suggested that the qualitative research approach represents an attempt to explore the uniqueness of a situation as part of a unique context and interaction. The basic interpretive study helps the researcher to explore the experiences uniquely without attempting to predict the future. Moreover, the interpretive study design offers a wide set of data collection and analysis tools. As is most common, the aim of this research is to collect information about the human experience, and the basic interpretive design provides the ideal tool for collecting this data, in the form of interviews. The tool is responsive, adaptive, and appears to be an ideal means for collecting and analyzing such data. The method is widely acceptable because it offers me as the researcher the

capabilities for nonverbal communication, verbal communication, and information processing at the time of data collection. In addition, if it is required for accuracy, I can clarify, summarize, and recheck information with respondents. This approach also offers me the capability to identify the recurring patterns of common themes that are prevalent across the data. In addition, this study is best formulated in the presence of literature, thereby making the techniques more authentic and reliable (Merriam, 2002).

Data in this study design can be collected by a number of methods; however, all those methods have one fundamental characteristic in common: The data comes directly from participants—for instance, through interviews, observations, or the like. The basic interpretive study design is quite suited to the situations in which the goal is to affirm a fact instead of develop a new theory. The interpretive study is a purely qualitative technique aimed at collecting the experiences of the participants to affirm the stated facts (Rhinas, 2006). Because the proposed study relies largely on input from former students, the basic interpretive design fits well. It is not a hypothesis-based research; rather, it attempts to determine the usability of the senior design course for engineering students.

Participants

This proposed study collected former students' experiences of their educational life and the application of those experiences to their actual work in the engineering industry; this process involved direct communication with students and learning in depth about their experiences. The students shared their experiences in the form of open-ended responses instead of close-ended questions as in a questionnaire. The participants were Kuwait University fresh graduates who have recently entered into the industry. The

graduates are in a position to truly assess the assistance that the capstone course provided in the initial stages of their professional life.

This study used purposive sampling for its sample selection, in which 12 participants were interviewed. Such sampling helps to define the criteria for the selection of candidates. Other methods of sampling are not suited to such a study (Merriam, 2002) because the proposed study is specific to the College of Engineering at Kuwait University. I selected the sample using the following criteria:

1. Participants must be engineers who graduated from Kuwait University.
2. Participants must have enrolled and studied in the capstone course at Kuwait University under the engineering discipline.
3. Participants must have at least 1 year of experience, and at most 4 years, in the engineering field.
4. Participants need to have started their engineering position within 1 year of graduation.
5. Participants must be employed in an industry where actual engineering skills are being used; for instance, oil and petroleum companies, construction companies, and the like. New graduates who opt for teaching do not fulfill the selection criteria.

Data Collection

For selecting participants, I used the snowball approach/networking. I contacted my fellow engineering colleagues, whom I asked to be participants; and then I asked them if they would contact someone else for me, to ask if I could contact them about being participants in the study. Appendix A is the script that I used for the telephone

contact. Appendix B is the email example. I scheduled an appointment with all participants based on their availability. Their participation, however, was voluntary, and they were allowed to withdraw at any time during this study.

Since these were all phone interviews, I faxed or scanned/emailed the Informed Consent form to them for their signature; they faxed or scanned/emailed it back. Once they had returned the form, I set up the interview using email. Once we had established a day and time for the interview, I called participants on the phone or by one of the free Internet audio software programs such as Skype. I made an audio recording of each interview. I allocated a time slot of no more than 90 minutes for each participant, from whom I attempted to gain insight about his or her experiences. I gave the participants the preference of language—either Arabic or English—that they want to use during the interviews. Most of the interviews lasted approximately 60 minutes. Also, I conducted all the interviews in Arabic, based on participants' expressed preferences. As noted, the intention of the proposed study was to collect personal experiences of the participants, which is why the interviews were open-ended. Here are the general questions that I asked during the interviews:

- What prompted you to take the capstone course?
- What were your expectations/requirements for the capstone course?
- How did the process of your capstone course work?
- What process did you go through to determine your needs for completing the requirements of the capstone course?
- How did you see this happening?
- What challenges did the capstone course process create for you?

- What was your timeline for designing, testing, and implementing your capstone project?
- What were the best things about the capstone course?
- What were the worst things about the capstone course?
- Who else was involved in your capstone project?
- What concerns did you have about the project?
- As an engineer, what kind of challenges are you facing in your professional work?
- What's the most important priority to you in this context? Why?
- What would you like to see improved in the capstone course? And how do you measure that?
- How did the skills you have learned in the capstone course help you in learning new skills in your work environment?
- Tell me about your experience of the engineering senior design course before you entered into the industry.
- If the engineering design course did not exist, what would be different in your work experience?
- How effective did you find the capstone course to be as the first step of your practical industrial learning?
- How effective did you find the capstone course to be as long-term learning?
- How do you evaluate your experience in the senior design course in terms of your work in the industry?

Data Analysis

For data analysis, I used the constant comparative analysis approach. This is a technique used widely by a number of researchers in qualitative analysis. The technique was derived from the Glaser and Strauss (1967) grounded-theory approach. The method adopts a range of techniques such as memo writing, close reading, coding, analysis, data matrices, and data diagrams. In the proposed study, I conducted the analysis by comparing the interview transcripts. Some of the steps of constant comparison include forming categories, establishing boundaries, assigning segments to the designated categories, and summarizing each category with respect to content (Boeije, 2002). This analysis helped me to unveil the differences among participants' opinions and also helped to limit the potential problem of bias.

First, I studied each interview and then converted each interview individually into codes. Because I started coding after I had completed the first interview, I made some changes to the questions for the next interview while I was finishing the coding of the first interview. I did the coding using Atlas.ti, qualitative data-analysis software that is capable of arranging the content to generate codes from the audio recordings. I treated the whole interview as one story that pointed toward a single opinion presented by the interviewee. I examined the consistency of the entire interview using the codes I obtained from the computerized program. This stage of the analysis resulted in a list of codes and a summary of each interview in a conceptual framework (Boeije, 2002). At the end of this step, I had interviews coded separately, with conceptual profiles of all the interviews.

After each interview was coded individually, I compared the results among the interviews, searching for common codes between participants and reducing the number of

codes. I created more codes as needed, and where appropriate concatenated some codes with each other to form a pattern. Then I looked across the interviews for common themes or categories. This was also when I brought in my field notes and observations.

Using the constant-comparison approach of Glaser and Strauss (1967), I analyzed the interview transcripts. With this method, one can form a new theory about a specific phenomenon. Using different techniques such as coding, analyzing, and developing matrices allowed me to make a constant comparison to develop a new theory. The analyses of interview transcripts have two potential phases of constant comparison—i.e., open coding and axial coding.

The scope of this study is limited to axial coding because its purpose is limited to knowing whether the capstone course helps students in their professional lives. The objective is not to develop new theories from the interview transcripts. The analysis began while I was recording the interviews and taking notes; however, the process began formally when I began the first interview. After the first interview, I jotted down all the key points and then developed codes for that text. I changed, merged, and created additional codes during the next interviews. With the help of the codes, I had a constant inflow of information during the analysis. The codes and their evolving nature identified the dimension in which they were operating. Most of the codes identify the level of abstraction, and with the development in codes, the level of abstraction also increases.

Trustworthiness

When a study becomes a part of academic research, it is usually referred to by a number of students and teachers in future research. The results of the study form the basis of further studies, so it is of utmost importance to ascertain that this study truly reflects its

intended objectives (Merriam, 2002). This consistency builds confidence, or trustworthiness, between the reader and the writer. For establishing trustworthiness in this study, I have selected three methods:

1. Peer-review: This study had been reviewed by colleagues and friends in an informal capacity as well by my dissertation committee members. I have had several discussions with many teachers to make this study better and more focused.
2. Clarifying researcher bias: It is very important to clarify the researcher's bias to the reader. In this clarification, the researcher comments on past experience and bias that have shaped the approach of the study. I did this in the introductory chapter.
3. Member checking: I sent all participants a copy of their respective interview transcripts for them to review and make sure that they reflect what they wanted to say. I also offered to send them copies of the final dissertation if they would like.

All in all, following this strategy during the research process increased the trustworthiness of the research investigations and strengthen the findings. As a result, doing so helped in answering the research questions, as well. Overall, by following this meticulous approach, we can trust that the proposed study will increase the knowledge of its readers and also will help Kuwait University in evaluating and upgrading its capstone course.

CHAPTER 4: FINDINGS AND ANALYSIS

This chapter contained three main sections. The first section, "Description of Participants," showed details about the participants, such as their academic majors, professional experience, and the gap in time between when they received their degree and began their first job. The second section, "Themes of Study," presented the four basic themes that emerged to give the meaning of their experiences of the overall study. The four themes are 1) the need for the capstone course, 2) applicability of and problems with the capstone course, 3) industry problems with training, and 4) students' attitudes toward the capstone course. The last section in this chapter, "Connection Between Themes of the Study," focused on the primary theme that all the other subthemes support.

Description of Participants

The tool I chosen to use to collect the data from the participants was the interview. I used snowball sampling to select a set of 12 participants. The interviews were in-depth, covering the experiences of the students. I prepared the interview questions in advance to keep the discussion on track. I provided ample opportunity to the participants to speak about their experiences, including their exposure to industry and their experiences with the capstone course. I used an interview-discussion format, prepared in advance, because humans have unique characteristics and an interviewer should be able to communicate with every type of participant. Table 4.1 summarizes the academic background and professional experience of the 12 participants.

Table 4.1

Summary of Participant Attributes

Background	Frequency (N=12)
Academic Degree	
Civil engineer	2
Mechanical engineer	2
Computer engineer	2
Petroleum engineer	2
Electrical engineer	2
Industrial engineer	1
Chemical engineer	1
Industry Experience	
1 year to 2 years	7
2 years to 3 years	3
3 years to 4 years	2
Time Gap between Degree Completion and First Job	
Less than 4 months	6
4 months to 8 months	6

The study is qualitative in nature, focusing on the personality and personal experience of each participant; therefore, to derive a theory useful for evaluating the usability of the capstone course, it is necessary to understand the individual participants. Table 4.2 shows more details about the academic background and professional experience of the individual participants:

Table 4.2

Individual Participant Details

Participant Name	Gender	Engineering Discipline	Professional Experience (in Months)	Time Gap between Job and Degree (in Months)
Sadan	Female	Mechanical	22	3
Nawaf	Male	Mechanical	13	2
Abdurrahman	Male	Civil	18	7
Talal	Male	Electrical	12	5
Mohammad	Male	Computer	12	4
Mossab	Male	Petroleum	28	1
Najat	Female	Industrial	22	2
Latifa	Female	Computer	34	2
Areej	Female	Chemical	13	6
Aseel	Female	Civil	26	5
Fahad	Male	Electrical	45	8
Fawaz	Male	Petroleum	41	3

Themes of Study

An analysis of the open codes resulted in 12 categories that ultimately helped in identifying the participants meaning of their experience. These 12 categories that were developed in the process of forming the meaning include the following:

- Capstone outcomes and expectations
- Need for the capstone course in degree completion and professional career
- Learning models
- Problems with the capstone course
- Capstone training process
- Capstone format, contents, and course coverage
- Capstone usability

- Capstone application within the organization
- Whether the capstone course creates a difference
- Opportunities for improvement in the capstone course
- Learning principles and the capstone course
- Applicability of the capstone course in the professional environment

The software formed and merged all groups, which resulted in the above-mentioned set that was finally merged into a few highlighted categories. These groupings are an important source for the emergence of themes from the interviews. With the additional help of subcategories and dimensions, I have extracted four core themes from the categories that give the meaning of the overall phenomenon of the study. In addition, the central theme of the study reflects the cross-analysis and common factors among the four themes.

The four themes are:

- need for the capstone course;
- applicability of and problems with the capstone course;
- industry problems with training; and
- students' attitudes toward the capstone course.

A discussion of each theme follows, together with development of an argument that addresses the core issue of whether the capstone course is meeting transfer-of-learning requirements at Kuwait University.

Need for the Capstone Course

All participants focused equally on the need for a capstone course in the degree-completion process and in industry. A primary focus of this theme was on identifying

what constitutes the need for the capstone course because students will learn only if they realize that the capstone course is essential. The following subsections reflect the subtopics within the theme of the need for a capstone course. Subcategories, which included the importance of the capstone course in degree completion and in one's professional career, the fact that the capstone creates a difference, and learning models, addressed the core theme.

Need for the capstone course in degree completion and professional career. A core idea that describes the need for the capstone course emerged from the natural theme that the capstone course is part of the degree program. Participants viewed the capstone course from two different perspectives: its necessity in degree completion and its necessity for them to attain professional skills. Most participants explained that the capstone course was necessary to successfully complete their engineering degree. Attending this course was compulsory; otherwise, they would not complete their degree. So it was not in their purview to take or reject the course. Talal was a student with average grades; he concluded his comments about the need for the capstone course as follows: "The capstone course was a normal course for me. It was the same as an independent study course.… We got the main goal, which was to complete it to get the degree."

Participants expressed the need for this course in academics mostly through words such as "compulsory," "obligatory," and "degree requirement." As stated, they undertook the course because it was a degree requirement; without its completion, they could not complete their degree. From their professional perspective, almost all participants

expressed their opinion in favor of the course. Mossab asserted that "We recognized that we had to follow him in order to graduate."

Among the participants, many expressed that the course was required for them to understand the actual environment and practical exposure to the instruments of engineering. Sadan explained the need through her words that "Training is insufficient in the field." She concluded, "To be honest with you, getting into this new world or environment is not that easy due to lack of training. That is where the capstone helped me a lot."

The capstone course was not only required in degree completion, but it also helped acquaint students with the professional environment. It helped them to acquire long-term learning for their professional lives. A number of participants expressed this view; for instance, Abdurrahman related the need for the course to long-term learning in his assertion that the capstone course is a tool for long-term success:

> As for the long term, I think I learned a lot. For example, I learned how to communicate with other experts. I learned how to come up with solutions for any complex problems. Moreover, I learned how to follow the timeline and meet the deadlines. (Abdurrahman)

Mossab endorsed the same point. He considered the capstone course as a catalyst in his long-term learning: "The capstone project helped me with how to communicate with different levels…. In addition, being organized and meeting the deadlines are the most important skills that I learned from the capstone project."

Abdurrahman also expressed this view. In his opinion, the capstone course was not only beneficial in the absence of training, but it also helped for long-term learning: "It was the first step for me to get along with the work ... this course played a great role to

shape my career as an engineer leader. The course was beneficial in my long-term learning."

Another participant, Mohammad, recalled that the capstone course was extremely necessary for him before actually going into the field. He recalled that:

> I did not realize the need for the capstone course when I took it; however, I realized it when I actually entered the software house. During the capstone course, I had to apply all the software I used during the initial semesters. The capstone course is really necessary before you enter the field. It gives you enough opportunity to recall the contents of the entire degree in just three to four months. (Mohammad)

Whether the capstone course creates a difference. A number of the participants defined the need for the capstone course from the perspective that it creates a difference. They explained the need with elements such as "conceptual clarity of engineering practices," "long-term career growth hidden in conceptual clarity," "competitive advantage to rapid learners," "capstone course is core competences," and "multiple responsibilities of professional players."

Participant Talal remembered that "having learned from the capstone course, I was more expert in handing the engineering environment than other fresh graduates [were]." Considering Talal as a single case, we see that his experience with the capstone course began as a normal one; he asserted that "the capstone course was a normal course for me. It was the same as an independent study course."

But with his interaction with the capstone course and her understanding of its format and benefits, Talal was convinced upon completion of the course that it can really help graduating students in their professional lives and serves to meet students' core competency requirements. He also discovered that the capstone course is a tool for enhancing learning and has the ability to provide engineers with conceptual clarity.

> My dean said that I will realize its importance once I complete this course, and amazingly this happened. I can say now with my accumulated experience of professional life and the engineering university that the capstone course is the core competencies. I would also add that it may be the core competencies to those who are rapid learners. (Talal)

Another participant, Najat, noted that "the capstone course was more a core competency [for me] in comparison to other students … this is because I got an ample opportunity of 4 months to actually apply all those things I learned during the engineering [courses]."

Most participants were of the view that the capstone course helped in creating a difference in their career. For example, Nawaf asserted that:

> The day I joined I was given my job description. I was surprised to see the list because it contained many things which I did not even know how to do. Then I figured out the new things which I had not learned or reviewed in the university or capstone course. They were a total of six in number, while the things I already knew were 15. (Nawaf)

Fahad had been working in the field for the past 3 years. He explained that the capstone course played a pivotal role in his promotions. "It worked as a catalyst in the learning process. After learning the basic skills in the capstone course, it was easy for me to update my skills."

Fawaz highlighted the importance of the capstone course as a tool for professional players. He asserted that professional engineers work on existing models yet may not understand how a model actually works. He stated that:

> Professional engineers have multiple responsibilities in their field. They need to work on every aspect of a project; they cannot remain limited to one aspect of the project. The capstone course was a complete project, and it enabled us to work on the project instead of one single task. (Fawaz)

Although Aseel did not specifically say that the capstone course was a tool for rapid learning, we can draw a few inferences from her points. She noted that:

> ...[the] capstone course was good, but I would see its role as limited. It just helped me in getting into the industry. It was written on my transcript that I had already completed 64 credit hours of engineering specialization and 6 credit hours of a specialized project. As you know, Kuwait Engineering University is the only university here offering this; so definitely my interviewer was impressed, and I got the job. So you may say it acted as a differentiator. (Aseel)

Learning models. Five participants asserted that the capstone course is needed because of its unique learning model and its ability to incorporate the essentials of the entire degree in one course. The core idea that the capstone course is needed is supported by the model it adopts to educate students. Participants explained the elements of its unique learning model in words such as "contents and format of capstone course," "comprehensive and effective learning," "feedback is important," and "communication of faculty members and students is the key source of student development."

Najat explained that the capstone course is a unique experience, and its unique style of learning and the ample opportunity for students to interact with teachers helped enhance her overall understanding of engineering. She explained:

> The key strong point of the capstone course is that it provides you a constant interaction with teacher or advisor … in the capstone course; I learned how to design equipment. This was made possible only with the help of my advisor, who helped me a lot. (Najat)

The experience of Aseel is similar to that of Najat. She also found that communication is the key item that makes learning effective. According to Aseel, the capstone course is distinct because it enables learners to stay in touch with the advisor. She stated:

> When you clear your last exam and join the capstone course, your teacher becomes your advisor. This is the beginning of another relationship with your teacher … I would say that the uniqueness of the capstone is hidden in the communication of teacher and students. It is the key source of student development. (Aseel)

Najat also highlighted that the learning model of the capstone course was interesting because its contents and format were quite different from stereotypical subjects:

> This project was quite different, and I really enjoyed it. You just need to do one project and you get 100% marks without falling for lengthy exams and boring assignments. I also appreciate this project because it identified the true learners instead of the crammers. Its learning methodology is quite interesting, to have comprehensive and effective learning instead of galloping around quizzes and assignments. (Najat)

Aseel also highlighted the unique contents of the capstone course: "The format and research methodology of the capstone course was different. I was the decision maker of my project. What topic I wanted to explore, what methodology, and even the selection of questions and participants were in my hand."

Another participant, Fahad, appreciated the learning model of the capstone course from another perspective. He concluded that:

> In the capstone course, I found much time from the teacher and I also got constant feedback from him about my project … I think feedback is the strong point of the capstone course; and of course we need the capstone course to provide students an opportunity to know how to work with constant feedback of their boss in practical life. (Fahad)

A number of participants observed that the capstone course offers comprehensive and effective learning because of its unique contents and format. As an example of this perspective, Latifa asserted that:

> From day one of my degree to the last day of the engineering course, I worked with my best friend in all projects. I was very good at designing front-end visuals, whereas she was expert in developing a connection between databases and interfaces. The capstone course was assigned for individuals, and I was shocked: Who will connect my database now? I was then exposed to real-time learning … the first project I got in my company as a professional was about databases, and then I was thankful that I had learned it. I really emphasize the need for the capstone course. (Latifa)

Fawaz also said that the learning model of the capstone course was interesting. He understood all the aspects of the project. He got regular feedback from his professor about his skills, learning and his enthusiasm to work. He concluded that:

> I had to complete my project alone. I understood each and every aspect of my project, whereas in a regular project I mastered only my portion of the project. In my capstone course, my teacher gave me constant feedback about my skills, my learning, and my enthusiasm to work. (Fawaz)

Applicability of and Problems with the Capstone Course

The core question of the study was to know whether the capstone course enables the transfer of learning to professional work. In this context, the participants expressed their opinions, from which emerged the theme of applicability of and problems with the capstone course—aspects that contribute to the core theme. Subcategories such as the capstone training process, its usability, and opportunities for improvement in the capstone course also address the fundamental question.

Capstone training process. Ten participants asserted that the capstone course is a replacement for the professional training process, and gradually it is becoming a part of the formal questions interviewers ask at the time of the job interview. Although it was not in my mind as a researcher that the capstone course could replace the training process, participants highlighted this view. I found it both interesting and surprising to note that companies were now interested in the candidate having completed 4 credit hours of work on a university-based project instead of any thesis or formal theoretical study. This assertion by participants formulated another subtheme under the topic of applicability of and problems with the capstone course. A number of participants linked the capstone course with organizational training. Abdurrahman especially recalled this connection:

> I was surprised when my panel asked about the capstone course. They were calling it a final project, and I was amazed why they were so keen

> about this specific course. During the selection process, I found that they preferred the students who have already completed their capstone course. The rest were not selected because the organization had to train them, which would bring a cost... (Abdurrahman)

Talal and Mohammad could be considered the most recent graduates in the entire group of interviewees. Each of them highlighted that the trend in organizations is to focus on innovation in the capstone course. Talal stated that:

> My interviewers were interested in knowing my innovation level, my creativity and unique [approach] in meeting electrical problems. They are hiring people who are skilled in actual [projects], and probably completion of the capstone course is the simple evidence of a student's ability to pursue practical work.

Students identified a number of other problems not limited to this issue that the capstone course helps to overcome. A few were implicit to the context, whereas others were quite explicit. Issues that are not widely covered in classes, such as meeting deadlines, communicating with bosses, and handling new environments are better addressed in the capstone course. Another participant, Abdurrahman, asserted that:

> As compared to degree courses, a lot more work is compulsory in the capstone course. You are assigned with an objective, which you have to accomplish. This not only creates a sense of responsibility but also prepares us for handling the pressure of the professional environment. It also reduces the training need in the professional environment because the student already knows how to meet his deadlines and how to report each step to his advisor. (Abdurrahman)

Aseel also shared her experience with respect to training procedures. She explained that the capstone course is gradually replacing initial training sessions. "I am also responsible in my organization for assessing technical needs of new entrants, and I myself have seen that students with a capstone course background need less formal training in the beginning."

Problems with the capstone course. While addressing questions about the worst aspects of the capstone course, participants highlighted problems in the capstone course that they believe hinder the transformation of learning. None of the participants said that no transformation of learning occurs; rather, most of them emphasized that with a few changes, the capstone course can be even better. They identified the main problems through words such as "difficult process to understand the theme of the capstone," "timing of schedules is not aligned," "lack of time and challenges of absorption," "faculty members' attitude is a hindrance," and "mode of communication is not predecided and leadership abilities are not well developed."

Another participant, Sadan, stated that she faced problems in the capstone course as the result of a less interactive advisor. She noted, "I would not say my capstone experience was bad; rather, it was strange. I got a noncooperative advisor who ruined my excitement for the project.… I contacted her several times; however, she never responded in the expected manner."

A number of students faced a problem with their advisors. A few were uncooperative, and a few were reluctant to guide the students. Only three participants were satisfied with their advisors; otherwise, the rest communicated that they faced problems on the part of the advisor. Areej stated her experience as follows:

> …I was disappointed. He was a careless person. He told us that we would meet just three times the whole semester: one at the beginning, and once in the middle to check the progress, and at the final. He didn't add much knowledge for me. All I learned was self-learning by me. He did not transfer his experiences to us. (Areej)

Fawaz also faced problems in the capstone course; however, his problem was collective to the entire class. He asserted that:

> I did not find any intranet page or any telephone number where I could communicate with my advisor. Although it was a minor problem, it became severe during the final days of [my] submission. My advisor did not exchange his contact number with me, so I could contact him only during his free hours at the university office. (Fawaz)

Besides the teachers' attitudes, other problems participants highlighted included timing and schedules, mode of communication, and lack of coordination. Abdurrahman stated that he felt there were problems in the capstone course, and it could have helped him more. He concluded that "I was really worried with the work assigned and the allotted time. I would say that there was a lack of time and too many challenges, which made my work on an ad hoc basis."

Najat also stated that she found the capstone experience worth undertaking; however, small problems weakened her sense of the course as otherwise strong. She concluded, "I faced problems due to the timing of capstone sessions. They all were conducted in one day for 6 hours, and four sessions in a month. It was difficult to gather all questions and ask [them] during 6 hours."

Participants, however, were more of the view that the capstone course is good in itself; the transfer-of-learning process was slow because of many problems. Latifa explained her experience this way:

> There was a lack of time and challenges of absorption. I think one semester is not enough to finish this project. Also, there was a lack of applicability and theory-based knowledge. Moreover, leadership abilities were not well developed. And let me repeat that again: time, time, and time was not enough to finish it at a higher level. (Latifa)

Mohammad also endorsed the same point about the development of leadership skills. He asserted that the capstone course was good in its overall function. However, it could have been even better if it had included certain aspects: "The course would have been better if it had included something about leadership training. The course required

developing something new, but the element of leadership training and actual exposure to the professional environment was missing."

Capstone usability. Fifteen participants covered the aspect that the capstone project was useful and helpful, but not as much as they had required. In other words, the course had some problems from the point of view of its usability. The participants highlighted that the capstone course helped them in getting the job; however; its impact could be even stronger. For example, Mohammad stated that "the capstone course was merely focused on specialization subjects. I personally feel that the other courses should have been a part of the capstone course because our jobs do not give us a complete chance to work in a specialized field."

Another participant highlighted the fact that the capstone course was highly useful in the transfer of knowledge. Mossab explained that "I would appreciate it if the focus was on long-term usability of the project instead of completion only."

Fawaz and Aseel made the same observation. Both were of the view that students can use the capstone course as a practice session for their role as managers. This assertion particularly pertains to the nature of their present jobs because both of them have been working in leadership positions. Fawaz is currently the project manager of his team, and he recalled the capstone course experience and its usability this way: "I would prefer if the capstone course was taught under engineering project management modules … The managerial aspect should be there in the capstone to enhance its usability."

Aseel had a slightly different idea for improving the usability of the capstone course. She wanted to benchmark the international standards and the universities for the capstone course.

> ...I think we need to look at the Yale and Stanford pattern for the capstone course. Their capstone course is a real-time project, which actually helps the society to improve on many things. I assume that the capstone course should be based on demands from companies. Students can actually join their [the companies'] research and development team, or they can assign simple projects to the students. This will benefit society, save cost for companies, and will fill students with a lot of enthusiasm to work on a real-time project. (Aseel)

Opportunities for improvement in the capstone course. Transfer of learning through the capstone course is not perfect. The course is contributing to students' learning of practical aspects of engineering, and it really helps them to get a firm knowledge of the field of engineering. Students who have completed the capstone course have a competitive advantage over others because they are able to apply their skills in field. The former students I interviewed, however, widely recommended improving the capstone course in terms of the transfer-of-learning process. They shared their experiences and how they felt the capstone course can play the most effective role in graduating students transferring their knowledge to the field.

The participants explained their ideas about how to improve the course through words such as "teachers have more knowledge than students," "coordination and capstone course are required to act as the same thing," "effective management of human resources," and "added care must be taken in practice and theory amalgamation." Mossab, a petroleum engineer, highlighted ways in which he saw the capstone project plan might show ample improvement. He stated that:

> I would have been comfortable if the capstone course had better human resource management. Every advisor was allocated almost five students, and it hindered in their giving proper and complete [attention] toward each student. I suggest that every teacher be assigned a maximum of two students so students may interact with the advisor more frequently. (Mossab)

In the views of Abdurrahman and Latifa, an excessive number of students was a core issue related to faculty members' distraction. Abdurrahman concluded that

> I assume that a professor must not be assigned to [too large a] number of students because his ability to coordinate with students goes down. I suggest that a maximum of two groups be assigned to one professor and at least two professors be assigned to each group. (Abdurrahman)

Fawaz suggested that the capstone course should present a mix of theory and practice. "I felt that that theory portion of my project was limited to writing the documentation of the project ... I think it would have been better if the capstone course contained an amalgamation of theory and practical knowledge."

Najat offered a comprehensive idea about how to improve the capstone course. She emphasized measurability, concreteness, and effective course management.

> I think it would be great if the course would accurately solve problems that address engineering economics issues, such as life-cycle analysis. Also, [if successfully completing] the course will demonstrate proficiency in oral communication of the kind expected in professional paper presentations. Also, the course needs to be more specific by using clear and definite terms describing expected abilities, knowledge, values, attitudes, and behaviors. In addition, the course needs to be more measurable. It is feasible to get the data; data are accurate and reliable. (Najat)

A few participants emphasized that the capstone course is sometimes not being designed by students themselves. Mohammad shared his personal experience about the capstone course and said, "I suggest university management should ensure that the project is designed by the student himself so as to ascertain the actual transfer-of-learning process. Added care must be taken by the university by letting the students take exams on capstone course."

In the opinion of Fahad, the capstone course can improve if students coordinate with the teacher. Students should believe that their teachers have more knowledge than

they have, and so they need to coordinate with the teacher. “I must repeat that faculty members have more knowledge than students, and students need to remain humble to get the knowledge.”

One problem with the capstone courses that participants noted was that they are time consuming. Almost all of the participants suggested that the university offer the capstone courses in sequence over two semesters. Sadan highlighted this view: “This course should be offered in two semesters’ sequence, at least, instead of one semester. Secondly, this course should be [made] more effective by reforming the roles of teacher, mentor, and student.”

Applicability of the capstone course in the professional environment. Applicability of the capstone course in the actual field was the main indicator in defining the overall theme of the study. Most of the study participants stated that the capstone course is of high practical importance, and its training can be readily applied in professional life. They felt the capstone course can be considered as the foundation for a new job, and it can replace job training. Fahad shared his experience about his first job assignment.

> Electrical engineering gives you a tough time. I luckily joined my new job after I completed my graduation. I was a junior there, and no major responsibility was assigned to me; however, I started understudying things such as the development of circuits. It was pure transfer of learning because I was applying the skills of my capstone course in my new organization without it even being noticed by the management. When management assigned me the duties, I did not take any special training and got the performance reward that year. (Fahad)

Latifa, however, had a different perspective of the course’s applicability. She also agreed with the point that the capstone course increases the ability of students to apply their skills in professional life.

> I selected the capstone course, and it was definite that it was going to help me in my career at some point of time, sooner or later. I have no hesitation in saying [that the] capstone course is purely practical knowledge and extremely useful for students for students of engineering. (Latifa)

Industry Problems with Training

Identifying the problems fresh candidates in industry are facing also helped to explain the main theme of the study—i.e., the success of transfer of learning from the capstone course to the actual professional environment. Participants stated that the capstone course, particularly in their final project, solved the problem of lack of training, and served to remind them of what they had learned in their university studies. Moreover, the teachers and faculty members who assigned the capstone course in Kuwait University were well versed in industry trends; for this reason, they assigned projects that meet current organizational needs. This theme included the two subcategories of "capstone application within the organization" and "learning principles and the capstone course."

Capstone application within the organization. Participants linked application of the capstone course within organizations and learning through the capstone course with phrases such as "lack of training impacts professionalism," "experience is the overall conclusion," "responsive and impulsive attitudes of the field," and "learning model in new technology." All these ideas reflect that the capstone course helps fill the gaps in training in the professional environment. As a number of participants asserted, the professional engineering environment is filled with impulsive behavior, a lack of training, and a preference of experience. In those situations, the capstone course helped students. The capstone course provides assistance in both the short term and the long term. Within the theme "need for the capstone course," this study found that the capstone course helps in long-term learning; at the same time, participants implicitly expressed that the course

helped them when they joined their organizations. Fawaz remembered the period when she joined her first job.

> The field has impulsive behavior, and it does not give you any consideration only because you are new. I had to recollect all my notes, assignments, and exams to complete my first job assignment, though they helped little. I would say that the capstone course can help if it is designed from real organizational perspective. (Fawaz)

Aseel also considered that the field is impulsive and one does not get the opportunity to relearn the concepts already learned in the university. Most of the participants recollected that after joining the company, they needed to perform instead of recalling the ideas they were taught. To sum up the comments of participants, they were of the view that the capstone course can help engineering students understand the project environment of organizations. Talal reflected on his experiences that his responsibility to revise the concepts of university learning into his job. Fahad also concluded the same; however, he looked at things from a different perspective.

> Once you sign the job contract, you are responsible for your projects. It's your responsibility to revise the concepts of university learning. I am sorry to state, but the professional environment is too harsh and one has to rush like others. I did not put strong focus on my capstone course, and I never got an opportunity to revise my fundamental programming concepts again because organizations do not pay you for learning. (Talal)

> In my personal experience, no one sees to which university a student belongs. The only noticeable thing is his understanding and experience, and the capstone course is a very good way to impart practical knowledge to the students, which can help them in organizations because experience is the overall conclusion in organizations. (Fahad)

Learning principles and the capstone course. The capstone course works on the principle of practical learning. This approach helps students to gain insight into the practical knowledge they will need on the job. In the light of participants' observations and the synthesis of the need for the capstone course and industry problems with training,

we can infer that the capstone course has a unique learning model. And that learning model also appears to be unique and different from the stereotypical courses in the eyes of Kuwait University graduates. Talal explained this view by stating, "For me, the capstone course was not an outstanding experience. I felt lack of focus in the course; however; I still admire its learning model."

This view parallels the learning model emphasized under the primary theme "need for the capstone course." As mentioned earlier, "industry problems with training" have a similar basis as the "need for the capstone course" in that both themes focus on how the capstone course is necessary for students later, in their professional life. A number of participants voiced this perspective. As an example, Areej recognized that the capstone course is the only course that has some resemblance to a real industry project: "Engineering assignments are a combination of multiple activities, like the capstone course. Unlike quizzes and theoretical assignments, I believe the capstone course gives more insight on practical issues of engineering."

As a subtheme, participants considered the relationship between the capstone course and industry's need for training. This subtheme is highly focused on the relationship between the applicability of the capstone course in industry and the need for training in the industry. In the study, I extracted this theme to better identify in what ways the capstone course with its unique model of learning helped students. This theme also indicates a constant relationship between the learning model of the capstone course and the professional learning environment.

Statements by Fahad and Latifa also linked the need for further professional training in the industry with the capstone learning model. As Fahad stated, "Having been

through the capstone course, I assume the fresh graduate is more receptive to understanding new skills of organizations and more comfortable in meeting deadlines."

Latifa highlighted the same concept with these comments: "I believe the capstone course is practical and guides students in how to actually operate with machines, software, and advisors. It tells how you may accomplish end-user requirements."

Students' Attitudes toward the Capstone Course

When asked about the general acceptability of the capstone course, most participants in this study expressed the opinion that whether students are capable of transferring their learning from the university to the professional environment depends on the student. Participants explained students' interest and capabilities though expressions such as "student's perception," "ability to work hard," and "interest in subject." Two of the 12 subcategories are part of this primary theme: "capstone outcomes and expectations," and "capstone format, contents, and course coverage."

Capstone outcomes and expectations. While discussing students' attitudes toward the capstone course, most participants also talked about the level of their expectations for the capstone course and the outcomes they experienced. Students who expected a high level of activity from the capstone course failed to transfer their learning when the course did not match their expectations. Fawaz discussed this issue with me: "…I admit I was excited to take this course; however, I did not learn anything new but revised [my] concepts of the complete degree program. It helped a lot but could not excite me."

In fact, the whole study was intended to explore the former students' experiences with the capstone course. This theme specifically involves discussion about the

participants' perception of and feelings about the course. The study is largely focused on personal experiences of former students throughout their university period as those experiences relate to the capstone course. However, this theme especially uncovers the role of the students in the success of the capstone course. Statements of the participating graduates suggest that the success of the capstone course is an outcome of the mutual interplay of capstone course contents, the students' advisors, how the university has designed and operates the program and, of course, each student's expectations and focus. The point at which the capstone course did not fulfill students' expectations is the point of disappointment for those students. Their disappointment focused on mismanagement of the capstone course schedule and contents. Most participants also said that the capstone course did not meet their expectations in terms of timing and teacher support . For example, Nawaf concluded that:

> I was disappointed to see the schedule of the capstone course discussion sessions. All were held in the morning, and no one changed them for students pursuing jobs. It was boring for me to do the final project while continuing the job. (Nawaf)

And as Areej noted, "...I cannot say that the capstone course benefits all students. The outcome of the capstone course really depends on the student who wants to extract something out of the course."

The participants of the study generally were of the opinion that students' interest is the key element in any type of learning. Mossab's reflections about these generalizations were similar. He concluded his comments about the applicability of the capstone course by saying:

> I can say I liked the course, but I cannot say whether everyone else liked it or not. The difference of opinion is always there, and it is rooted in students' perception and experiences. Students willing to do hard work on a project can extract greater knowledge, whereas others may not get the

> same. The outcome of the capstone is a product of the university effort and the student's own efforts. (Mossab)

Capstone format, contents, and course coverage. Based on the results of this study, the capstone course has some gaps, and it is possible to implement a better design. This theme was extracted based on the observation of a number of participants. According to them, the capstone course offered by Kuwait University lagged behind their expectations in a number of areas. As various participants explained, the course is in its initial stages; therefore, it requires significant improvements. The prominent elements that changed the attitude of these former students toward the capstone course were the selection of topics and how the contents of the course were covered. They noted that the entire contents of the course *were* revised during the students' projects, which introduced disorientation among the students. Various participants confirmed that the topic selection and how the course contents were covered determined their attitude about the course perspective by complaining about the capstone course format, contents, and coverage. For example, Fawaz stated that "I think it would have been better if the topic was under the discretion of the students. In my group, the professor assigned the topics, and many of us got undesired topics."Also, Mossab concluded that:

> I think the capstone course should be monitored right from the day of allotment [from the first day] … I think that there should be a proper check and balance to monitor the work and to ensure that proper skills are being utilized by students for preparing the project. (Mossab)

Connection Between Themes of Study

After I had studied the various themes that arose from this study, it became evident that all four themes identified at the beginning of the chapter support the connection between the themes. So we can consider this connection, whether the capstone course is meeting transfer-of-learning requirements at Kuwait University, as the

common factor among the other four themes. This primary theme reflects the cross-analysis and the common factors among the four themes. In the views expressed by study participants, there is a need for the capstone course because it helps them in developing professional understanding. Mohammad clearly asserted that:

> I highly appreciate the capstone course because it is playing a role in the transfer of learning. I am very clear on it that the final project was the ultimate opportunity for me to prepare myself for the professional environment, and I did so. (Mohammad)

Combining the themes of the need for the capstone course and the industry problems with training, I see a clear role for these themes in promoting the value of the capstone course. A number of former students did not get any opportunity for formal industry training, and the transfer of their learning from the capstone course worked in that context for them. Students had to be reminded of what they had studied during the capstone course, and they had to apply those skills in the professional environment, as Mohammad stated that:

> Few among the batch of trainees hired last year were known to me. I contacted them before [I took] the capstone course, and they assured me that at least this course is nothing more than a formality for degree completion. Unfortunately, I took the course this way and focused on completing the work instead of learning. When I entered the field, I did not get a supportive boss like my seniors, so I had to understand everything myself ... for this, I recompiled all my university books, projects, and notes. It was a matter of survival for me, so I worked to transfer the learning from the university to the professional environment; and the capstone course did help in this. (Mohammad)

Connecting the students' perceptions with the question of the applicability of the capstone course also helps in explaining the central theme of the study. None of the students expressed their regret for taking this course; rather, all expressed their sorrow for not taking the course seriously. Mohammad stated:

> It was not only timing problems with the capstone, but I would say that I also played a role in spoiling the schedule. I did not start work in time, and today I can say that starting an assignment in time brings you success. Professional life does not relax you like student life. (Mohammad)

Connecting themes and inferences from the subthemes in this study provides further direction toward the central theme. Inferences include that former students understand the applicability of the capstone course, and they understand its importance from the organizational perspective. Most participants confirmed that the capstone course helped them in their first year of their job. It also worked as a catalyst for them in understanding their professional responsibilities. The capstone course was applicable in their professional work. If we bring together students' perspectives on the later theme of opportunities for improvements in the capstone course and its applicability within the organization, the result also supports the premise related to the main theme that the capstone course helps in transfer of learning. Former students widely recommended improvements in the capstone course because they felt that improvement in this course could further help students in transferring their skills from the university to the professional environment.

CHAPTER 5: DISCUSSION

This chapter contains five major sections. The first section offers discussion in light of the current literature; it includes the statement of purpose and the research questions, and it discusses how the findings of this research and the results derived from responses to the research questions are linked to the literature review in chapter 2. The second section discusses the limitations of the study. The third section focuses on the proposed implications of the study for Kuwait University–in essence, that Kuwait University can use this study to reformulate its capstone course. The fourth section offers recommendations to be presented not only to Kuwait University but also to students and policy-making institutes to enhance the transfer-of-learning processes from universities to the professional environment. The fifth and final section discusses potential future research that can be done for the purpose of adding to current understanding about the value of senior design capstone courses.

Discussion in Light of Current Literature

The main research question that guided this basic interpretive qualitative study, as previously noted, is *What is the meaning of the students' experiences in the senior design course with respect to the course's applicability to their experiences in the industry?* As noted earlier, I investigated the basic research question by way of four secondary questions, each investigating a distinct area of student experience with the capstone course. To recap, the research subquestions that I pursued are

- What do students gain during the senior design course that is helpful in their actual work in engineering?
- What is the value of the senior design course to the working engineer?
- What senior design course method helps the most?
- What do the participants suggest as ways of improving the transfer of learning from the senior design course to the field of work?

Interviews and the subsequent coding of responses were directed at answering those questions for the purpose of answering the basic research question.

Like most universities with engineering programs, Kuwait University has a capstone course whose primary goals are to conclude the entire degree program, enhance the students' abilities with engineering instruments, and prepare students for professional life. Behind these objectives, the utmost goal of the capstone program is to facilitate transfer of learning.

Senior Design Course Advantages and Value

I addressed the first two subquestions—i.e., what students gained during the capstone course and the value of the capstone course to working engineers—through an exploration of the participants' experiences as students. Every student experience was different from the others. A few of the former students found the capstone course to be overwhelming, whereas the rest found it a formality for degree completion. And a few participants experienced the course as a waste of time. Overall, what these former students gained during their capstone course was the ability to handle projects, meet deadlines, and revise the whole course, in addition to on-the-job training for their specific working environments. Rambau (2005) highlighted the fact that if students are capable of

transforming their learning into practice and actual skills, as well as prepare themselves for specific working conditions, this is transfer of learning.

This conclusion by the former students in this study, as well as that of Rambau (2005), has its roots in the theory Ellis (1965) put forth. In a simple definition of transfer of learning, Ellis stated that if performance in one learning situation has an impact on another work situation, it is transfer of learning. The "need for the capstone course" subtheme of the present study, along with other subthemes such as "the capstone course creates a difference" and "learning models," emphasizes that transfer of learning is taking place through the capstone course in Kuwait University. In the opinion of Kuwait University graduates in this study, they were able to apply their skills in the practical environment of the industry, and the capstone course helped them in multifaceted ways. This course helped them in getting a job, improving job performance, being promoted, and establishing their professional images, thereby improving their daily lives (Leberman, McDonald, & Doyle, 2006).

All participants had significant discussion about how the capstone course helped in their professional engineering work. And the secondary themes that support the primary theme of the study investigate this question extensively. In the opinion of most participants, the capstone course prepared them for the professional environment and enabled them to gain a distinctive advantage over other graduates in that respect. This theme, however, is in strong contrast with the findings of Mestre (2002). Statements such as "professional life is not easy," "professional life is different from student life," and "the field has impulsive behavior" clearly depict that the professional and student environments reflect different contexts. Nevertheless, all participants applied the skills

they attained during the capstone course to their work environment. Mestre (2002) was of the view that if the context and learning environment changes, the transfer of learning is significantly reduced; nevertheless, the responses to these themes in our study generally depict that if the situations are variable, former students who have completed the capstone course can better utilize their skills. This outcome is reflected by statements such as those of Sadan:

> The capstone course gave me the practical exposure [to] and knowledge of the field. I faced behavioral challenges and professional challenges in the field … Due to the capstone course I knew many things, and I managed to save my image in professional life. The capstone course helped me in getting knowledge of the field.

When we consider this theme in terms of the current study, it also rejects the theories of Thorndike and Woodworth (1901) and Smith (1991). Their theory of the importance of identical situations and identical elements is not found to be valid for the capstone course at Kuwait University.

The question about how the capstone course helps the working engineer inevitably looks for the advantages the capstone course offers to both organizations and engineers. A number of participants discussed that companies are hiring people who have completed between 4 and 6 credit hours in the capstone project. Aseel stated it this way:

> It was written on my transcript that I have already completed 64 credit hours of engineering specialization and 6 credit hours of specialized project. …my interviewer was impressed, and I got the job; so you may say it acted as a differentiator.

Other participants emphasized the same view, as well as the fact that companies are hiring graduates with a capstone course background because it will save on their training costs. The organizations are considering the capstone course as their initial training. And according to participants, they are right in doing so because the capstone

course did help them in their actual projects. This argument strongly endorses that of Enos, Kehrhahn, and Bell (2003), who found, in their research, that informal training accelerated self-regulation as experienced by participants. They discussed that new perspectives are being developed, and we can surely consider as a new perspective the replacement of formal training with the capstone course to save costs in organizations.

Senior Design Course Methods

The third question was to know the methods used in the capstone course that may be of most help in the transfer of learning. All participants discussed the contents, format, and learning model of the capstone course and found them unique in comparison to other stereotypical courses. Participants suggested no specific method; however, most of them emphasized characteristics such as innovation, creativity, uniqueness, independence, and an open environment for learning. Participants appreciated the generic model of capstone courses wherein the project grade comprises the entire grade for the course.

The opinions of Fahad, Mossab, Abdurrahman, and others support the thesis that the capstone course is necessary to inspire innovation and creativity among the students, which in turn enable them to invent something using their prior knowledge (Schwartz, Verma & Martin, 2008). Participants also asserted that if companies coordinate the capstone project process, students will get ample opportunity in the course to learn more that is applicable in practical environments. Ozaturk (1995) also proposed this approach. Ozaturk was of the view that local industry should work to propose potential designs to be pursued by students, faculty, and engineers. In this study, Aseel stated the same idea: "[The] …capstone course should be based on demands from companies. Students can

actually join their research and development team, or they [the team] can assign simple projects to students."

Framing the third question about the methodology of the capstone course, the study concludes that students need an amalgamation of methods. The former students mentioned that they need a mix of methods and a blend of theory and practice. This point supports the thoughts of Prince (2004) when he stated that problem-based learning (often denoted as PBL) serves as an instructional method. With PBL, at the commencement of the instruction cycle, problems are brought in and are used to suggest the context for the learning process. This learning style also incorporates noteworthy amounts of self-directed learning.

Jiusto and Dibiasio (2006) also noted that a traditional academic structure doesn't encourage learning that is self-directed. They found that experiential interdisciplinary project programs, also known as global studies programs, enhanced students' willingness toward self-directed learning (SDL). In this context, Mahendran (1995) noticed that students best understood the theories of civil engineering when emphasis was on its practical application. The simple methodology of teaching led to reduced motivation among the students. In contrast, practical design projects contributed greatly to their development of skills.

A group of current study participants also indicated a requirement that the capstone course should be more professional and more focused. This in fact points toward application of the Mudd Design Workshop at Kuwait University. Required improvements from participants include characteristics of Mudd design, such as inculcating cultural values in the capstone course, adding continuous improvement, and

incorporating timely assessment during the entire study program. Moreover, as a number of participants identified, the capstone course requires additional care, and teachers must ensure that each student is working on the project in the desired manner (Dym, Sheppard, & Wesner, 2001).

Recommended Improvements to the Senior Design Course

The last question in support of the primary question focused on suggestions for ways to improve the capstone course. Most participants asserted that the capstone course should adopt changes such as focusing on behaviors; incorporating continuous assessment of participants' tasks and ongoing suggestions for improvement; facilitator/teacher self-involvement in the course instead of outsourcing; and providing new ways for learning. Dym, Sheppard, & Wesner (2001) highlighted these improvements as elements of Mudd design. Participants did not refer to the Mudd design; however, if we connect their improvement model with the literature, we can conclude that Mudd design is actually required for a new and improved capstone course. Participants also emphasized Holton's theory (1996) in their suggestions for improvement. According to the participants, it is the behavior of the teacher in capstone sessions that hinders student learning; therefore, an improvement in teachers' behavior is required.

Participants suggested a number of other ways for improving the capstone course. Some of the complaints participants raised bore a high resemblance to issues Bufarsan (2000) addressed. According to Bufarsan, improvements could be made by allocating a whole semester to the capstone course, appointing experienced and well-behaved supervisors, and allocating a separate meeting area for students. Participants in the

current study indicated that to improve the transfer of learning, universities need to have more experienced and courteous staff and an intranet page where students may communicate with their teacher round the clock.

When we look at individual themes that arose in the current study and observe the perceptions of these former students of Kuwait University relative to the capstone course, a prevalent theme is the inability to generalize the applicability of the capstone course to the professional setting. Kirwan and Birchall (2006) addressed this issue and asserted that generalization about a matter such as this is not possible. From the former students' viewpoint, every student has different capabilities; thus, we cannot say that the capstone course always enables transfer of learning from the university to the professional environment. Although the course's applicability is not always generalizable, most of the students found the it to be a useful tool for transferring their learning. We can safely say that Kuwait Engineering University's capstone course is capable of enabling students to transfer their learning to the professional environment, just as the course offered by United Stated Air Force is doing. We can consider the characteristics of the USAF course as a benchmark (Jenkins, Pocock, Zuraski, Meade, Mitchell, & Farrington, 2002); and comparison with that benchmark highlights the fact that the Kuwait University capstone course also sustains a high academic influence and transfer-of-learning capability.

Savsar and Allahverdi (2008) portrayed that a capstone course should be able to develop an insight within students that may spur them to invent something new. From the perspective of the perceptions of former students in the current study relative to needed improvements in the capstone course, it appears that the capstone course of Kuwait Universality is still not capable of spurring students to invent something new. Based on

the open codes derived from the interviews, getting a job is the main incentive of the capstone course. This implies that students of Kuwait University take the course because they think that they will get a job after they have completed the course. Connecting these ideas with participant responses to the question about the need for a capstone course, the final attitude is clear: Students realized the importance of the capstone course only after they entered into their professional lives.

Participants, in this study, from numerous job sites took the capstone course only because it was a degree requirement and they expected that completing it would give them a better job. I cannot say that the results of my study contradict the findings of Savsar and Allahverdi. Rather, it is reasonable to assume that the capstone course of Kuwait University is still in its initial stages and therefore requires improvement to attain the level of influence that Savsar and Allahverdi prescribe.

Conclusions and Significance of Findings

Transfer of learning is occurring in Kuwait University, and it is interesting to note that this transfer is occurring not simply with engineering skills, but they are also transferring all types of instructions and information they have acquired during their course of study at in the university. As Haskell (2001) discussed, these students are not only transferring engineering skills; they also are getting hands-on experience for dealing with the professional environment. Haskell's observation is prevalent in responses to the question about the applicability of the capstone course in the professional setting, a subtheme of the main theme of this study. The students learned how to meet deadlines and how to do tasks step by step with the coordination of their advisor. Recall also Holton's (1996) views that engineering course training methods are ineffective, and that

the original and transfer situations must be similar for transfer of learning to work. Although Haskell and Holton's ideas are independent of each other, the current study suggests that Kuwait Engineering University's capstone course is reflective of both theorists' ideas.

Former students who have experienced the capstone course recommend it to upcoming students, although they believe an improved course should be offered. As the related subtheme identified, participants stated frequently that the capstone course should be improved in the areas of timing, schedules, teachers' behavior, contents, and format. These results make the capstone course an emergent issue not only in the eyes of study participants, but also for the university (Scott, 2004) since a final goal for the study is that Kuwait University will use the results in practical application.

If I frame the students' experiences in terms of the original research questions, I have found the answer to the significant questions. From the results, we can conclude that students gain significant exposure to practical engineering through the capstone course. As the primary research questions asked, the participants satisfactorily stated that their learning and skills improved when they completed the capstone course. The other research questions had to do with the students' perception of the value of the senior design course. As Ellis (1965) and the former students themselves stated, the experience of their performance on a task influenced them on other succeeding tasks. In this survey, within the themes of students' perception of the course and the need for it, the results show that the compulsory capstone course met their need for job training. In fact, their experience of working in the university in this course helped them in their work in the professional environment. As many of the participants acknowledged, they were not

given on-the-job training; the only training source for their first official assignment was their degree and what they had learned in the capstone course.

Participants who shared their experiences identified components that can enhance learning, such as the joint focus on theory and practical learning. The former students identified that their base knowledge of engineering transferred automatically to the new environment, along with peripheral knowledge, such as behavioral knowledge. In contrast, motivation experienced from participating in the capstone course does not transfer to the professional environment. As extracted from the results of the "need for a capstone course" theme, the participants' level of motivation on the job is higher than it was in the capstone course. The improvements participants recommended will require both a university review of timing for the course and also of other factors such as orienting the course toward independent thinking, identifying motivational elements, understanding the culture of learning transfer, and following benchmarks in transferring learning to the work environment (Haskell, 2001).

The participants also stated that it is not possible to get the identical situation in professional life to what they experienced in the university. However, whether or not the situation is identical, the transfer of learning works. Under the topic of the need for a capstone course, participants identified that the capstone course works better when fresh graduates on the job are assigned with multiple tasks and receive less training. A forced transfer took place in this environment where former students have to recall everything they applied during their studies; they also may have to recompile their study material in order to save their professional reputation. According to the theory of identical elements that Thorndike and Woodworth (1901) proposed, this theory presumed that transfer will

occur in situations in which identical elements exist in both the original and transfer situations. The degree and types of transfer that occur will be determined by the similarity of the two situations (Smith, 1991). Interviews results indicate that having an identical situation at the university and on the job is not realistic or applicable, thereby rejecting the ideas of Thorndike and Woodworth (1901) on this subject.

Participants discussed the methodology of the capstone course. Almost everyone expressed that individualized activity was the strong point of the capstone course. While students are working in groups, individual weaknesses and limitations are not addressed and so do not improve. Doing the same project individually increases the level of effort required, and students have to work on those aspects on which they have not yet worked. In contrast, Zhao, Anand, and Mitchell (2004) are of the view that group teaching and group learning are the most effective way to transfer knowledge. They asserted that transfer is widely possible through group learning, and that the group approach provides a platform for complex transfer. Nevertheless, participants in the current study stated that students learn and transfer their learning better through individual activity.

From among the problems related to transfer of learning in Kuwait that Ali and Mensch (2008) identified, the present study supports the issues of lack of management support and workload management, and lack of time. The core problem the former students in the current study faced in their capstone courses was lack of time and an inability to manage the project schedule. These conclusions are again in contrast to those of Ali and Mensch, who stated that the language barrier and lack of management support are specific to Kuwait, while the other issues are specific to Europe. In comparison, our

study concludes that Kuwaiti engineers primarily face problems related to time management and management support.

Limitations

This study had limitations that affect the results. The main limitation was language. Although all of the participants studied their courses in English, they preferred to speak in Arabic during the interview. As a result, I had to translate each interview into English. Then I started coding after I had finished each translation. Moreover, during the translation process, I was unable to translate some cultural terms and expressions accurately from Arabic to English.

All in all, the findings of this research are bound by the participants and cannot be generalized to the entire population of Kuwaiti engineers who have experienced the senior capstone design course. In addition, the results of this research build upon an understanding of the value of capstone course aspects that have influenced the engineers in their professional experience.

Implications for Kuwait University

Kuwait University is the prime source of knowledge for engineers in that region. The university produces engineers not only for Kuwait but also for the entire Middle East; therefore, the university's engineering degree must be refined and perfected for that purpose. The capstone course of Kuwait University, as identified by the participating Kuwaiti engineers, is in its initial stage. The university offers the course over a timeframe of four to six months, or one semester. However, according to the former students, the actual working environment "warms up" after two months, and students are usually left with only four months to complete the course work. An advisor is assigned to a number

of students, and he usually is not able to meet with all students regularly and contact them as frequently as the students require.

Major limitations and weaknesses participants found in the capstone course include inconsiderate behavior on the part of the advisor, and content, format, and timing problems. Secondary issues include prompting by students and the inability of the university to add something new to the capstone course.

Participants also stated that Kuwait University was among the few universities that have initiated the capstone course, and that the university always works for the welfare of students. The present study will help Kuwait University in identifying the problems in its capstone course. By using this study, the university will be in a position to better understand the problems related to both students and advisors. By considering the perspective of former students, the university will get an opportunity to reassess where the problems lie. It will also be in the position to improve the allocation of advisors and to set up a special communication channel, such as an intranet page. Moreover, the university can require its advisors to stay in touch with their students.

At the policy level, Kuwait University will be in a better position to reformulate its strategies and policies about the capstone course. If the university uses the results of this specific study, decisions such as duration of the capstone course, its contents, an assessment of methodologies, and determination of the preferable methodology of assignments will better align with students' academic and on-the-job requirements.

Therefore, Kuwait University can use the study to reformulate its capstone course. Based on Mudd design, the proposed capstone course for Kuwait Engineering University may have the following design:

- Allocate two professors as advisors to each group; each professor may not advise more than two groups.
- The capstone course necessitates frequent meeting sessions between students and teachers—at least every fortnight. Every meeting session should be graded by the teacher, and the advisor must note the progress of each student's work, along with reviewing students' completed work.
- The university must develop an intranet board where students can communicate with the teacher around the clock. All advisors are required to reply to students' queries within 24 hours of submission; otherwise, they may face a penalty by the university.
- The curriculum of the capstone course must be revisited. The new capstone course needs to include theory as well as practical sessions. The students are required to work like managers and reflect on every aspect of the project, such as budgeting, staffing, and monitoring and control, to attain managerial proficiency.
- The capstone course also should have measures to ensure that projects meet ethical and legal requirements. The course must reflect on behavioral issues in the workplace, as well.
- An extended time slot, such as eight months or two semesters, is needed for many students to complete the course. The project must be divided into phases to ensure timely completion of deliverables.
- Kuwait University should conduct training sessions for its advisors to train them for their positions as advisors. The university must ensure that professors understand their duties and maintain enough knowledge to guide their students.

- To ensure transfer of learning, Kuwait University must assess students' work on projects during the semester—for example, that the second-semester project uses techniques from the previous semester's project, and so on. The capstone project should then be a blend of all those skills the student has attained during the entire program of study.
- At the university level, Kuwait University is required to communicate with certain organizations to place its students at their research centers for capstone projects. This also can be used as a method to motivate students for hard work and to achieve true transfer of learning—i.e., placing only top-rated students.
- The university must fund the projects through different committees, to allow students to fully concentrate on their engineering designs instead of having to spend time searching for funding for their projects.
- For students pursuing a capstone project, the university must arrange extra lab sessions so students may practically explore the engineering design and may apply their skills.

All these implementations will help ensure that an accurate transfer of learning is occurring through the senior design capstone course. Steps such as allowing students to use lab sessions frequently and budget allocation may not directly affect participants in the effective transfer of learning. In other words, the University should try to find funding for students' projects and remove the funding responsibilities for their projects from students However, they may pave the way for transfer of learning, as participants of this study have asserted. According to participants, faculty involvement such as lab sessions, frequent communications between teacher and student, and an established mode of

communication provide participants with peace of mind and allow them to focus on the project instead of on other secondary issues. The university, in order to ensure transfer of learning, must take care of every minute aspect of the capstone course.

Recommendations for Higher Education Institutes

Based on the analysis performed and inferences drawn in the light of the current literature, I present the following recommendations not only to Kuwait University but also to students and policy-making institutes to enhance their transfer-of-learning processes from universities to the professional environment:

- All universities, including Kuwait University, should identify the caliber and understanding of their students before they offer the capstone course.
- Student should coordinate and discuss their capstone course projects with an engineer so that the project selection remains within the parameters of actual on-the-job data collection.
- All universities, including Kuwait University, should hire faculty specifically to run the capstone course. The staff should be well experienced and courteous, and should understand the workings of the capstone course.
- A maximum of two participants or groups are allocated to one advisor, thereby reducing the advisor's workload. In this way, participants would be able to communicate with the advisor more frequently and easily. Also, the advisor will be in a position to understand two projects more easily and comprehensively.
- All universities, including Kuwait University, are required to adopt the 11 principles of the Haskell framework. At present, the university capstone course is accomplishing the transfer of students' primary knowledge base, the transfer of

peripheral knowledge. The course also must incorporate the history of and pertinent data about the transfer-of-learning content area, motivational factors, and transfer drills and practice; and it must observe the incubation time and practice the theory that underlies transfer-of-learning principles.

- Students of the university are required to improve their behavior because their behavior is the fourth pillar of the transfer-of-learning process. The subtheme identified in this study clearly states that students' perception of the capstone course plays an important role in the success or failure of learning transfer. Students must work on their projects from day one and formulate an approach to their work that results in effective and comprehensive learning.

Future Research

Maintaining the usefulness and applicability of the capstone course requires the constant attention of Kuwait University management and policy makers. Other educational institutions, policy makers, and Kuwait University can explore three areas identified in this study. The study does not explore those areas completely because of its limited scope; however; the areas can serve as food for thought for upcoming research.

The present study includes the recommendation that the capstone course at Kuwait University be benchmarked with international universities such as Yale and Stanford. However, the scope of this recommendation and a plan of action still must be designed. To do this, more research on the topic is important. For example, a prospective research question might be *What steps should Kuwait University take to adapt the best components of Yale and Stanford's capstone courses?* This study could be approached using in-depth interviews with the policy makers in these institutions. In addition,

detailed research is also necessary on the topic of sponsoring relationships between Kuwait University and various multinational companies that are serving in Kuwait. Beyond this, policy makers might also explore and study the possibility of offering the capstone course in an extended semester. A number of participants in our study have identified this issue; however, the present study includes it only as a recommendation. This recommendation requires significant research because it would require altering the time period for attaining a degree and the related educational hours, compared to other recommendations that focus on improving the course content and mode of communication. This recommendation also requires a comprehensive comparative study on transfer of learning results in both systems--i.e., the conventional capstone course timeframe and the extended capstone course timeframe.

Another area for potential future research should focus on developing the project-based course in earlier stages of students' educational program by investigating more about the relationship between student achievement and the market demand. In other words, a prospective research question might be *Are there advantages to offering the capstone course in the earlier stages of students' course of study, such as at the sophomore or junior levels?* I suggest that future researchers might benefit from the personal and professional experiences that these engineers , from the present study, have gained from their work and the capstone course.

Another area that could provide a significant source for future research relates to the design of the capstone course and potential alteration in its learning model. Future research should focus on selecting an appropriate model for the capstone course, such as the Mudd design or a conventional design that can improve transfer of learning. Along

with this, future research could also explore possible reasons for professors' lack of interest in the capstone course and possible remedies to improve their attitudes and behavior. This information might be acquired by doing a focus group study about the capstone course; research questions could be *What ar**e** the possible reasons for some professors' disinterest in the capstone course? What are the possible solutions to improve their attitudes and behavior?*

The current study shows different Kuwaiti engineers' perspectives on the engineering senior design (capstone) course as it relates to their professional experiences. Future research might be conducted with Kuwait University students using the quantitative research method. This study could be considered a pilot study, to generalize the results—in other words, to support the current qualitative study.

Moreover, future researchers can investigate the development of capstone course teaching methods to help students become more creative engineers rather than traditional engineers. This current research represents the first steps toward reforming engineering education courses, and especially the capstone course; it is an indicator that the new era of engineering education has just begun.

REFERENCES

Abdelraheem, A. Y. (2003). Computerized learning environments: Problems, design challenges and future promises. *The Journal of Interactive Online Learning, 2,* 2.

Al-Duaij, J. (1997). Statistical study for attrition rate of 1990 students at the end of 1995–1996 academic year. Office of the Vice Dean for Student Affairs, College of Engineering, Kuwait University.

Al-Tabtabai, H. M. (2000). A capstone design course on professional construction management for undergraduate students. Proceedings of Construction Congress VI: Building Together for a Better Tomorrow in an Increasingly Complex World , ASCE, Reston, Va., 271–279

Ali, A., & Mensch, S. (2008). Issues in informing science and information technology. *Issues and Challenges in Selecting Content for Web Design Courses, 5*(1), 210–231.

Alkhezzi, F. A. (2002). *Internet use of graduate and undergraduate students in the college of education at Kuwait University.* Unpublished doctoral dissertation, University of Northern Colorado, Greeley, CO.

AlMahboub, S. (2000). *Attitudes toward computer use and gender differences among Kuwait sixth grader students.* Unpublished doctoral dissertation, University of North Texas, Denton, TX.

Andrew, A. (2005). Still in transition: An ethnographic case study of the academic and cultural experiences of Kuwaiti students enrolled in a formal agreement partnership between an American university and the State of Kuwait. Retrieved from Dissertations and Theses database. (AT 3170668).

Andrew, A., & Clifford. (2005). *Still in transition: An ethnographic case study of the academic and cultural experiences of Kuwaiti students enrolled in a formal agreement partnership between an American university and the State of Kuwait*. Retrieved from Dissertations and Theses database. (AT 3170668).

Bandar, S. A. (2000). The developmental stages of concern of teachers toward the implementation of the information technology curriculum in Kuwait. *Doctor of Philosophy (Curriculum and Instruction), 1,* 137.

Boeije, H. (2002). A purposeful approach to the constant comparative method in the analysis of qualitative interviews. *Quality & Quantity, 36,* 391–409.

Bufarsan, F. (2000). *Curriculum analysis in teacher preparation programs at the College of Basic Education in Kuwait*. (Doctoral dissertation). Retrieved from University of North Texas Electronic Dissertations and Theses database. (UMI No. 3042831) http://digital.library.unt.edu/ark:/67531/metadc2583/

Calais, G. J. (2006). Incorporating Haskell's theoretical framework for achieving general transfer in the content areas. *National Forum of Teacher Educational Journal*. *17*(3), 214–230.

Carey, G. (1998). Multivariate analysis of variance (MANOVA) II: Practical guide to ANOVA and MANOVA for SAS. Retrieved online, at http://ibgwww.colorado.edu/~carey/p7291dir/handouts/manova2.pdf

Christoforou, A., Al-Ansary, M., and Yigit, A. (2004). Improving engineering programs at Kuwait University through continuous assessment: Preliminary results. American Society for Engineering Education.

Cicchelli, T., & Baecher, R. (1985). Introducing microcomputers into the classroom: A study of teachers' concerns. *Journal of Educational Computing Research, 1*, 55–65.

Cook, D. J., Holder, L. B., & Youngblood, G. M. (2007). Graph-based analysis of human transfer learning using a game testbed. *IEEE Transactions on Knowledge and Data Engineering*, *19*(11), 1465-1478.

Cresswell, J. (1998), *Qualitative inquiry and research design: Choosing among five approaches* (1st ed.). London: Sage.

Cresswell, J. (2007), *Qualitative inquiry and research design: Choosing among five approaches* (2nd ed.). London: Sage.

Cree, V. E., & Macaulay, C. (2001). *Transfer of learning in professional and vocational education: Handbook for social work trainers.* Routledge Publications. London.

Croissant, J. L., Ogden, K., & Ogden, G. (2000). Teamed internships in environmental engineering and technology: A project report. *Journal of Engineering Education, 89*(2), 111–114.

Dutson, A. J., Todd, R. H., Magleby, S. P., & Sorensen, C. D. (1997). A review of literature on teaching engineering design through project-oriented capstone courses. *Journal of Engineering Education, 86*(1), 17–28.

Dym, C. L., Sheppard, S. D., & Wesner, J. W. (2001). A report on Mudd Design Workshop II: Designing design education for the 21st century. *Journal of Engineering Education, 4*(1), 8–25.

Elinor, S-H. (2005). Correlates of reading fluency in arabic: diglossic and orthographic factors . *Reading and Writing, 18*(6), 559-582.

Elen, J. (2004). Turning electronic learning environments into useful and influential 'instructional design anchor points.' *Educational Technology Research and Development, 52*(4), 67–73.

Ellis, H. C. (1965). *The Transfer of Learning.* New York: The Macmillan Company.

Enos, M. D., Kehrhahn, M. T., & Bell, A. (2003). Informal learning and the transfer of learning: How managers develop proficiency. *Human Resource Development Quarterly, 14*(4), 369–387.

Ercolano, V. (1996). Designing freshmen. ASEE *PRISM, 1*, 21–25.

Fallon, C., & Brown, S. (2002). *E-learning standards: A guide to purchasing, developing, and deploying standards-conformant e-learning.* Boca Raton, FL: CRC Press.

Felder, M. R. (1988). Learning and teaching styles in engineering education. *Engineering Education, 78*(7), 674–681.

Fentiman A. W., & Demel, J. T. (1995). Teaching students to document a design project and present the results. *Journal of Engineering Education, 84*(4), 329–333.

Ferguson, C. (1959). Diglossia. *Word*, *15*, 325-340.

Gregson, P. H., & Little, T. A. (1998). Designing contests for teaching electrical engineering design. *International Journal of Engineering, 14*(5), 367–374.

Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: Strategies for qualitative research.* Chicago: Aldine.

Hardon, John, S. J., Fr. (2003). Islam. Retrieved from http://catholiceducation.org/articles/religion/re0679.html#20

Haskell, R. E. (2000). *Transfer of learning: Cognition, instruction, and reasoning*. England: Academic Press.

Haskell, R. E. (2001). *Transfer of learning: Cognition, instruction, and reasoning.* New York: Academic Press.

Holton, E. F., III. (1996). The flawed four-level evaluation model. *Human Resource Development Quarterly, 7*(1), 5–25.

Howe, S. & J. Wilbarger (2006, June). *2005 National Survey of Engineering Capstone Design Courses.* In *ASEE National Conference and Exposition*. Chicago, IL.

Jenkins, S. R., Pocock, James B., Zuraski, P. D., Meade, R. B., Mitchell, Z. W., & Farrington, J. J. (2002). Capstone course in an integrated engineering curriculum.

Journal of Professional Issues in Engineering Education and Practice, 128(2), 75–82.

Jervis, K. J., & Hartley, C. A. (2005). Learning to design and teach an accounting capstone. Issues in accounting education capstone courses prepare students for transition to working. *Journal of Engineering, 22*(2), 311–339.

Jiusto, S., & Dibiasio, D. (2006). Experiential learning environments: Do they prepare our students to be self-directed, life-long learners? *Journal of Engineering Education, 95*(3), 195–204.

Kartam, N. A. (1998). Integrating design into civil engineering. *Education International Journal of Engineering, 14*(2), 130–135.

Kirwan, C., and Birchall, D. (2006). Transfer of learning from management development programmes: Testing the Holton model. I*nternational Journal of Training and Development, 10*(4), 252–68.

Knowledgerush. (2009). Retrieved from http://www.knowledgerush.com/kr/encyclopedia/Diglossia/

Koch, C. (2004). The tyranny of projects: Teamworking, knowledge production and management in consulting engineering. *Economic and Industrial Democracy*, *25,* 277–300.

Kunda, G. (1992). *Engineering culture: Control and commitment in a high-tech corporation.* Philadelphia, PA: Temple University Press.

Kuwait University College of Engineering and Petroleum, Civil Engineering Department. (2009). Five year action plan (2005–2010). Retrieved online at http://www.eng.kuniv.edu/civil/index.php?com=content&code=Five+Year+Plan

Leberman, S., McDonald, L., & Doyle, S. (2006). *The transfer of learning*. Brookfield, VT: Gower Publishing, Ltd.

Litzinger, T. A., Wise, J. C., & Lee, S. (2005). Self-directed learning readiness among engineering undergraduate students. *Journal of Engineering Education, 94*(2), 215–221.

Mahendran, M. (1995). Project-based civil engineering courses. *Journal of Engineering Education*, *84*(1), 1–5.

Maskell, D. (1999). Student-based assessment in a multi-disciplinary problem-based learning environment. *Journal of Engineering Education*, *88*(2), 237–241.

Merriam, S. (2002). Introduction to qualitative research. Retrieved online at http://media.wiley.com/product_data/excerpt/56/07879589/0787958956.pdf

Mestre, J. P. (2002). Probing adults' conceptual understanding and transfer of learning via problem posing. *Journal of Applied Developmental Psychology, 23,* 9–50.

Mulopo, M., & Fowler, H. S. (2006). Effects of traditional and discovery instructional approaches on learning outcomes for learners of different intellectual development: A study of chemistry students in Zambia. *Journal of Research in Science Teaching, 24*(3), 217–227.

Noble, J. S. (1998). An approach for engineering curriculum integration in capstone design courses. *International Journal of Engineering Education, 14*(3), 197–203.

Ozaturk, O. H. (1995). A center for teaching design in electrical and computer engineering. *Journal of Engineering Education, 1,* 127.

Patton, M. Q. (1985, April). *Quality in qualitative research: Methodological principles and recent developments*. Address to the American Educational Research Association, Chicago, Illinois.

Paretti, M. C. (2008). Teaching communication in capstone design: The role of the instructor in situated learning. *Journal of Engineering Education, 97*(4), 491–503.

Prince, M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education, 93*(3), 223–231.

Qualters, D. M., Sheahan, T. C., Mason, E. J., Navick, D. S., & Dixon, M. (2008). Improving learning in first-year engineering courses through interdisciplinary collaborative assessment. *Journal of Engineering Education, 97*(1), 37–45.

Raju, P. K., & Sankar, C. S. (1999). Teaching real-world issues through case studies. *Journal of Engineering Education, 88*(4), 501–508.

Rambau, S. T. (2005). *Transfer of learning: Constraints as experienced by management trainees in the private sector.* (Master's thesis). University of Pretoria, South Africa. Retrieved from http://upetd.up.ac.za/thesis/available/etd07292005161902/unrestricted/00dissertation.pdf

Rhinas, J. D. (2006). *Resiliency in the face of interparental violence: A qualitative investigation.* (Master's thesis). Available from Department of Educational Psychology and Special Education, University of Saskatchewan, Canada. (URN: etd-08182006-110721). Available online at http://library2.usask.ca/theses/available/etd-08182006-110721/

Savsar, M., & Allahverdi, A. (2008). Senior design course in industrial engineering at Kuwait University. *International journal of Continuing Education and Life-Long Learning, 18*(2), 253–263.

Schwartz, D. L., Varma, S., & Martin, L. (2008). Dynamic transfer and innovation. To appear in S. Vosniadou (Ed.), *Handbook of conceptual change* (pp. 479-508). Mahwah, NJ: Erlbaum.

Scott, S. W. (2004). Adapting engineering design model to Middle Eastern culture: The Colorado School of Mines brings engineering design to the Petroleum Institute. International Conference on Engineering Education, October 16–21, 2004. pp 1–5.

Smith, M. U. (1991). Toward a unified theory of problem solving: Views from the content domains. Hillsdale, NJ: Erlbaum.

Stephen, L. P., Jan, F., & Michael, W. J. (2008). Capstone business course assessment: Exploring student readiness perspectives. *Journal of Education for Business, 83*(3), 41–146.

Suh, Koo-Won, Couchman, Paul K., Park, Jong-Won, & Hasan, Helen. (2003). The application of activity theory to Web-mediated communication. From Reading notes: Activity theory, Adrian Chan, 2005. Retrieved from http://www.gravity7.com/AdrianChan_ReadingNotes_ActivityTheory.pdf

Taylor, D. G., Magleby, S. P., Todd, R. H., & Parkinson, A. R. (2001). Training faculty to coach capstone design teams. *International Journal of Engineering Education, 17*(4), 353–358.

Thorndike, E. L., & Woodworth, R. S. (1901). The influence of improvement in one mental function upon the efficiency of other functions. *Psychological Review, 8,* 247–261.

Todd, R. H., Magleby, S. P., Sorensen, C. D., Swan, B. R., & Anthony, D. K. (1995). A survey of capstone engineering courses in North America. *Journal of Engineering Education, 84*(2), 165–174.

Transfer of learning (2009). Retrieved from big dog and little dog's performance juxtaposition Website at http://nwlink.com/~Donclark/hrd/learning/transfer.html

Turner, P. R. (2001). Teaching scientific computing through projects. *Journal of Engineering Education, 90*(1), 79–83.

Wiki Symbian Developer Network (2008). Kuwait University. Retrieved online at http://developer.symbian.com/wiki/display/pub/Kuwait+University

Yamnill, S., & McLean, G. N. (2001). Theories supporting transfer of training. *Human Resource Development Quarterly, 12*(2), 195–208.

Zhao, Z., Anand. J., & Mitchell, W. (2004). Transferring collective knowledge: Teaching and learning in the Chinese auto industry. *Strategic Organization, 2,* 133–167.

APPENDICES

Appendix A: Recruitment Phone Script

- Hello
- May I speak with Engineer……
- How are you? I hope I have not disturbed you. I am a student at Colorado State University and I am working on my dissertation, for which I do need your kind favor.
- I am conducting a study on the usefulness of the capstone course and its effectiveness for students from Kuwait University in transferring their learning to industry. For this, I need your precious time and your information. The interview will be only about one hour.
- This will be a brief interview, and I will be more than happy to share your feedback about your experiences when you entered the industry and encountered new situations.
- If you agree to participate in the study, I will mail, fax, or scan/email the Informed Consent form to you for your signature, and you can fax, mail or scan/email it back.
- I think we can settle on an appointment in the coming three weeks, depending on your availability. Please tell me when you are free so I can arrange a meeting over the phone so that our precious time is not wasted.
- This is my phone number, +1 562 644 8070, at which you can please tell me of your availability. I will wait for your call. Or you can email me at a_alsagheer@yahoo.com.
- Regardless of your decision about being part of this study, I wonder if you might contact your engineering colleagues and ask them if they would like to be participants in the study. Please have them contact me.
- I look forward to hearing from you soon; good-bye.

Appendix B: Recruitment e-Mail Letter

Colorado State University

Date: March 31, 2010

Dear (Name):

It is my utmost pleasure to communicate with you. I am a PhD student at Colorado State University. I am working on a research project for which I need your kind favor. You are a valuable asset of Kuwait University, and your feedback about your experiences is always important for upcoming students.

I am writing this letter to request that you share your study and practical life experiences. We are conducting a study on the usefulness of the capstone course and its effectiveness for students from Kuwait University in transferring their learning to industry. For this, I need your precious time and your information. We will be requiring about one hour for a brief interview, and I will be more than happy to have you share your experiences about when you entered the industry and confronted new situations.

If you agree to participate in the study, I will mail, fax, or scan/email the Informed Consent form to you for your signature, and then you can fax, mail or scan/email it back. I will be greatly obliged to you for this kindness. I request that you please give your consent, along with a time slot during which you are free for the interview. I request that you agree to set an appointment in the coming three weeks so that we may expedite the process. You can also contact me via email or phone for your consent. Should you have any inquiries, you may call me at my number.

Regards,

Abdullah AlSagheer

Student's Name:
Abdullah AlSagheer
PhD Candidate
1020 Wabash St Unit 25-101
Collins, Fort Collins, CO 80526
Cell Phone: +1 (562) 6448070
E-mail: A_alsagheer@yahoo.com

Advisor's Name
Don Quick, PhD
Assistant Professor
Colorado State University
School of Education, Room 215
Fort Collins, CO 80523-1588
Email:Don.Quick@ColoState.EDU
Phone: (970) 491-4683