

**LEARNING OUTCOMES AND EMPLOYABILITY SKILLS OF COMPUTER
SCIENCE REAL WORLD PROBLEM BASED SENIOR CAPSTONE COURSE
FROM THE PERSPECTIVES OF INDUSTRY AND COMMUNITY
ORGANIZATION PROFESSIONALS**

**A Dissertation Presented in Partial Fulfillment of the
Requirements for the Degree of
Doctor of Computer Science**

By

Nana Liu

Colorado Technical University

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Committee

Dr. Rick Livingood, PhD, MCSE, CISSP, CSSLP, Chair

Dr. Steven Munkeby, DM, Committee Member

Dr. Michael Alexander, DM, Committee Member

Jan 1, 2018

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Abstract

Computing disciplines in universities are tasked with preparing students for the future workforce. Computing curriculum offers coursework in a wide variety of subject areas in anticipation that such knowledge will be useful to students' professional lives and provide employable skills in both academic and soft skill domains. A real-world problem based senior capstone project is the major way to help enhance employability skills and make them transferable to any environment. In addition to employability skills, senior capstone courses also have specified learning outcomes. The expected learning outcomes can typically be achieved from Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning areas. This research employs a qualitative methodology to explore both expected and need-to-be-enhanced learning outcomes and employability skills of computer science major students through a real-world problem based senior capstone project from the perspectives of industry and community organization professionals. The study's sample and methodology consisted of in-depth interviews with 13 industry and community organization professionals. Stakeholders perceived that they expect to see interpersonal skills, information skills, analytical skills, behavioral skills, academic development, client interaction, personality success, communication, collaboration, and teamwork as learning outcomes and employability skills. Stakeholders also specified the aspects of various learning theories that contribute to enhanced employability skills. In addition, stakeholders indicated the benefits of senior capstone projects in support of employability skills.

Dedication

I would like to dedicate this dissertation to my husband, Wei, for supporting me through the whole process, to my older daughter, Richelle, for never losing faith in me, and to my younger daughter, Rosabelle, for your endless patience and love that helped me through this long journey.

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CHAPTER ONE

Computer science programs in universities are tasked with preparing students for the workforce in the industry setting. While other curriculum goals also exist, computer science curriculum generally offer coursework in the area of programming, web development, database development, system analysis, and cyber security in anticipation that such knowledge will be useful to students' professional lives and provide employable skills to organizations who employ computer science (CS) graduates. Employability skills are a wide range and can be in several domains such as academics domains (such as written communication skills), personal management domains (such as positive attitude), and teamwork domains (such as ability to work with others). The personal management domain and teamwork domain fall into the category of soft skills. According to Russell, Russell, and Tastle (2005), typical computer science graduates only spend about two hours throughout the entire degree program working on their soft skill development. Students typically have been introduced to soft skills in general education courses and are in need of exposure to a variety of circumstances where soft skills are needed to engage in authentic working environments (Stumpf, 2007). Employability skills can therefore be learned in multiple ways and can be transferred to any environment. Overall, there are many ways to improve the soft skills over one's academic life.

Besides employability skills, senior capstone courses also have specified learning outcomes from the academics' point of view. The learning outcomes typically include: (a) gain knowledge in a social construct; (b) apply the knowledge to a real world problem; (c) gain skill and knowledge by working on an authentic project for an extended period of time; (d) apply theories from major courses to particular issues that are relevant to the major discipline and are

able to identify concepts outside of the major discipline so they can be applied within the context of major discipline; and (e) integrate meaningful community service to enrich the learning experience. These learning outcomes can typically be achieved in the areas of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning.

Many employers put the trust on colleges/universities and believe they are the ones responsible to prepare students for the workforce. There also exist many studies where researchers have asked employers from many industries what skills college graduates should possess. Besides the core technical skills, employers also want potential employees to have industry working experience, and some even place more weight on actual experience than academic credentials when it comes to evaluating students for employment (Chronicle of Higher Education, 2012).

It turned out to be difficult for computer science curricula to respond to the industry demands by creating authentic learning that can help to bridge the gap between theory and actual practice. While employers want their workers to be equipped with practical skills, these may be quite difficult to obtain in the traditional academic setting when students are sitting in a classroom and listening to lectures. One-way computer science programs have responded is by incorporating a capstone course into the curricula. A capstone is a unique educational learning experience that intends to synthesize the content learned in a particular major (Gardner & Van Der Veer, 1998). The purpose of the real-world problem based senior capstone experiences is to provide an opportunity for students to develop critical soft skills while demonstrating technical hard skills in authentic work projects (Brown & Benson, 2005).

This research focused on addressing the learning-outcomes and employability-skills gained by computer science major students through a real-world problem based senior capstone project from the perspective of industry and community organization professionals. The goal was to explore the expected employability-skills and learning outcomes in the area of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning. It was also the goal to explore the different aspects of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning that contribute to the enhanced employability skills.

Topic Overview/Background

Senior capstone course has been defined in many forms. Henscheid and Barnicoat (2001) classified capstone courses by five models: (a) department or discipline-based courses; (b) interdisciplinary courses; (c) transition courses; (d) career-planning courses; and (e) a small section of capstones that do not fall under any of the other four types. Department or discipline-based courses are focused on summarized student learning within their major through the use of group projects or presentations. Interdisciplinary courses offer students an opportunity to synthesize general education courses and major courses. Transition courses are used to support the transition from undergraduate study to either the work force or graduate study through the means of portfolio-based project. Career-planning courses specialized in professional development. In addition, there are a small percentage of senior capstone courses that do not fall under any of the four types. Regardless of the different forms, evaluating students' learning outcomes and employability skills are the major goals for higher education institutions.

The capstone course in computer science programs emerged as a result of a perceived lack of practical skills in graduates (Dutson, Todd, Magleby, & Sorensen, 1997). The capstone course originally started with simulated projects devised by faculty members. Over the years,

there has been a steady increase demand for industry sponsored and real-world problem based senior capstones in which can be added a new complexity to the course (Bright, 1994).

The senior capstone experience provides students with the opportunity to consolidate both technical skills and non-technical skills that they learned throughout their entire education. Such capstone subjects are often used in computing disciplines, so students can apply the knowledge and skills gained during education in a life-like context. Most of the existing research of computing capstone course focused on describing the content, curriculum design, and structure of the capstone course (Goold, 2003; Mills, Hauser, & Pratt, 2008; Tabor, 2005; Wei, Siow, & Burley, 2007), the educator's reflections on capstone best practices, as well as the student's experience and perceptions on capstone experience. None of the existing literatures focus on project sponsor's perceptions about the development of students' learning outcomes and employability skills.

This study aims to address this gap in the literature by exploring the expected and needed enhanced learning outcomes and employability skills when the computer science senior capstone course is partnered with real clients on a real-world problem from the viewpoint of industry and community organization sponsors.

Problem Opportunity Statement

Students spend four years on average, learning, studying, and developing into well-educated graduates. For educators, they design curricula to impact students' academic learning experience, provide connection through multiple disciplines (major and non-major), and ideally deliver a positive well-worth educational experience to students. Seniors complete their undergraduate experience through the senior capstone course. The design of capstone course varies from majors to majors and departments to departments. Capstone course is used for the purpose of this study, as the description of a senior-level course in the major program of study

which every student must take prior to graduation. Durel (1993) defined capstone course as “a crowning course or experience coming at the end of a sequence of courses with the specific objective of integrating a body of relatively fragmented knowledge into a unified whole” (p. 223). To understand students’ developmental transformation during their final portion of their undergraduate education, a capstone course experience thorough investigation is necessary.

Prior research takes into account the impacts of capstone courses on student identity, the connection between general education and capstone course, capstone used as an assessment tool, as well as benefits of capstone. Some prior research exists on the learning outcomes of capstone course; however, only from academic side of perspective. There also exist a few empirical studies to explore a student’s experience and perception of the capstone course from the viewpoint of student, parents, and faculty. However, prior research has not explicitly examined the learning outcomes and employability skills when the project is partnered with industry and/or community organizations from the point of view of industry/community organization professionals. Another missing connection is the relationship between employability skills and learning outcomes that could really affect a student’s development. This study will explore different pedagogies targeted to real world problem-based senior capstone courses and highlight the expected and needed enhanced learning outcomes and employability skills from sponsoring professionals’ perspectives.

Purpose Statement

The purpose of this study is to examine the learning outcomes and employability skills computer science students gained through senior capstone courses when the courses are partnered with industry/community organizations through real-world problems. This study is suited in a wide theoretical framework of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning. In addition, it also helps the

academic community to have a deeper understanding of the types of employability skills sought by industry employers. Understanding the various learning outcomes and employability skills can assist faculty members in senior capstone courses' curricula development so graduates have the potential to fully meet the needs and requirements of real industry. Upon completing this research, the feedbacks received from industry/community organization professionals can be applied to a senior capstone course to fully enhance the overall undergraduate experience.

Research Question(s)

The study accomplished the purpose statement through the following research questions:

Research Question (RQ1) - What would the industry/community leaders expect to see in the area of learning outcomes and employability skills when the computer science capstone project is initiated, developed, contributed, and partnered with organizations to include real-world problems?

Research Question (RQ2) – Which, if any, essential learning outcomes and employability skills identified by industry/community information technology (IT) professionals should be enhanced in capstone courses to support Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning?

Research Question (RQ3) – Which aspects of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning contribute to enhanced employability skills?

Proposition

This research proposed that industry/community organization professionals are expected to see enhanced learning outcomes from capstone courses in the area of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning. This proposition was drawn from the literature review found on students who benefit from all these

areas when their senior capstone project was partnered with a real-world problem in the real setting. The study explored the different aspects of the expected learning outcomes of the various learning theories from the viewpoint of industry/community organization professionals.

The research also proposed real world problem based senior capstone courses that can support Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning. It explored the essential need for enhanced learning outcomes and employability skills.

The final proposal of the research was to explore which aspects of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning contribute to enhanced employability skills.

Conceptual Framework

Three learning theories provided the conceptual framework for this study. The theories include Bloom's taxonomy of learning (Bloom, 1956), Bloom's mastery learning (Bloom, 1984), and 21st century learning (Snape & Fox-Turnbull, 2011). First, the study will address Bloom's taxonomy of learning theory of using application, analysis, synthesis, and evaluation skills in project-based capstone courses to influence students' learning outcomes. Second, Bloom's (1984) mastery learning theory will be evidenced through perceptions of student participation in a project-based capstone course that allows them to differentiate their own personal learning experiences. Lastly, the 21st century learning theory (Snape & Fox-Turnbull, 2011) of infusing technology to facilitate problem and design-oriented capstone courses in a student-centered environment will be evidenced by enhanced student capacities. All three theories can be evidenced by students' enhanced learning outcomes and employability skills from industry project-based capstone courses, therefore addressing all the research questions.

Assumptions/Biases

Assumptions are things that are accepted as true or at least plausible by researchers and the audience who might read this dissertation (Gall, Gall, & Borg, 2007). Assumptions in this research included the honesty of participant responses on the interview questions. It is assumed that industry/community IT professionals who participated in this research made a sincere effort and truthfully answered all the questions in the survey. It is also assumed that the researcher was able to filter and interpret the findings of the study appropriately. Additionally, it is assumed that the participants had a good understanding of a project-based senior capstone course, Collaborative Learning, Experiential Learning, Transfer of Learning, and Service Learning.

It is quite impossible for any researcher to be completely unbiased. The primary data collection method for gaining insight was interviews with industry/community leaders. Some interview questions are specific about the capstone learning outcomes and employability skills, and it is possible that the interviewees might miss some outcomes and skills when they are not prompted. However, to further minimize bias, the researcher remained neutral throughout the whole process (Yin, 2011).

Finally, it is assumed that the interviewing method used in this study was suitable for discovering the learning outcomes from capstone courses from the viewpoint of industry/community organization professionals.

Significance of the Study

There were four significant deliverables as a result of this study.

Added Value to the Research Exists in Computer Science (CS) Capstone

While numerous studies exist on senior capstone courses, most of them are either in business or engineering areas. There has been very little research reported on the value and impact on computer science capstones that are based on real-world problems.

Helpful for Academic Personnel in Developing Effective Capstone Curricula

Universities have been blamed for failing to educate the future workforce with both technical and non-technical skills most needed by employers. Many employers state that college graduates are not prepared for the workforce (Tetreault, 1997). Candy and Crebert (1991) pointed that:

One of the main criticisms that employers make of their new employees is that they tend to emerge from the university with their heads full of theories, principles, and information but are often ill-equipped to deal with aspects of the workplace such as problem-solving, decision-making, working in a team, and learning for themselves. (p. 572)

U.S Department of Education (2006) pointed that, “employers reported repeatedly that many new graduates they hire are not prepared to work, lacking the critical thinking, writing, and problem-solving skills needed in today’s workplaces” (p. 3). The findings of this study will help academic administrators and faculty members to better align capstone curricula to support the learning outcomes identified by industry sponsors, so graduates are better prepared for the future workforce.

Promote Stronger Relationships between Faculty Mentors and Students

Besides promoting the direct interaction with clients, the faculty member’s mentoring role should be enhanced as well. By expanding the traditional meaning of senior project mentoring to a broader operational sense, students’ employability skills can be future enhanced. The study will be of particular importance to faculty who are fully involved with capstones from curriculum development to project coordination and mentoring.

Promote Future Coordination between Academic and Industry/Community Organizations

On the other hand, industry/community organization professionals can see the great benefits of forming a partnership with educational institutions to get projects executed and implemented. This would promote more interactions between the two entities in the future.

Delimitations

Morse, Barrett, Mayan, Olson, & Spiers, (2002) emphasized delimitations as restriction that the researcher imposed prior to the inception of the study to narrow the research scope to a more manageable size within the limited timeframe. The delimitations were the researcher's choice to not examine some learning theories other than Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning.

Moreover, the study only focused on industry/community organization professionals, other stakeholders such as students, faculty mentors, academic management teams, and parents were not involved. This restriction helps to keep the study to a more manageable scope, so the researcher can complete the study within the limited timeframe.

Limitations

There were three major limitations of this study. First was the population and demographics of the participants of the interviews. To keep the research scope to a more manageable level, the researcher conducted 13 interviews with participants from industries and community organizations across the state of Illinois.

The next limitation related to the number of years the participants had working with college computer science major students on a real-world problem-based capstone course. Two participants had over five years' experiences, another two participants had over two years' experiences, and the remaining nine participants all had between one to two years' experience working with students on real world problem-based senior capstone projects.

The final limitation of this study was the researcher's passion and experience for real problem-based senior capstone courses as the best practice in education. The limitations of a research are the potential weaknesses that cannot be controlled by the researcher (Bluhm, Harman, Lee, & Mitchell, 2011). The limitations cannot be blocked but can be minimized (Rubin

& Rubin, 2012). It was imperative for the researcher to stay objective in the data collection process as well as data interpretation process to minimize the limitations. It is important to eliminate all bias throughout this research.

Definition of Terms

The following definitions of terms are provided to ensure understanding of the major terminology used in this study

Capstone: “A crowning course or experience coming at the end of a sequence of courses with the specific objective of integrating a body of relatively fragmented knowledge into a unified whole. As a rite of passage, this course provides an experience through which undergraduate students both look back over their undergraduate curriculum in an effort to make sense of that experience and look forward to a life by building on that experience” (Durel, 1993, p. 223).

Industry sponsored capstone: Industry sponsored capstone have gained recognition as an important test of students’ ability to synthesize the curriculum while also fast-tracking their career development through fostering decision-making and other important skills (Holley, 2009).

Collaborative learning: Gokhale (1995) defined collaborative learning as “an instruction method in which students at various performance levels work together in small groups toward a common goal” (p. 1). In general, small groups will share the responsibility for project outcomes.

Experiential learning: Phipps, Osborne, Dyer, & Ball, (2008) defined experiential learning as “an experience-based approach to learning in which students experience a direct encounter with the phenomenon under study, reflect on that experience, draw general conclusions, and test their newly acquired knowledge through subsequent performance” (p. 530).

Project-based learning: Hong (2007) defined project-based learning as a learning method that is based on both theoretical and practical needs to motivate learners and guide them to understand knowledge application through the project development life cycle.

Transfer of learning: Rambau (2005) defined transfer of learning as “putting into practice the skills, knowledge, and attitudes that were gained through learning intervention on either the classroom or on job training in a specific working environment” (p. 3).

Service learning capstone: It is defined as a form of special experiential learning in an educational field in which students get to engage in activities that can help address community and human needs, together with structured opportunities for reflection designed to achieve desired leaning outcome (Bringle, Jacoby, & Ehrlich, 1997).

Employability skills: Overtoom (2000) defined employability skills as, “transferable core skill groups that represent essential functional and enabling knowledge, skills, and attitudes required by the twenty-first century workplace. They are necessary for career success at all levels of employment and for all levels of education” (p. 1).

Team-work: Larson and LaFasto (1989) define a team as two or more people with a specific performance objective or recognizable goal, and activities are coordinated within the team.

Bloom’s Taxonomy Theory of Learning: Krathwohl (2002) declared it as:

1. Common language about learning goals to facilitate communication across persons, subject matter, and grade levels;
2. Basis for determining for a particular course or curriculum the specific meaning of broad education goals, such as those found in the currently prevalent national, state, and local standards;

3. Means for determining the congruence of educational objectives, activities, and assessments in a unit, course, or curriculum; and
4. Panorama of the range of educational possibilities against which the limited breadth and depth of any particular educational course or curriculum could be contrasted” (p. 1).

Re-interpreted Bloom’s Taxonomy Theory of Learning: “Unlike the original taxonomy that was unidimensional, this anomaly was eliminated in the revised Taxonomy by allowing these two aspects, the noun and verb, to form separate dimensions, the noun providing the basis for the Knowledge dimension and the verb forming the basis for the Cognitive Process dimension.”(Anderson, Krathwohl, Bloom & Bloom, 2001, p 3).

Bloom’s mastery learning theory: In Bloom’s mastery learning theory, Bloom suggested for teachers to use assessment as learning tool to provide feedbacks and to guide the correction process instead of just using assessment as an evaluation tool (Bloom, Block, Airasian & Carroll, 1971).

The Twenty-First Century Learning Theory: Technology education offers rich connections, problem solving, critical thinking, cooperation and collaboration with others, and practical engagement in real world activities (Snape & Fox–Turnbull, 2011).

General Overview of the Research Design

The research methodology, research design, the overview of data collection, and the overview of data analysis are presented in this section. This research used an exploratory qualitative methodology. Gerrish (2011) emphasized that the qualitative method allows the researcher to make the connection between the theoretical aspects of the research and the practical sides of the study under research. Based on the explorative nature of the research questions, the qualitative methodology was effective in that the researcher was able to gain deeper understanding of the phenomenon being studied.

Merriam (2009) also pointed that the research design must be consistent with the study's purpose. The purpose of a phenomenological study design examines a lived experience through in-depth interviews and could really fit for this study. Therefore, the instrument used for this exploratory qualitative research is an in-depth interview session with industry/community organization professionals.

The population of this research consisted of industry/community organization professionals who have experience working with college students implementing a real-world problem based senior capstone project. The study utilized purposive sampling and selected 13 participants from the state of Illinois to participate in the interview process. The interview strategies for gathering data best addressed the research questions and the routes were developed to guide 13 participants. Routes were semi-structured, so participants had the freedom to define the phenomenon from their own unique point of view (Merriam, 2002). All participants first received the informed-consent forms and interview questions. Once the signature from each participant was secured as part of the informed consent, the interview was scheduled and conducted using WebEx. The interview ranged from 20 minutes to one hour 25 minutes. Afterwards, the recorded interview audio files were transcribed into textual files.

The draft textual files were then reorganized into a word document with responses listed under each research question. The participants' perceptions were analyzed using a five-step data coding process as well as cross-referenced with audio recording to ensure data accuracy. The semi-structured interview questions, field notes, and WebEx conference were used as data collection tools. Creswell (2013) observes, "The process of data collection, data analysis, and report writing are not distinct steps in the process - they are interrelated and often go on simultaneously in a research project" (p. 182). This type of ongoing data collection and

management is reflected in the qualitative research process and involved a great amount of time reading, transcribing, annotating, and analyzing transcripts from the interviews. The researcher started annotation process that leads to the coding process. After coding and identifying significant statements, themes were further developed in an attempt to reduce the large amount of textual data into a more manageable package. These themes directly related to the goals of the research and analytic conclusions were reached at the end.

Summary of Chapter One

This chapter talked first about the research background. Thereafter, the problem opportunity statement, purpose statement, research questions, hypotheses, and the conceptual framework were highlighted. Further, the biases, significance of the study, delimitations, and limitations were discussed. The chapter ended with a summary of definitions, general overview of the research design, and organization of dissertation.

Organization of Dissertation

This dissertation is organized into five chapters. Chapter one presents the research background, problem statement, purpose statement, research questions, hypotheses, theoretical framework, assumptions, delimitations, limitations, definition of terms, and general overview of the research design. Chapter one provides the rationale for the research, the problem opportunity, the importance of conducting such research, and the contribution of the theoretical understanding of the topic.

Chapter two contains a review of literature in three broad categories: (a) Senior Capstone Course; (b) Learning Outcomes and Employability Skills; and (c) Capstone Course Instructional Methods. This chapter also provides a solid theoretical foundation for the proposed study by examining the Bloom's Taxonomy Theory of Learning, re-interpreted Bloom's Taxonomy Theory of Learning, Bloom's Mastery Learning Theory, and the Twenty-First Century Learning

Theory. Chapter two situates the research focus within the context of the wider academic community and summarizes the critical relevant literature review. Moreover, it identifies a gap within the literature that this study attempts to address.

Chapter three, the methodology section of this dissertation, explains in detail the methodology used in conducting the research. Chapter three started with research tradition, research questions, and research design. Thereafter, the chapter talked about population and sample, sampling procedure, instrumentation, validity, reliability, data collection and data analysis. Further, the chapter discusses about the various ethical considerations. This chapter links back to the chapter two literature review and explains the reason of adopting such research methodology as well as the academic basis of the choice.

Chapter four discusses about the participants' demographics, presentation of the collected data, and the research findings. This chapter interprets and explains the key experimental results. It helps answer the three research questions and justifies the approach. It also critically evaluates the study.

Chapter five focuses on the conclusions drawn from the research. The chapter discusses the research findings in association with research questions and why the research is important. Further, the chapter presents the limitations of the study, the implications for practice, and the implications of study. Finally, the chapter makes recommendations for future research.

CHAPTER TWO

Based on rapid technology development, the culture of today's student has changed dramatically. According to Kannapel (2012), "these skills included making connections across disciplines, applying knowledge to real-life problems, increasing higher order thinking and analytical abilities, building intercultural competencies, and organizing and utilizing information" (p. 3). The senior capstone project is considered as a vehicle to prepare today's students to be self-directed quick learners who can engage in the learning process. As opposed to traditional practices where instructors are information disseminators while students are passive, the current practice is that today's students are placed in the driver's seat that actively motivates the whole learning process. A senior capstone course that fosters experiential learning and provides for inquiry learning allows for a rich knowledge experience for all participating students. The senior project characteristics were listed by Kannapel, as "it engages students as active participants in the learning process, centers on students rather than teachers, promotes the development of higher-order thinking and problems-solving skills, emphasizes making connections across disciplines, and bridges theory with practice" (p. 3). Lainez, Deville, Dessy, Dejemeppe, Mairy, & Van Cauwelaert (2014) pointed out that capstone projects deliver important skills such as a basic understanding of business processes; a product development with high-quality concerns; communicative abilities, initiative, leadership and teamwork; and analytical, problem solving, and personal abilities. In addition, Clarke (2005) suggested that capstone projects help increase student confidence and allow students to explore areas of technology not covered in the academic curriculum. Senior capstone courses have been in existence since the 1990's. An extensive list of work has been done in this area. Prior work, however, focused mainly on course curriculum development, course structure development, aspects of team-based projects, and the type of assessment framework used. There has been very

little research done to support the valuable outcomes of such an experience (Dotson & Grimes, 2010; Kannapel, 2012; Puente, 2012), especially from the viewpoint of industry sponsors as an assessment tool in regard to learning outcomes, measurable employable skills, and added values. The senior capstone course is a bridge that can be used to improve academia-industry relations. It is important to have a full grasp of the understanding of the requirements of industries and what they expect from the students they hire, as industries are important clients of academia. This literature review looked at the body of knowledge for three categories: capstone course overview, promoted learning outcomes, and capstone course instructional methods. The Conceptual Framework is introduced at the end and includes four theories: Bloom's taxonomy theory of learning, re-interpreted Bloom's taxonomy theory of learning, Bloom's mastery learning theory, and the Twenty-First Century Learning theory.

The keywords used to search articles include: senior capstone course, capstone course curriculum, capstone course framework, capstone course learning outcomes, structure of capstone courses, capstone learning outcome, collaborative learning, experiential learning, project-based learning, transfer of learning, portfolio capstone, service learning, Bloom's taxonomy, mastery learning theory, and 21st century learning theory. The search was conducted using Career and Technical Education ProQuest, Computing Database ProQuest, Education ProQuest, ProQuest dissertations and Theses Global database, IEEE Xplore, Academic Search Premier Ebsco, Education Research Complete Ebsco, SAGE Research Methods, and Google Scholar.

The categories were selected based on the research topic of *Learning Outcomes and Employability Skills of Computer Science Real World Problem Based Senior Capstone Course from the Perspectives of Industry and Community Organization Professionals*. The literature

review explores the role of the senior capstone course in higher education, curriculum development understanding, students' learning outcomes, and deliver methods. The review of the literature helped in identifying the elements needed to address the research question and gaps in all existing research.

Review and Discussion of the Literature

Capstone Course Overview

Several definition of capstone courses exist, the common components include the opportunity for senior years students to assemble fragmented knowledge, a culminating experience, the opportunity for students to employ teamwork and critical thinking skills, and the opportunity to facilitate the transition from the academic world to the professional world. Durel (1993) defined the capstone courses as:

A crowning course or experience coming at the end of a sequence of courses with the specific objective of integrating a body of relatively fragmented knowledge into a unified whole. As a rite of passage, this course provides an experience through which undergraduate students both look back over their undergraduate curriculum in an effort to make sense of that experience and look forward to a life by building on that experience. (p. 223)

Nilsson and Fulton (2002) studied and analyzed many capstone course theorist definitions and found the common student engagement in the area of: “problem identification, integrating accumulated knowledge and technical skills into finding a solution, critical thinking, and communicating conclusions” (p. 8).

The purpose of the capstone project is to enhance learning while cultivating critical abilities in both the academic and professional settings. The capstone can help students develop strategies for solving, analyzing, and addressing problems; establishing connections with the community; and working with others in a team setting. It is a course where students can work on a project to solidify abstract academic theory and other educational experiences they have

acquired. To synthesize themes of general education, Schilling and Schilling (1998) suggested goals for transitions of capstone seminars as follows: Study transition in the senior year experience; Prepare students for transition during the senior year; Have students engage in analysis, self-assessment, and reflection about the meaning of their total undergraduate experience; Have students demonstrate what they have learned from their liberal arts and general education courses and demonstrate the interrelationship between at least two disciplines; Have students demonstrate what they have learned in a career planning process that will be provided in the course; Have students prepare a portfolio to document and portray what they have learned and how they have developed in college both academically and personally; Allow students to participate in an academic support group of fellow students in which they receive instruction, support, and feedback from their instructors and classmates and in which they provide the same to them.

The senior capstone courses can not only introduce but also enhance the students' learning process. In *Reinventing Undergraduate Education: A Blueprint for American's Research Universities*, the Boyer Commission on Educating Undergraduates in the Research University (1998) made the following recommendations:

- Senior seminars or other capstone courses appropriate to the discipline need to be a part of every undergraduate program. Ideally the capstone course should bring together faculty members, graduate students, and senior undergraduates in shared or mutually reinforcing projects
- The capstone course should prepare undergraduates for the expectations and standards of graduate work and the professional workplace
- The course should be the culmination of the inquiry-based learning of earlier course work, broadening, deepening, and integrating the total experience of the major
- The major project may well develop from a previous research experience or internship

- Whenever possible, capstone courses need to allow for collaborative efforts among the baccalaureate students.

Historically, the senior capstone course has evolved as a critical part of college curriculum. The earliest course can be traced back to the end of the 18th century when college presidents taught courses that integrated religion and philosophy. Since 1947, the senior capstone course has been provided by higher educational institutions to give college students a common experience. According to Henscheid (2000), only three percent of participating institutions sponsored senior seminars in the early 1970's. Later in 1999, the National Survey of Senior Seminars and Capstone Courses conducted research and found that these forms of a culminating experience were the most widely used.

More than 70 percent of sample respondents reported that senior seminars and capstone courses are discipline or department based [with] 75 percent used to foster integration and synthesis within the academic major, promote integration and connections between the academic major and the work world, and improve seniors' discipline- specific career preparation and pre-professional development. (Henscheid, 2008, p. 79)

By 2011, nearly all higher education institutions were offering senior capstone courses of some form to students, with 35.4% of the institutions in the sample reporting that every graduate had passed through a senior capstone experience (Padgett & Kilgo, 2012).

The Different Types of Senior Capstone Courses

The senior capstone courses in the early 21st century fall into the following five types in general. Henscheid and Barnicoat (2001) examined the five-capstone course pedagogy, as shown in Figure 1.

Capstone Model and Activities		
Capstone model	Purpose	Instructional activities
Department or discipline based	Summarize learning within the academic major	Group projects or presentations
Interdisciplinary	Synthesize general education and major classes	Broad project topics and often includes ethics and bias
Transition	Support the move from undergraduate to either the work force or graduate school	Developing resumes or building portfolios, self-assessment and financial planning
Career planning	Covering trends in field and procedures for licensure and job seeking	Building portfolios, often taught by career center professionals
Other	Fostering integration and synthesis with broader boundaries that do not fit with any other model	Always taught by academic faculty with smallest course size

Figure 1. Capstone Model and Activities.

Henscheid and Barnicot (2001) describe these types as follows:

Department or discipline-based courses

The overriding goal of department or discipline-based courses is to summarize learning within the academic major. These types of classes are also likely to make connections between the academic learning and the professional world. Some institutions use these courses as a means to encourage seniors to pursue postgraduate study. This subset of courses makes up the majority

of the capstone courses offered. These courses are typically offered through the academic department and may be required for graduation. Faculty members within the academic discipline typically teach these courses at the conclusion of the students' academic careers. The classes are taught by a single faculty member or team-taught by a group of faculty; three credit hours are normally offered for a letter grade.

Interdisciplinary courses

Interdisciplinary courses, representing a smaller percentage of senior seminars and capstones, offer students an opportunity to synthesize general education, major classes, and co-curricular learning. These courses are more likely to be found at private institutions, taught by a single faculty member. Letter grades are prevalent, and students receive three to four semester hours of credit for completing these courses. Credit for interdisciplinary senior seminars and capstone courses is applied most often as a major requirement, core requirement, or a general education requirement. Presentations and major projects are most often employed as instructional components in these courses. Topics are broad, often involving philosophical issues such as ethics. These courses tend to stress the inter-relatedness of different academic majors and their role within society.

Transition courses

Transition courses, the third most prevalent type of senior seminars and capstones, focus on preparation for work, graduate school, and life after college. Faculty or career-center professionals most often teach these courses, which typically award a letter grade, although they are less likely to do so than department or discipline-based courses and interdisciplinary courses. Topics for transition courses mainly consist of students' transition issues, and students enrolled in them are likely to engage in job search and life transition planning. Discussions centered around self-assessment, financial planning, the job search, and the first year on the job. Presentations

weigh heavily in evaluation of performance in these courses, but rather than major projects, students often develop a portfolio or use the career center.

Career-planning courses

Career-planning courses assist students as they engage in pre-professional development. In some cases, career-planning is the only goal of these courses. Career-planning courses are likely to be taught by career-center professionals, but in some cases academic faculty might teach them. Although students typically receive grades for these courses, they are less likely to receive as many credit hours as students enrolled in other types of senior seminars or capstone courses. The classroom experience in these courses is evaluated most often by the creation of a portfolio, followed by a major project and a presentation. Classroom topics for career-planning courses include current trends in the field; procedures for licensure and job seeking; students' roles in the workplace; and development of a résumé, cover letter, and portfolio.

Other

There are also a small number of senior seminars and capstone courses that do not fit in these four types. These courses often span curricular boundaries and attempt to address institutional goals. These courses do share many of the characteristics of other courses. The primary goals of fostering integration and synthesis within the academic major and promoting integration and connections between the academic major and world of work are similar to those of most types of the other senior courses. These courses do not generally focus on general education and are almost always taught by a member of the academic faculty. They tend to be the smallest of the senior courses, often enrolling fewer than nine students. They are most often held for one academic term and students are usually assigned a letter grade.

The inclusion of the other category type allows for the study of immersion courses and any other specially designed service learning courses. This other category also opens up opportunity for faculty mentors to self-identify course pedagogy.

The Goals of Senior Capstone Courses

American higher education has put in plenty effort in studying the goals of senior capstone course. In the early 1970s, the first study was conducted. The first study looked at 270 catalogs from higher education institutions in the United States and examined for course structures and course types. The study found out that only three percent of participating institutions sponsored senior capstone courses. The study concluded that these courses are offered at one in every twenty institutions at any given time and in all kinds of different forms.

In the late 1990s, as a second effort, Joseph (1998) evaluated the Senior Year Experience. The study focused on characterizing the senior year experience types, goals, and forms, including senior capstone courses; and therefore, suggested these senior capstone course goals:

- Promotion of the coherence and relevance of general education
- Promotion of integration and connections between general education and the academic major
- Fostering of integration and synthesis within the academic major
- Promotion of meaningful connections between the academic major and work and career experiences
- Explicit and intentional development of important student skills, competencies, and perspectives that are tacitly or incidentally developed in the college curriculum
- Enhanced awareness of and support for the key personal adjustments encountered by seniors during their transition from college to post-college life
- Improvement of seniors' career preparation and pre-professional development, that is, facilitation of the transition from the academic to the professional world
- Enhancement of seniors' preparation and prospects for postgraduate education

- Promotion of effective life planning and decision making with respect to practical issues likely to be encountered in adult life after college (for example, financial planning, marriage, family planning).

In 2000, Jean Henscheid reviewed modern senior capstone courses. Henscheid's review suggested that these senior capstone courses are most often associated with academic specific discipline and coordinated through academic departments.

Rosenberry and Vicker (2006) conducted research on the goals and purposes of capstone course design and reported that "courses cannot be pigeonholed as one or the other and they are as diverse as the institutions that offer them and the faculty that teach them" (p. 269). In examining the capstone course research, Rosenberry and Vicker (2006) pointed the following prominent themes:

Integration

Integration and synthesis are the most commonly mentioned terms used to depict capstones courses. Integration simply means pulling together prior learning either from the major field of study or general education field of study. This integration puts learning instead of teaching at the core of the whole capstone course experience and can help students achieve a sense of college experience closure.

Application

Another common theme is application. Through application, the capstone course can help students apply the abstract theories they have learned towards real-world case studies. In-class learning can help integrate knowledge of interpersonal communication as well as organizational communication.

Transition

An applied experience can help students make that transition smoothly from the classroom to the real business world. When capstone courses address career related issues,

students can often get a better understanding of what they have learned at school and how it can be applied in real world.

Other

Some other less-frequently mentioned but still significant topics include extension of knowledge, opportunities for in-depth study, reinforcement or extension of basic communication competencies, and critical thinking skills development (p. 270).

The Purposes of Senior Capstone Courses

In general, there are some common purposes of capstone courses in higher education institutions. The common purposes include: synthesizing students' specific discipline learning, transitions of learning from the academic world to the industry world, career preparation, opportunity that allow students to reflect, assessment of whether discipline-specific learning has occurred, and accreditation. Each purpose is presented in the following section.

Synthesize discipline-specific learning

Synthesize whether or not learning has taken place within the specific academic discipline is one of the major goals of a capstone course. The Association of American Colleges and Universities (2002) summarized a common set of student learning outcomes: knowledge of human cultures and the physical world, intellectual skills and practical skills, personal responsibility and social responsibility, and integrative learning and applied learning. The last learning outcome focuses on synthesis of information learned from both specific academic discipline and general studies.

Career preparation and connection from academic to industry

According to Henscheid (2000), the most frequently cited second and third goals of capstones are career preparation and learning connection from the academic discipline to the real industry world. Higher educational institutions use several different ways help students make

connections: employers, industry working professionals, and alumni can serve as classroom guest speakers; IT professionals can serve on the departments' industry advisory board; special course project can be conducted with IT professionals on various IT topics; internship experience where students get to work on real industry project in a real business setting; and a senior year course that is tied with service-learning.

Levine (1998) pointed that the major purpose of the capstone course is to help students make smooth transition from college to industry. McGill (2012) conducted research using a mixed-methods to measure students' opinion of their capstone course experience. The researcher conducted a faculty focus group and student focus group, surveyed students before they took the capstone course and after they completed the capstone course. This research result confirmed that students indeed really valued the capstone as a way to prepare them for future career success as students described the capstone as the most practical way to prepare them for their future job success and graduate school.

Opportunities for reflection

Opportunities for students to reflect on their learning is yet another important goal of capstones course. Reflection plays an important role in experiential learning in that it can help enhance student learning from experiential learning. Bringle and Hatcher (1999) pointed that reflection is the bridge between service and learning; the experience cannot be defined as service-learning without reflection. In regard to capstones courses, reflection is considered to be a bridge that provides students with a way to synthesize course objective and program. Dewey (1933) defined reflection as, "active, persistent and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it, and the further conclusions to which it tends" (p. 118). Krathwhol (2002) describes reflection as a metacognitive skill requiring students to think about how they think. It can help students generate learning as

well as deepening learning which in turn results higher-order thinking skills that employers desire. Schon (1987) described reflection as “bridge between the worlds of university and practice” (p. 309) and suggested putting reflection at the core of curriculum instead of being placed at the end of a curriculum sequence.

Hatcher and Bringle (1999) defined a set of characteristics for experiential class reflection: (a) link the learning experience to the outcomes; (b) ensuring a rich learning experience that is highly structured; (c) ensuring more frequent experience so students are able to deepen their reflection; (d) providing timely feedbacks; and (e) including opportunities for students to display/explore meaningful personal values.

Assessment

According to Schilling (1998), higher education institutions use senior capstone courses as a main element for overall assessment. Capstone course assignments cannot only help students self-assess their learning outcome but can also provide critical information needed for institutional formal assessment.

Senior level students often have more valuable insights and institutions can use the assessment result to strengthen and improve their curriculum. Integration and reflection can both be used to help students self-assess their achievement in capstone courses, bring closure to their education experience, and help them transition to their next stage after college (Schilling, 1998). In addition, capstone course assessment results can be used as a tool to loop to previous courses. Having such extensive and continuing feedback loops is essential to quality assessment.

Accreditation

Institutional assessment is often tied with program accreditation. Institutions are increasingly referencing accreditation bodies such as the ABET and Higher Learning Commission as well as other accrediting agencies when building their assessment. As a matter of

fact, each department often plans their prospective curriculum based on requirements of their accreditation. Accreditation actually plays an important role in determining these course offerings of these different programs in each department.

Senior Capstone Course Advantages and Limitations

Senior capstone courses are the ones that students needed to take often in their final semester before they exit the program. They are of much importance and value. Dunn, McCarthy, Baker, Halonen & Hill, (2007) discussed the capstone course usefulness in assessing the undergraduate education quality in the U.S. and claimed that the capstone course provided a venue for assessing how successfully the major has been in helping students attain the overall educational goals. The authors also explained that college departments use capstone courses to assess their majors in a variety of ways, ranging from rudimentary to rigorous. The best practices, however, involve detailed project analysis to know the project quality and to use that evidence to make any future improvements of curriculum.

Capstone course experiences can be useful for five reasons:

- The courses allow students to bring together their learning in their major of study and demonstrate that they have met the learning objectives. This gives students a chance to know what they know about their field of study and to understand their own growth in their chosen fields over time
- The courses can serve as a bridge to the next step since they often ask students to extend their knowledge and work collaboratively with other team members while under faculty supervision
- The courses provide a “destination” for faculty members in planning/developing courses at different levels to know where students will eventually “end up”
- The course also provides information to the departments about their curricula strengths/gaps
- When faculty members discuss the senior capstone course experiences together, they often provide student performance information in an aggregate way. Therefore, the courses can serve as an assessment tool.

Moore (2005) noted some considerable advantages of the capstone courses. The following list provide a summary of the educative values:

- Enables the establishing of "a clear link between knowledge in ... communication and the rest of [a student's) education" (Dennis & Defleur, 1991, p.78)
- Enables evaluators to determine if the departmental curricula is part of, or adjunct to, the university curricula
- Allows the adaption and integration of institutional mission statements, departmental/school mission statements, and course objectives to the general goals of higher education
- Allows conclusions to be drawn from student performance regarding the level of involvement in the liberal arts versus professional training. It also enables faculty to address perceived weaknesses in a curriculum. Ongoing assessment in the capstone course allows for continual evaluation and development of the curriculum so that students are demonstrating that they are leaning what faculty think they are teaching
- Is a broad-based course drawing together disciplines across the university? This allows for unique partnerships to develop between departments resulting in a greater integration in the university fabric
- As a summative tool, provides the opportunity to evaluate students at the end of their major program of study
- As curricula and expectations change, the course can address and incorporate new approaches and objectives
- Capstone courses can be tailored to measure outcomes in any of the various divisions or configurations of the communications field. Research projects can be applied to a wide variety of interests, issues, or professional settings
- Is a multi-faceted instrument of assessment? It goes beyond examinations and simple projects by integrating various assessment strategies. These particularly include a senior thesis, an applied project for the thesis, public oral performance, and a portfolio
- Places expectations on students so that they become independent learners. The course is student-centered and self-directed allowing each student to work at a pace with which he or she is most comfortable and, in a direction suitable to career aspirations

- Requires students to perform at higher level learning by forcing a student to engage in analysis, synthesis and evaluation of past learning, and apply it to new experiences
- Allows students to perform and excel in those leaning modalities most appropriate to him or her
- Integrates skill demonstrations into objectives of an experiential nature providing a real opportunity for business and industry alliances.

Moore (2005) also noted some capstone course potential limitations and suggested that such limitations should be understood by higher education institution departments as well as faculty members:

- Subjective evaluations resulting from nonspecific expectations
- Too much flexibility for less motivated and goal-oriented students
- Too unfocused
- Requires faculty to abandon specialized agenda
- Great demand on student time, learning, and performance
- Does not adequately assist average or below average students.

Some other capstone courses disadvantages and drawbacks are also quite evident when they fail to provide the foundation for entry-level software developer positions or for advanced graduate studies. Christoforou, Al-Ansary, and Yigit (2004) posited that 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. In addition, there is often a lack of broad education for a good understanding of ethical and professional responsibility as well as the software development solutions' impact on society as a whole.

Capstone Course Structure and Development

Senior capstone courses are now a requirement in many higher education institution curricula. Coordinating a capstone design course requires faculty members to put in a significantly amount of effort. Educators develop the capstone course structure based on the different projects they provide to students. Learning often starts with simple problem identification and continues with the application of sophisticated skills and ideas to complex problems. The senior capstone course represents a critical role in many computing discipline programs. Pembridge and Parette (2010) pointed that a large number of capstone projects often span one or two semesters and involve teams of four to six students. The emphasis is to facilitate students' application of technical tools, techniques, and knowledge learned previously to an open-ended, realistic, and creative problem-solving experience (Friesen & Taylor, 2017). Howe and Wilbarger (2016) found out that the capstone course increased the mutual cooperation among students coming from different backgrounds and majors, therefore reduced the feeling of individuality among those students.

According to Fentiman and Demel (1995), students in capstone courses are instructed to organize the design process, speak clearly, and properly develop the context of the design. The authors also emphasized the purpose of having students produce reports both orally and written. With such incorporation, faculty mentors no longer need to put in as much effort, and students will have the ability to produce quality project presentations as well as documentations.

Raju and Sankar (1999) posited that capstone courses along with real-world problems usually concentrate on cross-disciplinary education, and this has greatly assisted students in vicariously understanding the situations inside the classroom that they might come across in the near future. This cross-disciplinary education along with real-world problems combination obviously reduces the gap between practice and abstract academics theories.

Mulopo and Fowler (2006) stated that the traditional teaching method was no longer an effective way since most students failed in achieving their educational goals. It is the active learning and proper design procedures' application that made the capstone courses highly successful.

Capstone Course Curriculum and Framework

To understand curriculum development completely, it is important to define the term – curriculum. However, the term itself, is often ambiguous. Lattuca and Starc (2009) proposed that, as an academic plan, curriculum should involve decisions of the following elements:

- *Purpose*: knowledge, skills, and attitudes to be learned
- *Content*: subject matter selected to convey specific knowledge, skills and attitudes
- *Sequence*: an arrangement of the subject matter and experiences intended to lead to specific outcomes for learners
- *Learners*: how the plan will address a specific group of learners
- *Instructional processes*: the instructional activities by which learning may be achieved
- *Instructional resources*: the materials and settings to be used in the learning process
- *Evaluation*: the strategies used to determine whether decisions about the elements of the academic plan are optimal
- *Adjustment*: enhancements to the plan based on experience and evaluation.

Many researchers and educators have presented different proposals in regards to a unified senior capstone curriculum/framework from different perspectives. In summary, there are two major proposed curricula frameworks. One was to train students on specific industrial problem solving without any replication of the actual industrial procedures and processes. And the other one was to train students on specific industrial problems solving with replication of the actual industrial procedures and processes with the involvement of the actual stakeholder.

Beyerlein, Davis, Trevisan, Thompson, and Harrison (2006) proposed a framework for developing capstone courses assessment; and such framework incorporated perspectives from the educational researcher, the student learner, and the professional practitioner. It provided a structure for aligning course learning outcomes and offering feedbacks. Franchetti, Hefzy, Pourazady, and Smallman (2012), in the meantime, proposed a framework for collaboration between academic and industry through the design clinic. These proposed frameworks were based on no replication of the actual industrial procedures and processes.

Todd and Magleby (2005) asserted that computing discipline education has a number of stakeholders including the industry; academics personnel such as faculty members, students, and academic administrators; and others. In this research, Todd proposed alternative approaches to develop the senior capstone course so industrial needs can be matched. This alternative approach included designing senior capstone courses based on input from those stakeholders; replication of the actual industrial processes; consideration of stakeholder needs and wants; as well as listening to feedback from alumni on the success of their course.

Category 2: Learning Outcomes and Employability Skills

Students Learning Outcomes

According to Moore (2005),

Capstone course is designed to draw all learning together and provide a single opportunity or experience during which a student demonstrates that he or she has accomplished or achieved the university and department's educational goals as represented by the various courses taken and the appropriate mission statements. (p. 3)

The various reasons for defining capstone course learning outcomes include:

- The capstone course shows to students the competencies they are expected to develop
- The capstone course shows to future employers the various skills they can expect from a graduate

- The capstone course shows to the faculty member the competence development they have to facilitate in the course curricula
- The capstone course helps faculty members to ascertain dimensions they can use to measure students' achievement during their programs of study
- The capstone course shows to accreditation institutions the focus of the higher education institution
- The capstone course shows to politicians the focus of the Higher Education in general.

Lattuca and Stark (2009) suggested broader categories of the students learning outcomes in their book "Shaping the College Curriculum". They pointed that while some faculty members may stress some basic skills, some might stress general learning skills acquired at school, and others might stress out specific skills related to a particular academic field. The authors suggested the following broader categories based on instructional style and discipline:

- *Basic Skills:* communication, numerical, and problem solving
- *Course Related Skills:* facts, concepts, vocabulary, principles, inquiry method, application method, professional skills, and occupational skills
- *Other General Skills:* cognitive characteristics and independent thinking skills

The expectations of capstone course show the learning ability and leaning mastery based on project requirements. The following figure shows the summarized capstone course achievements level in different learning modalities and students' performance expectations.

Cognitive Learning	Course Expectations
Recall of Knowledge Comprehension Application Analysis Synthesis Evaluation	Students are presented with a problem and draw upon their knowledge and research to weigh and select various data leading to a solution of the problem which is workable and intellectually defensible.
Affective Learning	Course Expectations
Receiving Responding Valuing Organization Value Complex	The approach and decisions made reflect attitudes, values, feelings and beliefs characteristic of the discipline and the profession.
Psychomotor Learning	Course Expectations
Gross Bodily Movements Finely Coordinated Movements Non-verbal Communication Speech Behaviors	The production of a project, solution to a problem and the oral and visual presentation, reflects a degree of skill competency as a communicator.

Figure 2. Capstone Course Achievements Level.

In addition, Blanchard and Christ (1993) conducted research on the most rational and tangible measures on the outcomes. They cited the Michigan Professional Preparation Network Report and listed their ten outcomes as a framework to be applied to examining learning outcomes in major program of study. The ten outcomes by the Michigan report include:

- Communication competence is the ability to read, write, speak, and listen and to use these processes effectively to acquire, develop, and convey ideas and information
- Critical thinking is the ability to examine issues rationally, logically, and coherently

- Contextual competence is an understanding of the societal context or environment in which one is living and working
- Aesthetic sensibility is an enhanced aesthetic awareness of arts and human behavior for both personal enrichment and application in the enhancement of work
- Professional identity is a concern for improving the knowledge, skills, and values of the profession
- Professional ethics is an understanding of the ethics of a profession as standards that guide professional behavior
- Adaptive competence is anticipating, adapting to, and promoting changes important to a profession's societal purpose and the professional's role
- Leadership capacity is exhibiting the capacity to contribute as a productive member of the profession and assuming appropriate leadership roles
- Scholarly concern for improvement is recognizing the need to increase knowledge and to advance the profession through both theoretical and applied research
- (j). Motivation of continued learning is exploring and expanding personal, civic, and professional knowledge and skills through a lifetime. (p. 15-16).

The course itself, by its very nature, is a method of summative evaluation. The course cannot only assess previous major program of study cognitive learning, but also provides a baseline for faculty members to assess students' overall learning experience. Besides cognitive learning, learning can also occur in affective learning domain and psychomotor learning domain. The three domains of learning were developed between 1956 to 1972 and were adopted by most educators. Kemp and Smellie (1989) pointed that such a course allows for a mixture of evaluative styles that support effective assessment of the wider range of students' past experiences. This evaluation style allows students to demonstrate their learning strength of each particular area. Affective learning evaluation is associated with feelings and emotions in the category of receiving, responding, valuing, organization, and characterization (Bloom, Krathwohl, & Masia, 1964). Psychomotor learning, on the other hand, was evaluated by the

application of skills and performance of the skills. Students' competence should be demonstrated in all three learning skills ideally. Moore (2005) summarized various aims of education within different styles of learning as well as requirements of the course based on the Michigan report. The following three figures show the cognitive learning, affective learning, and psychomotor learning styles.

	Thesis Based	Project Based	Presentation Based	Portfolio Based
Cognitive Learning	<p>Scholarly concern for advancing the profession through research.</p> <p>Improve one's knowledge of the profession or discipline.</p> <p>Ability to acquire, develop, convey, and integrate knowledge and information.</p> <p>Critically examine issues.</p> <p>Quantitative/qualitative analysis.</p> <p>Evaluation of data collected and conclusions related to issues of thesis.</p>	<p>Advancing the profession through applied research.</p> <p>Adaptive competence in relating knowledge to a project.</p> <p>Discrimination between concepts applying relevant approaches to the problem.</p> <p>Creative thinking and design of solutions: organization, treatment, production.</p> <p>Leadership capacity to initiate and manage a project to conclusion.</p>	<p>Understanding of the communication/presentation process: informative, narrative persuasion, etc.</p> <p>Use of supporting strategies and information: non-verbal communication, imagery, visual support, ethos-pathos, questioning, presentation of proof or reinforcement.</p> <p>Strategy for organization: comparison/contrast, problem solving, etc.</p> <p>Understanding the audience, shaping of ideas appropriately.</p>	<p>Works exhibit a broad range of abilities.</p> <p>Shows imagination, concept development.</p> <p>Shows an understanding of the responsibilities and attributes of a communicator.</p>

Figure 3. Cognitive Learning Aims Achieved by the Evaluation Instruments.

	Thesis Based	Project Based	Presentation Based	Portfolio Based
Affective Learning	<p>Understand the societal context of learning.</p> <p>Convey professional values and ethics.</p> <p>Show motivation for continued learning.</p>	<p>Applying knowledge, skills, values of profession or discipline to a new or unique problem.</p>	<p>Assumption of a proper professional identity appropriate for delivery of the theses or project.</p> <p>Display an attitude for performance that indicates mastery of verbal techniques: clarity, relevance, effectiveness.</p> <p>Creative planning and presentation of thesis and/or project.</p>	<p>Professional value & interest is evident in preparation of the work.</p> <p>Presentation of work represents a professional identity.</p> <p>Creative approach to the display of work.</p>

Figure 4. Affective Learning Aims Achieved by the Evaluation Instruments.

	Thesis Based	Project Based	Presentation Based	Portfolio Based
Psychomotor Learning	<p>Competence in reading, writing, research.</p> <p>Computer Literacy.</p> <p>Library Competency.</p>	<p>Mastering the skills of the profession and application of them to a project.</p> <p>Design, writing, scripting, visual representation & production.</p>	<p>Performance Skills: Non-verbal communication; oral communication skills; mediated presentation.</p> <p>Presentation skills & organization.</p> <p>Production and use of supporting materials.</p>	<p>Collection of mastered skills and abilities.</p> <p>Technical acumen evident in displayed work.</p>

Figure 5. Psychomotor Learning Aims Achieved by the Evaluation Instruments.

Collaborative Learning

Collaborative learning is the research topic in the field of education where studies have been done on how students work together in teams and how such a team environment influences learning. Collaborative learning is often based on a knowledge network. Knowledge network is the type of study where researchers study towards how teams can share various knowledge and learn together as a group. There are three major research fields within knowledge network: creation of knowledge, transfer of knowledge, and adoption of knowledge. Phelps, Heidl, and Wadhwa (2012) posited that “knowledge creation is the generation of new knowledge, typically in the form of ideas, practices, research papers, technical inventions, or products” (p. 5). Transfer of knowledge simply means knowledge sharing from one team member to another. Adoption of knowledge stands for the ability to implement a discrete knowledge element towards the problem domain. In addition, they noted that “knowledge won’t end with creation of knowledge, once knowledge is created, cognitive and other resources are needed to transform and translate it to facilitate its transfer, which is often necessary for discrete, embodied knowledge to be adopted and used in subsequent efforts” (p. 6).

Gokhale (1995) defined collaborative learning as “an instruction method in which students at various performance levels work together in small groups toward a common goal” (p. 1). Boud, Cohen, and Sampson (2014) stated that collaborative learning should be a two-way reciprocal learning activity that involves the sharing of knowledge, ideas, and experience between the participants in the team environment informally. Collaborative learning is quite different from traditional lecture-based learning. Students will be placed in a small team environment and learning often occurs through teamwork. Gokhale (1995) summarized the benefits of collaborative learning as:

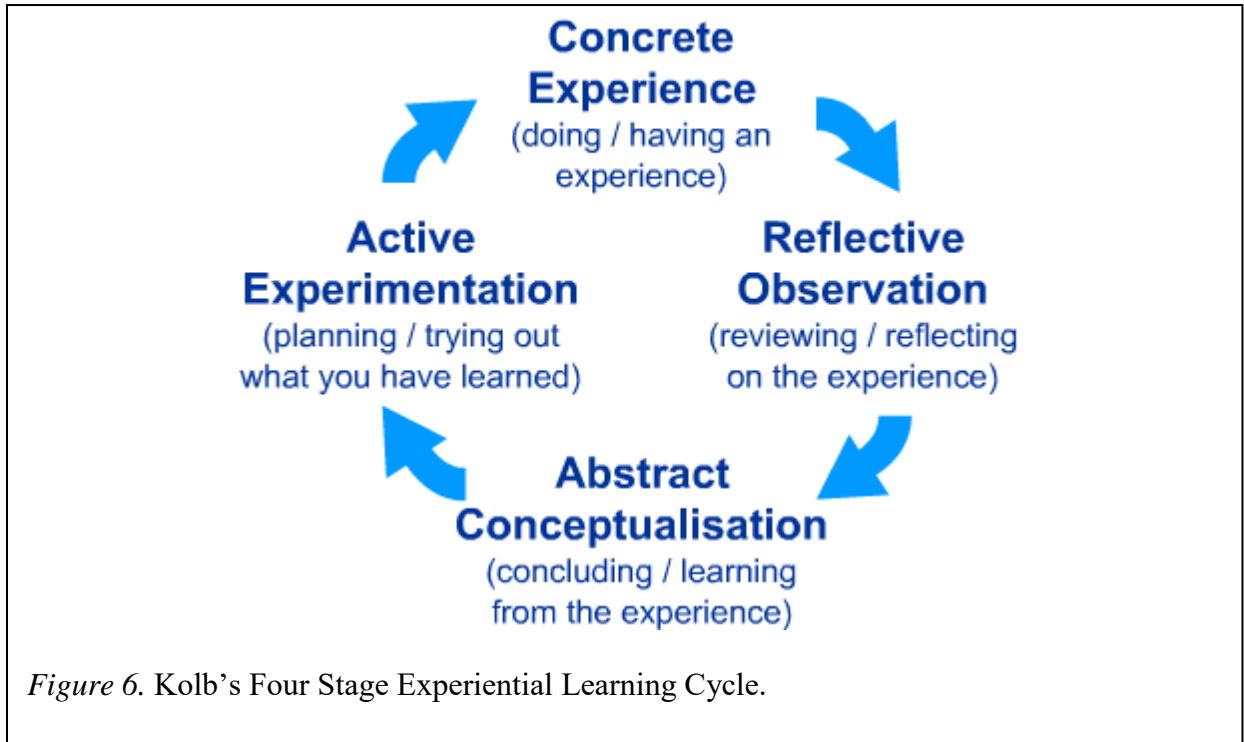
Collaborative learning fosters the development of critical thinking through discussion, clarification of ideas, and evaluation of others' ideas. However, both methods of instruction were found to be equally effective in gaining factual knowledge. Therefore, if the purpose of instruction is to enhance critical- thinking and problem- solving skills, then collaborative learning is more beneficial (p. 8).

Experiential Learning

Experiential learning has been defined by Phipps, Osborne, Dyer, and Ball (2008) as “an experience-based approach to learning in which students experience a direct encounter with the phenomenon under study, reflect on that experience, draw general conclusions, and test their newly acquired knowledge through subsequent performance” (p. 530). Lewin (1957) emphasized that students can receive a concrete learning experience through this type of learning since it allows them to well test their original ideas. Transactions between the learners and the surrounding environment is a must have component for experiential learning to take place. Learners can get concrete experimentation which in turn motivates them to explore further.

The famous phrase, “Learning by Doing” has been mastered by computer science educators across the nation. College level capstone projects well fit into the category of learning by doing and can certainly be considered as one of the common implementations of experiential learning. Kolb (1984) presented experiential learning as a conceptual learning model that describes the whole process. He pointed out that “learning is the process whereby knowledge is created through the transformation of experience” (p. 26). This author further explained the hands-on learning experience by expanding experiential learning using a four-stage cycle model: concrete experiences (CE), reflection on the experience (RE), abstract conceptualization (AC), and active experimentation (AE). In this four-stage model (see Figure 6), all elements are cycled. Students can start their service learning at any given point of time within this cycle, but all four parts must be completed for experiential learning to occur (Bringle, Jacoby, & Ehrlich, 1997).

These authors further posited that learning is more likely to be more effective when service learning is sequenced so concrete experience happens before reflection and abstract conceptualization.



First, the learners participate in a “concrete experience”. The learners then step back and take time to reflect on what have learned. Next, the learners connect abstract academic concepts with the actual experience. Lastly, the learners can experiment the new way after they have reflected on the experience; and this can result them beginning the four-stage cycle again.

Such experiential learning cycle can help us understand how learning can occur through experience. At the first stage of the cycle, a concrete experience is where assignments are designed intentionally to promote learning, and the learner completes these assignments. During the second stage of the cycle, the learner performs reflection by doing self-analysis of the

experience. The third stage of the cycle, abstract conceptualization, the learners often analyzes different ideas and tries to conceptualize a theory of what they observed during their learning experience. Finally, during the last active experimentation stage, the learners get to acted out based on what they learned during the whole cycle. Kolb's theoretical basis for the experiential learning cycle include the following:

Learning is a process that never ends, and ideas are reformed through experience continually.

Learning is holistic that it involves thinking, feeling, perceiving and behaving.

Learning involves both the person and their surrounding environment, and such environment is needed for the learning to occur.

Learning is the process of creating knowledge and such process happens through life and cultural experiences (Bringle, Jacoby, & Ehrlich, 1997).

Project Based Learning

According to Bugg and Dewey (1934), project-based learning was one of the earliest components of hands-on based learning and has been employed in a wide variety of student activities where students become involved in their own learning. There has been an old tradition of incorporating hands-on based academic activities into classroom.

Malicky, Huang, and Lord (2006) explained that senior capstone courses are considered as one of the most common college level implementations of project-based learning. The purpose is to provide a learning activity that is experiential based from which students are able to apply knowledge gained from previous courses to an actual hands-on based senior project (Dutson, Todd, Magleby, & Sorensen, 1997). As such, project-based learning shares some common characteristics and theoretical bases with capstone courses such as mentoring and procedural qualities.

It is worthy to note that project-based learning is different from problem-based learning. Problem based learning is more directed as knowledge acquisition while project-based learning is directed as knowledge application (Perrenet, Bouhuijs, & Smits, 2000). Although the capstone course may need knowledge application, the primary purpose is to apply skills and knowledge learned previously. Barron et al. (2008) noted that project-based learning promote links among subject matter disciplines and is adaptable to different learners and learning situations. Therefore, use actual project in the learning process simulate professional reality and can help bridge abstract conceptual academic theories and real-life experience.

Blumenfeld, Soloway, Marx, Krajcik, Guzdial, and Palincsar (1991) pointed out two project components: first, it often requires a problem to drive the whole activity and second, the activity can produce a final product that in turn addresses the original problem. Both components are prominent, as design problems are usually open ended and also have more than one acceptable solution (Dym, Agogino, Eris, Frey, & Leifer, 2005). On the other hand, projects also need to be designed to support the learning process, and learners are normally being supplied with design specifications for the end product. Barron and Darling-Hammond (2008) stated that it is important to provide students with learning appropriate goals to help students understand the origins of the project. These authors also pointed out the fact that the problem that drives the project needs to make a connection between conceptual knowledge and activities.

For capstone courses, students are being put into small teams and this resembles professional reality. Blumenfeld et al. (1991) noted the small teams allow students to critique all project aspects and therefore can reflect students' knowledge. This way, students can be motivated by the project and naturally enhancing their communication and teamwork skills as a direct result of the team working experience.

Hong (2007) noted that project-based learning is based on both theoretical and practical needs to motivate learners and guide them to understand knowledge application through the project development life cycle. As such, students are able to develop motivation, initiative skills, and organizational skills (Mills et al., 2008). Projects are often lead by student leaders and therefore require students to have the high-level skill of self-direction. In addition, to complete the project, students need to have several components of self-directed learning such as problem-solving skills and metacognitive strategies that they may not have had a chance to develop in their previous educational experiences (Perrenet et al., 2000). This issue can occur in capstone courses similarly due to the lack of prior knowledge and effective learning strategies. When the needed knowledge and skills are lacking, it is the role of faculty mentor to assist students in filling the gap, so the project is achievable. Thomas and Magilvy (2011) noted the faculty mentoring as a strong role in project facilitation and management throughout the whole project. Thomas also posited that the faculty mentor's role is much like the role of a capstone course instructor, and can be described as that of motivator, advisor, manager, and consultant.

The above descriptions of project-based learning showed some similarities of senior capstone courses. These similar characteristics include course purpose, course structure, project management, and goal of the project. Therefore, senior capstone course can be considered as one example of project-based learning.

Transfer of Learning

Transfer is a critical concept of learning theories since most education aspires to convey knowledge (Haskell, 2001). According to Cree and Macaulay (2001), transfer of learning has been defined by as the ultimate goal of teaching; however, this goal is regarded as one of the most formidable challenges in the educational field. From different educational levels, we learn all sorts of knowledge and frameworks, and we transfer such learning to different situations later

on. The final education purpose is to apply what students learned in different subject areas and to apply that learning to new situations.

Rambau (2005) defined transfer of learning as “putting into practice the skills, knowledge, and attitudes that were gained through learning intervention on either the classroom or on job training in a specific working environment” (p. 3). In addition, Ellis (1965) posited that the transfer of learning as experience on a task influences performance on some other subsequent task. For the education field, “transfer of learning” related to generating knowledge and information through education which refers to the capacity to generalize and to learn by analogy (Subedi, 2004). Such definitions make certain that skills and knowledge one gained during a learning experience in either the working domain or education domain can be transferred later on. For the working domain, transfer of training can promote the successful rate of tasks to be performed. For the education domain, transfer of learning can deepen the general knowledge base.

The benefits of transfer of learning is obvious. Instructors need to make sure students well understand and can tuck the learning into their schema before they move on. The transfer of learning can therefore occur in classrooms such as capstone courses and other subject areas, as well as outside classroom and into everyday lives. To practice learning, the classroom is often a highly desirable place. Once students feel valued and affirmed, they will be truly engaged in learning. Instructors also expect students to be able to transfer learning from one level to the next level and one subject to another. One of the greatest benefits of transfer of learning is the practice that students implement their knowledge in previous classes within their field of study. This is especially true when students take senior capstone courses where they can transfer their previous knowledge in a new classroom setting.

Haskell (2001) proposed two major kinds of taxonomy for transfer of knowledge. The first taxonomy focused on six levels of transfer (Figure 7), with each level specifying a precise degree of similarity between present knowledge and past knowledge. The second taxonomy elaborated on the fourteen kinds of specific transfers (Figure 8).

Taxonomy1 – Six Levels of Transfer	
Level 1: Nonspecific transfer	This level implies that all learning essentially is transfer of learning since all learning is contingent upon previous learning.
Level 2: Application transfer	This level refers to the application of what we have learned to specific situations.
Level 3: Context transfer	This level refers to the application of what we have learned under slightly different situations.
Level 4: Near transfer	This level occurs when we transfer previous knowledge to new situations that are similar but not identical to the initial situations.
Level 5: Far transfer	This level occurs when we transfer previous knowledge to new situations that are completely different than the initial situations.
Level 6: Displacement or creative transfer	This level can results in the creation of a new concept based on the similarities of the new knowledge and old knowledge.

Figure 7. Six Levels of Transfer.

Taxonomy2 – Fourteen Kinds of Specific Transfers	
Content-to-content transfer	Content-to-content transfer occurs when we utilize knowledge in one subject area in order to learn another subject area.
Procedural-to-procedural transfer	Procedural-to-procedural transfer involves occurs when we apply procedures learned in a specific skill area to another.
Declarative-to-procedural transfer	Declarative-to-procedural transfer helps us to actually do something based on the knowledge we learn about that subject area.
Procedural-to-declarative transfer	Procedural-to-declarative transfer allows us to acquire additional abstract knowledge about a desired subject area given the fact we already have practical experience in that area.
Strategic transfer	Strategic transfer occurs when we gain knowledge concerning our cognitive processes by monitoring our activities while learning.
Conditional transfer	Conditional transfer allows us to decide when our knowledge we gained in a specific context may be appropriate for another context.
Theoretical transfer	Theoretical transfer occurs when we are able to transfer our cause and effect relationships understanding from one area to another area.
General transfer	General transfer means nonspecific transfer which allows our past knowledge that is not specific in one situation to be transferred to other situations.
Literal transfer	Literal transfer entails the direct application of knowledge in a novel learning situation.
Vertical transfer	Vertical transfer occurs when learning necessitates some prerequisite skills.
Lateral transfer	Lateral transfer occurs when we transfer our previous learning to the identical level within a knowledge hierarchy family.
Reverse transfer	Reverse transfer refers to backward transfer which involves modifying our schemata relative to their similarities to novel information.
Proportional transfer	Proportional transfer means a more abstract type of transfer.
Relational transfer	Relational transfer occurs when we perceive two things to be relational despite the lack of any underlying relationship.

Figure 8. Fourteen Kinds of Specific Transfers.

In addition, Haskell (2001) enumerated eleven learning principles in his theoretical framework to resolve failures of classroom transfer of learning:

First Principle: Primary Knowledge Base

Second Principle: Peripheral Knowledge

Third Principle: History of Transfer Area(s)

Fourth Principle: Motivation

Fifth Principle: Nature and Function of Transfer

Sixth Principle: Orientation to Think and Encode in Transfer Terms

Seventh Principle: Cultures of Transfer

Eighth Principle: The Theory Underlying the Transfer Area

Ninth Principle: Drill and Practice

Tenth Principle: Incubation Time

Eleventh Principle: Reading and Observing Exemplary Works of Transfer

Given the above analysis of transfer of learning, we can see that both the effect and functions of transfer are equally important. At educational field, similarities frequently exist within and across different disciplines, therefore opportunities of transfer of learning abounds at interdisciplinary levels. The learning usually occurs when students use what they have learned in different courses, situations, and conditions. We can observe different transfer of learning aspects in capstone courses.

Service Learning

Many senior capstone projects involve partnering with non-profit organizations, therefore, service learning becomes part of the learning theories related to senior capstone projects and worth exploring. Service learning is often rooted in civics where people are involved in the society. This educational pedagogy is actually derived from experiential learning. Bringle and Hatcher (1999) defined service learning as “competency-based and credit-bearing educational experience in which students (a) participate in mutually identified service activities that benefit the community, and (b) reflect on the service activity in such a way as to gain further understanding of course content, a broader appreciation of the discipline, and an enhanced sense of personal values and civic responsibility” (p. 222).

There are five major types of service programs: volunteerism, community service, internships, field education, and service-learning (Furco, 1996). For volunteerism type, the intention is to help an individual person, groups of people, or a community with very little focus on learning. For community service type, the intention is to engage students within the community on a voluntary basis; however, it is not a typical part of a formalized curriculum and therefore, may lack academic credibility. For the internship type, students perform paid or unpaid jobs, and the primary focus is based on what the students learn. For field education type, students typically learn by being exposed to the community environment. Lastly, for service learning type, the intention is to expand on volunteerism and community service by including experiences that are tied to academic learning outcomes so both students and the recipients of the service can benefit from the experience.

The best practices of service-learning in higher education include increased civic mindedness and reciprocal collaboration. Service-learning is attractive to higher education institutions since it can prepare students to become active members of the society. It can help students see themselves both as individuals and as part of a larger community with social problems that students might be able to impact, therefore, promoting civic mindedness (Rhoads, 1997). On the other hand, effective implementation of service-learning involves collaboration between the students, academic personnel, and community leaders. Such three-party collaborations help building trust and accomplishing goals. Service-learning allows students to interact with those who are different from them; therefore, helping students understand issues such as privilege, power, and oppression.

The outcomes of service-learning include four development areas: academic development, civic development, social development, and career development. For academic

development, service-learning has a big impact on students' educational success from a wide variety of disciplines including: critical thinking, team work, and communication. For civic development, service-learning has shown to have a positive effect on students' sense of social responsibility and citizenship skills (Levine, 1998). In addition, it also promotes for future volunteer work (Astin, Vogelgesang, Ikeda, & Yee, 2000). For social development, it has positive effects on students' motivation for learning and their levels of civic, social, and academic engagement (Eyler & Giles, 1999). Service-learning has also shown to impact student's career in numerous ways. The impacts include: understand job responsibilities, being able to work well in teams, leadership skills, and obtaining skills that would make future contributions to the society (Prentice & Robinson, 2010).

Employability Skills

There have been initiatives to define the types of employability skills in university degree programs' senior capstone course area. In addition, there has been some debate about the terminology used for employability skills (National Centre for Vocational Education Research, 2002). McKinnon and McCrae (2011) defined employability skills as “a set of attributes, skills and knowledge that all labor market participants should possess to ensure they have the capability of being effective in the workplace – to the benefit of themselves, their employer and the wider economy” (p. 8). This definition pointed out that employability skills are the ones that can support college graduates to progress in both personal careers and within the organizations where they will work.

CBI (2009) and the National Centre for Vocational Education Research (2002) both summarized employability skills, and there is considerable commonality of both summaries with some slight variations in terminology. CBI (2009) listed a unique skill “application of numeracy” which is the effective manipulation of numbers and its applications. On the other hand, the

National Centre for Vocational Education Research (2002) listed a unique skill “learning” which implies the management of ongoing learning such as investing time in effort in learning new technology. Other common employability skills include (CBI, 2009; National Centre for Vocational Education Research, 2002):

- *Communication* – Effective speaking skills, writing skills, reading skills, and listening skills; and effective negotiating skills and persuading skills
- *Problem Solving* - Collecting facts, analyzing collected information, understanding problems, researching solutions, testing assumptions, identifying and solving problems using different strategies, and developing solutions
- *Team work* - Identifying member strengths, identifying member weaknesses, mentoring effectively, providing timely feedbacks, defining roles; making meaningful personal contribution, support active cooperation, and working toward a common goal
- *Technology* - Effective use of all software and Internet search engines, actively learning new IT technology, and using technology as a management tool
- *Planning and organizing* - Effective use of all kinds of resources, allocating resources appropriately to tasks, establishing deliverables; adapting resources to respond to contingencies, taking initiative, making decisions, engaging in continuous improvement, and understanding business rule/regulation/policy
- *Self-management* – Effective time management, willing to accept new responsibility, articulating good ideas, evaluating performance, willing to accept feedbacks, and being flexible about the feedbacks
- *Entrepreneurship* - Adapting to new contexts, being able to identify new opportunities, initiating new ideas, taking risks, and developing long-term strategic plans.

While CBI and the National Centre for Vocational Education Research well summarized the employability skills in a general nature, other bodies such as the ACM and AIS’s Curriculum Guidelines for Undergraduate Degree Programs in Information Systems (Topi et al., 2010) examined employability skills that are actually relevant to the Information Systems (IS) discipline. The IS related employability skills include:

- *Leadership and collaboration skills* – These skills are important because IS graduates often work in cross-functional teams analyzing real-world problems.
- *Communication skills* – This is needed by IS graduates because they must observe/listen/interview all kinds of stakeholders of the organization, analyze organizational process/problems to come up with proposed solutions, present possible solutions to the stakeholders, and produce written reports.
- *Analytical and critical thinking skills* – These are important because IS graduates must be able to analyze possible risks, solve complicated problems, and be creative.
- *Negotiation skills* – These are essential because IS graduates' jobs often involve complex negotiations with user teams, product management teams, service providers, team members, and other stakeholders with unfortunate competing priorities.

The overlap between the skills in general employability skills and IS specific employability skills are obvious. Further, the interrelated nature of the skill sets implies that it is very important for computer science (CS) educators to develop senior capstone course learning experiences that give CS major students the opportunity to integrate these employability skills, rather than simply exposing students some subsets of these employability skills.

Category 3. Capstone Course Instructional Methods

There are numerous capstone instructional methods used in capstone computer science courses. The three major capstone instructional methods include: project portfolio-based capstone, service-learning capstone, and industry sponsored capstone.

Project Portfolios Based Capstone

Huba and Freed (2000) posited that it is important to understand what a portfolio is and how it can benefit students as a developing professional and life-long learner. At the same time, the capstone portfolio provides a framework for students' self-assessment and self-reflection as well as future professional career development. It provides an opportunity for students to tell a story about what they have learned and reflect the story the portfolio tells, therefore, deepening

students' learning (Morse, Barrett, Mayan, Olson, & Spiers, 2002). Klenowski (2002) noted that utilizing portfolio allows students to shift their self-perception from one of a student who has to perform in accordance with course policy and criteria to one of a learner who is attaining specific self-determined goals. Increasingly, computer discipline related programs are using portfolios in major courses and capstones both as a learning tools and a process-oriented assessment tool. Portfolios often require the compilation of student performances, projects, and any other assignments over a semester. Within a capstone course, a digital portfolio might be a collection of students' best work as chosen by themselves, or a comprehensive collection of all of their work of previous major related courses. The portfolio, therefore, can possibly demonstrate students' achieved outcomes. The portfolio could ask students to include items across all curricula, or it could focus on items within the specific academic discipline (Schilling & Schilling, 1998). Some higher education institutions have made their senior capstone course to be a capstone portfolio course and require students to achieve a score no lower than C for them to graduate. The portfolio becomes the property of the students and is mainly student-driven with a good amount of collaboration with faculty mentors and peers.

The goals and purposes of computer science capstone portfolio varies, but the major ones include:

- Allow the students to demonstrate multiple intelligences such as logical problem solving, interpersonal, and intrapersonal skills (Gardner, 1993)
- Provide faculty members greater insight to the students' understanding and application of concepts to professional practice (Schulz, 2005)
- Promote the use of metacognitive skills (Klenowski, 2002)
- Provide a rich learning environment that includes group projects and internships further enhancing the reflective educational process inherent in portfolio development (Schulz, 2005)
- Synthesize information from the capstone and/or discipline-specific courses

- Engage in integrated reflection to enhance students' engagement in their own learning by reflecting on their performance on various assignments and developing insights into the learning process itself (Mummalaneni, 2014)
- Provide a tool for career preparation since portfolios may contain evidence of school and career accomplishments; transcripts, references; awards and evidence of skills; and knowledge and abilities (Amirian & Flanigan, 2006).

There is a substantial amount of literature on both the strength and weakness of the portfolio use in higher education programs. The benefits and limitations that are presented by a range of research spanning from 1993 to 2003 are summarized in Figure 9.

Benefits of Portfolios	
Well illustrate the interdisciplinary connections between program courses.	(Banta, 2003)
Students can gain skills in reflection.	(Gilman, 1994)
Can show strengths and weaknesses within given area of content and across the program curriculum.	(Banta, 2003)
Used as tools used when students are seeking for employment.	(Banta, 2003)
Demonstrate a good way to measure both teaching quality and learning quality of instructors and students.	(Banta 2003)
Give faculty better insights into the results of their teaching strategies and course curriculums.	(Banta, 2003)
Developing student's skills of reflective thinking.	(Banta, 2003)
Help students see their academic growth and measure students' accomplishments within their major area of study.	(Cook-Benjamin, 2001)
Help measure students' higher-order critical thinking skills.	(Henkin, 1993)
Giving faculty the ability to measure students' learning quality in previous major courses.	(Banta, 2003)
Can help reveal a trail of growth and improvement based on feedbacks so future evaluation plans can be made.	(Schechter, Testa, and Eder, 2001)
Can be used as tools in seeking employment.	(Banta, 2003)
Limitations of Portfolios	
May require additional time and effort to perform evaluation.	(Banta, 2003)
Scoring methods are hard to be determined - holistic or analytic?	(Banta 2003)
Agreement across faculty on final assessments of portfolios approach can differ greatly.	(Banta 2003)
Portfolios storage cost should be considered.	(Banta, 2003)

Figure 9. Benefits and Limitations of Portfolios.

Service-Learning Capstone

Multiple service-learning definitions are in use today. It is defined as a form of special experiential learning in education field in which students get to engage in activities that can help address community and human needs, together with structured opportunities for reflection designed to achieve desired leaning outcomes (Bringle, Jacoby, & Ehrlich, 1997). Bringle (2015) stated that service-learning must be part of the formal academic's curriculum. Today, however, the term service-learning has been used to include a wide variety of experiential educational endeavors, from internship programs, field studies, volunteers, and community partnerships.

Furco (1996) proposed a model (See Figure 10) to highlight the differences between service-learning and community-based work and experiential learning. He characterized each program type by its benefit and its degree of focus on services and learning.

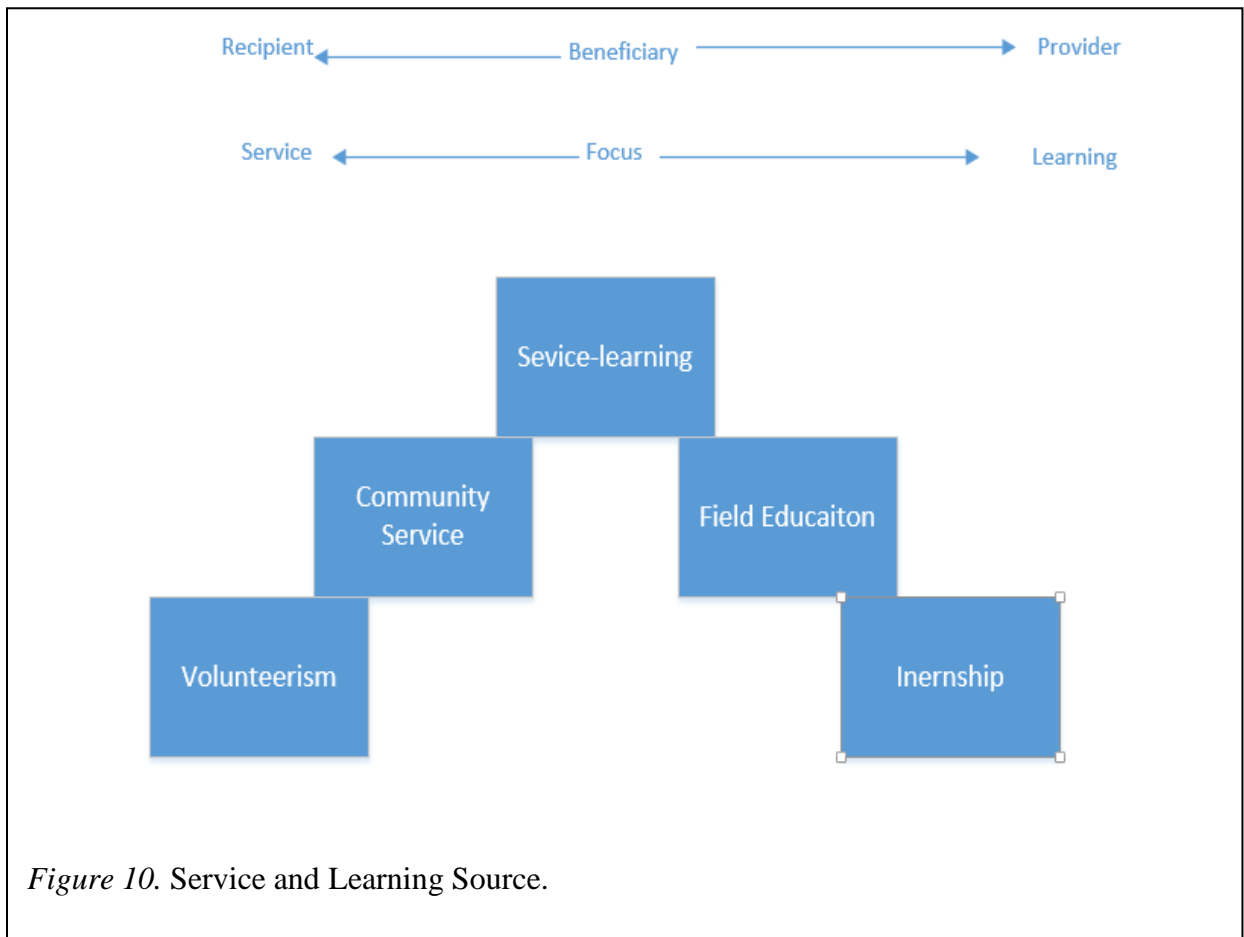


Figure 10. Service and Learning Source.

The volunteerism and community services on the left side focus on the benefits of the organization, community, and individuals being served. The bottom volunteerism is all about providing services with no intentional connection to learning. The top community service engages students in community needs-based activities and is more structured than volunteering, thus providing more benefits but still lacks academic credibility. The internship and field education on the right-side focus on learning. Internship provide opportunities for students to learn skills in their subject area, so they can gain some actual working experience in a potential career field; however, they may or may not have connection with any course work. Field education on the other hand does have connection with curriculum and is aimed on enhancing

learning within students' field of study, and thus may include reflection as part of the experience. Service-learning located at the top and center of the model, is designed to seek for a balance between community and learning outcomes intentionally; therefore, focuses on both learning and service and can benefit both providers and students. In service-learning, both reflection and learning are integrated into the academic curriculum.

Today's service-learning has its root in Dewey's theory (1933) of experience and education. In the late 1960s and 1970s, along with cooperative education, internships, and other experiential learning forms, service-learning became well established. Since the early 1990s, the scope of service-learning has gained a dramatic increase with the enhanced university community outreach program. Since the early 2000s, civic engagement has become prominent in the higher education field. Most recently, the calls for civic engagement with colleges and universities have intensified, and there is a greater demand for students to acquire civic knowledge/skill into every aspect of what they do.

Service-learning greatly promotes students' learning while making an unique contribution to addressing unmet local, national, and international needs. According to Bushouse (2005), service-learning is distinct in "its potential to create a win-win-win situation for the university, students, and community" (p. 32). Some well-documented, long-term benefits of service-learning include:

- Personal growth and development such as moral development, sense of social responsibility, commitment to service, spiritual growth, and empathy
- Greater academic learning outcomes such as deeper understanding of course objectives and stronger ability to apply abstract academic theory to real practice
- Enhanced critical thinking skills, problem solving skills, and cognitive development
- Improved interpersonal skills such as leadership, civic collaboration skills, workplace collaboration skills, and communication skills

- Stronger confidence in career choices
- Better facilitation of cultural and racial understanding thus resulted reduced stereotyped thinking
- Greater satisfaction towards college education, therefore, increased graduation rates
- Enhanced capability to conduct research
- Strengthened networking among community organizations.

In addition, the Council for Advancement of Standards in Higher Education (2012) cited some short-term service-learning benefits. Figure 11 shows the summarized version.

Service-Learning Short Term Benefits	
Reported Benefits	Detailed Description of Benefits
Knowledge acquisition, integration, construction, and application	Understanding knowledge from a wide range of disciplines; being able to connect knowledge to other ideas and experiences; relating knowledge to real life; and to constructing new knowledge
Intrapersonal development	Realistic self-appraisal, self-understanding, self-respect, identity development, commitment to integrity, and spiritual awareness
Cognitive complexity	Critical thinking, effective reasoning, reflective thinking and creativity
Humanitarianism and civic engagement	Understanding and human and cultural differences, social responsibility, global perspective, and sense of civic responsibility
Interpersonal competence	Meaningful relationship, interdependence, collaboration, and effective leadership
Practical competence	Pursuing goals, communicating effectively, technical competence, managing career development, managing personal affairs, demonstrating professionalism, maintaining health and wellness, and living a purposeful and satisfying life
Source: Council for the Advancement of Standards in Higher Education. (2012). <i>CAS professional standards for higher education</i> (8th ed.). Washington, DC.	

Figure 11. Service-Learning Short Term Benefits.

Based on the benefits of service-learning, higher education institutions should intentionally offer a wide range of service-learning experiences for students at different levels of development at various stages of their education. Educators should prioritize and develop these experiences based on institutional priorities, student interest, community needs, as well as all available resources over time. Service-learning experiences are often categorized as: direct, non-

direct, indirect, and community-based research. Direct service-learning experience means having face-to-face interaction with the client at the client's site such as tutoring services. Non-direct service-learning experiences happen at the community site with service-learners performing behind-the-scenes activities. Indirect service-learning experience occurs away from the service site and are physically distant from the population being served; such experiences typically include developing a website for a community organization. Community-based research is a collaborative research that is partnered with community agents such as nonprofit community organizations or government agencies, together with higher education partners such as faculty mentors and students, in research projects that address community-identified questions or issues (Paul, 2009). When service-learning occurs inside an academic course, it can really benefit from the course structures including required class meeting times, course assignments, the number of credit hours, and course final letter grades. The learning outcomes can therefore be defined and assessed clearly, the standards of academic rigor can be met, the discipline's knowledge base can be tied tightly, and students can be fully engaged in learning objectives. When service-learning occurs outside the course curriculum, it is usually more flexible in terms of scheduling and more likely to benefit from the leadership from students. Both curricular service-learning and co-curricular service-learning experiences should be offered at different levels of frequency along with different level of intensity/commitment. Opportunities for students who are ready for serious commitment include:

- Course related community-based research
- Independent study with or without a faculty mentor
- Liaison with a community organization
- Teaching assistant for a course that utilizes service-learning experience

- Capstone courses that involve students working on community organizations or government agencies on professional-level projects.

A thoughtfully service-learning co-curricular can allow students to have greater outcomes. Sanford (1967) pointed out that the individual will stagnate and not move forward if the support system is too great, and there is not sufficient challenge. Educators need to put efforts into curriculum development by offering challenges while providing enough support, so students can feel comfortable enough to tackle the challenges. While service-learning is not appropriate for every course, it can be a beneficial strategy in every discipline. To eventually determine whether or not service-learning is the right pedagogy for a course, it is important to start with the desired learning outcome of a course: 1) what do you expect students to know; 2) what do you expect students be able to do as a result of taking the course; 3) what are the skills/knowledge/awareness do you want students to gain, and 4) what learning outcomes can likely be achieved. Bringle (2015) summarized the following learning outcomes that are found to be particularly effective:

- Synthesis and analysis of information to solve complex problems with multiple possible solutions
- Application of concepts and knowledge to practice in new contexts
- effective oral, written, and visual communication
- Working collaboratively with others, especially across difference
- Exercise of well-reasoned judgment
- Taking ownership for learning
- Using a discipline's knowledge base to address social issues
- Developing the skills and habits of critical reflection
- Other outcomes that involve manipulating, relating, structuring, developing, interpreting, decision making, prioritizing, and like skills (p. 81)

Service-learning has been observed often in behavioral sciences, social sciences, education, health professions, and agriculture. However, computer science is not very visible in the service-learning world and integrating service-learning into STEM disciplines has been a challenge task for educators. A recent Google search on the term “computer science service learning” resulted 28,400,000 hits. While learning computer science concepts and technical skills, there are still numerous opportunities for serving the community. Most computer science service-learning activities fall into the following categories:

- Developing a web project for a local organization
- Developing an information system for a local organization’s administrators
- Developing a database system for local organizations
- Developing a website/IS for local not for profit organizations
- Developing educational software to be used at classroom for local schools
- Performing networking activities for local organization’s computing resources
- Providing tutoring services or other instructional activities.

Industry Sponsored Capstone

Experiential learning-based capstone projects are becoming increasingly popular in computer science programs. It is often provided in conjunction with the support from industry organizations, and these projects can typically benefit both students and industry sponsors. This type of industry sponsored capstone project links student teams with corporate sponsors and can provide a great opportunity for students to translate their abstract theories and the quality tools learned in the academic setting into real world situation. The capstone courses especially the ones that are sponsored by industry have gained recognition as an important test of students’ ability to synthesize the curriculum while also fast-tracking their career development through fostering decision-making and other important skills (Holley, 2009). There are a number of

researches done to explore the value of incorporating industry-sponsored projects into capstone courses based on capstone courses for undergraduate degree programs offered in a traditional setting. Applied science, engineering program, and computer sciences make extensive use of capstone courses that often incorporate projects that are sponsored by real industry (Farr, Lee, Metro, & Sutton, 2001).

There have been many successful cases reported. Bruhn and Camp (2004) highlighted the impact of an engineering capstone course when the capstone project worked with industry sponsors. The faculty worked with students to assign the experiential projects to each team and provided mentorship to students on how to produce a deliverable that would benefit the industry sponsor. The capstone course employed a special three-tiered monitoring system, which included students' own self-monitoring, faculty mentorship, and corporate sponsor mentorship. Such mentoring systems allowed every student member to pull an equal amount of weight and perform a fair share of the assignments. At the very end, all team members felt they are now better equipped to move into the real industry, and there was a consensus that this capstone course was invaluable to the curriculum. Gorman (2010) reported another successful case in delivering an operations management capstone course of undergraduate program in a university. This capstone course is offered in six-credits spanning into a two semesters format. During the first semester, students are required to finish a one-credit requirement of project proposal after communicating with the industry client by gathering user requirements. During the second semester, each team worked on the project's actual implementation based on the approved proposal, and they earned the remaining five credits. Conclusions drawn from this experience suggest that a consulting-style capstone project can provide college seniors a both rewarding and unique experience, and such projects are equally valuable to the industry clients. Both reported cases support key

determinants of success that include a well-defined project scope, faculty and client full commitments, a fast approach used to address key concerns, reliance on the facts provided, and students' excellent oral/written/presentation skills.

There are a number of literatures that reported the limitations of industry sponsored capstone projects. The difficulties exhibit the following aspects:

- *Process control:* As the project development goes on, students often lose track of important objective deliverables easily. Due to lack of effective communication, faculty mentors often have no way of tracking the expected progress, which in turn will affect students' grade.
- *Unrealistic expectations:* Sponsoring companies often have unrealistic expectations as to the amount of work and level of quality that the students are capable of delivering in a couple of semesters.
- *Hard to control situations:* The industry sponsored capstone has many uncertainties such as delays, ambiguity, and company specific constraints; faculty mentors may find themselves adjusting to situations that they cannot even control.
- *Poor availability:* The sponsoring company's point of contact not being available to the team, and there is a resulted overall delay of the project delivery.
- *Constant scope change:* Once the scope is defined, the sponsoring company often changes the scope of the project resulting the students abandoning the original project proposal or constant changes to the proposal.
- *Quality control:* To increase the deliverables' quality, it is suggested that students should be able to access mentors' feedback about their work-in-progress in a timely manner to ensure the suggested changes can be implemented accordingly. The fast feedback delivery can raise big overheads to both faculty mentors and industry sponsors, which would inevitably impede the overall project outcomes' quality.
- *Project management:* Many artifacts such as user requirements, user change requests, user cases, meeting review minutes, test cases, and project reports can be generated along the development process. Lack of project portfolios often make it difficult to monitor/collaborate/review the project development (Lo & Karam, 2013).
- *Project traceability:* Such academic capstones often lack CASE (Computer-aided software engineering) tools, therefore, it is extremely time-consuming for both students and mentors to trace all related project artifacts.

- *Teamwork*: The students assigned to each project all have different personalities and lack of proactive communication is common during the team development process. In many cases, it turned out to be the faculty mentor who takes the initiative to gather students' progress information instead of the students themselves (Olarte, Dominguez, Jaime, & Garcia-Izquierdo, 2014).

What was even worse is that many team members do not actually know where their teammates are currently standing in the development process. Key characteristics of a high-performance project team include progress awareness, task awareness, and proactive communication (Borrego, Karlin, Mcnair, & Beddoes, 2013). Besides the difficulties, there are also a great amount of reported benefits of corporate sponsored capstone course. Industry involvement is beneficial to students, faculty mentors, sponsoring industries, students, and faculty. These benefits are categorized in the following three categories: industry sponsor, faculty mentors, and student team members:

Industry sponsor benefits:

- Industry sponsors benefit by receiving additional technical resources as well as labor resources dedicated to solving a problem at a much lower cost
- Industry sponsorship can benefit companies with limited resources, and therefore, allow them to make quicker progress on some lower priority projects without diluting their in-house resources dedicated to some other higher priority projects
- It provides a great professional development opportunity for the company employee who serves as a mentor
- The collaborative nature of an industry-sponsored capstone is instrumental in skills development such as problem analysis, critical thinking, problem-solving, team collaboration, and communication
- Companies were able to engage with the students in thinking in new ways about an existing problem
- Industry-sponsored capstone often provides context-specific challenges that cannot be duplicated easily in the academic environment
- Capstone sponsorship allows sponsoring companies to participate in the training of new software/web/database developers, advertise their companies to the institution, and gain access to a pool of graduating developers for recruitment

- Participation in industry-sponsored capstone is sought by many recruiters given the nature of the experience and the gained skills.

Student team members' benefits:

- Students can benefit from industry sponsorship through the opportunity to work on real-world problems of importance to the industry
- Students are exposed to real industry project management processes and product development processes. Therefore, they become more familiar with both economic and legal design constraints
- Sponsoring industry often provides additional resources to students that might not be available from their own department
- Industry-sponsored capstone experiences often lead to full-time employment with the sponsoring company for students right after graduation
- Students have the invaluable experience of working directly with an industry customer and dealing with professionals in a professional way
- Students often gain confidence in their project management skills, teamwork skills, and communication skills.

Faculty mentor benefits:

- Industry-sponsored capstone can help faculty members get their students well prepared for careers in information technology
- Industry-sponsored capstone provides faculty members networking opportunities with industry professionals so they may acquire future project ideas
- Industry-sponsored capstone may provide potential research funding and publication opportunities.

Conceptual Framework

Four learning theories provided the conceptual framework for this research. The four theories include Bloom's taxonomy theory of learning, re-interpreted Bloom's taxonomy theory of learning, Bloom's mastery learning theory, and the Twenty-First-century learning theory. The study's research question focused on the students learning outcomes of technology senior capstone course supports all of these learning theories. The research supported Bloom's learning

theory of using critical thinking skills in a project-based capstone course to influence student capacities for learning. The re-interpreted Bloom's learning taxonomy served as another solid conceptual framework for the research as capstone courses often serve as a major part of the most institutions assessment program. Bloom's mastery of learning theory was implemented through students' participation in personal learning experiences in capstone courses. And finally, the Twenty-First-century learning theory provided the framework for project-based capstone courses as they are rich in educational technologies. Figure 12 shows the Conceptual Framework for this study.

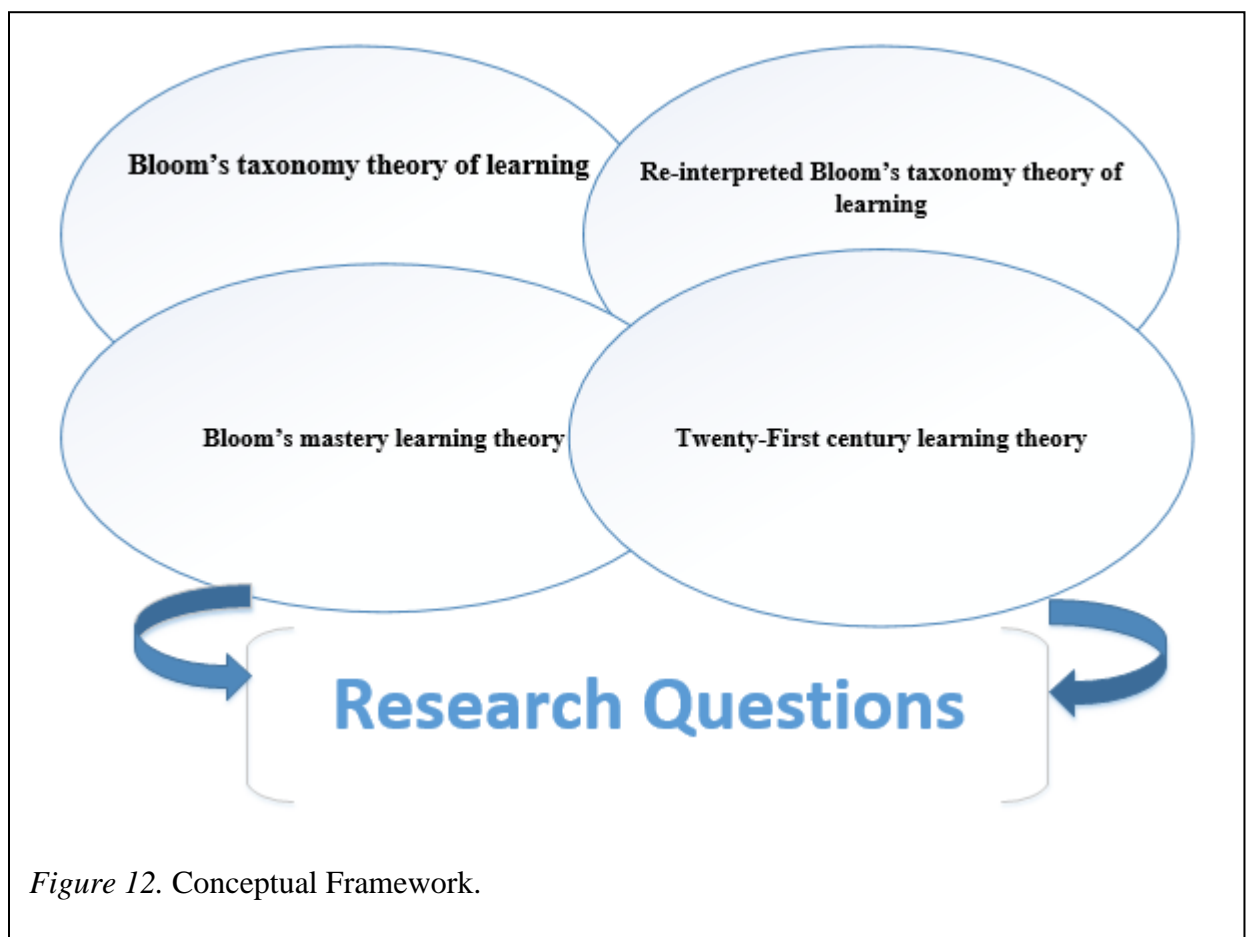


Figure 12. Conceptual Framework.

Category 1: Bloom's Taxonomy Theory of Learning

Understanding student learning outcomes' cognitive level can assist faculty members in identifying which critical thinking skills are considered as appropriate skills for college students to achieve through their major program of study. Bloom published the Taxonomy of Educational Objectives the Cognitive Domain in 1956. He treated the original taxonomy as more than a domain for measuring. Krathwohl (2002) stated that Bloom believed the original taxonomy could serve as:

- Common language about learning goals to facilitate communication across persons, subject matter, and grade levels
- Basis for determining for a particular course or curriculum the specific meaning of broad education goals, such as those found in the currently prevalent national, state and local standards
- Means for determining the congruence of educational objectives, activities, and assessments in a unit, course, or curriculum
- Panorama of the range of educational possibilities against which the limited breadth and depth of any particular educational course or curriculum could be contrasted (p. 1).

When it is originally introduced, many educators were not familiar with the term “taxonomy,” therefore, the framework received little attention at first. The framework became widely known later on when readers saw the potential. This framework provided a reliable procedure for students' educational learning outcomes' assessment. Bloom's taxonomy took student learning from the easiest knowledge base to some higher levels of critical thinking that includes comprehension, application, analysis, synthesis, and evaluation. Figure 13 shows the original Bloom's taxonomy structure.

Bloom's Original Taxonomy Structure	
1.0 Knowledge	1.10 Knowledge of specifics 1.11 Knowledge of terminology 1.12 Knowledge of specific facts 1.20 Knowledge of ways and means of dealing with specifics 1.21 Knowledge of conventions 1.22 Knowledge of trends and sequences 1.23 Knowledge of classifications and categories 1.24 Knowledge of criteria 1.25 Knowledge of methodology 1.30 Knowledge of universals and abstractions in a field 1.31 Knowledge of principles and generalizations 1.32 Knowledge of theories and structures
2.0 Comprehension	2.1 Translation 2.2 Interpretation 2.3 Extrapolation
3.0 Application	
4.0 Analysis	4.1 Analysis of elements 4.2 Analysis of relationships 4.3 Analysis of organizational principles
5.0 Synthesis	5.1 Production of a unique communication 5.2 Production of a plan, or proposed set of operations 5.3 Derivation of a set of abstract relations
6.0 Evaluation	6.1 Evaluation in terms of internal evidence 6.2 Judgments in terms of external criteria

Figure 13. Bloom's Original Taxonomy Structure.

These categories represented a cumulative hierarchy; mastery of learning in each earlier category was the prerequisite for the next level of category.

Wang (2012) emphasized a higher level of critical thinking is essential of effective learning along with the additional taxonomic level of knowledge creation. One of the most frequent uses of Bloom's original taxonomy has been identifying curricular objectives. The use of this framework "ensures all levels of learning are incorporated, from basic recall and application of statistical terms, formulae, and process through to critical analysis of real data" (Takona, 1999, p. 2). According to the framework, the learning objectives were divided into

knowledge (affective learning), comprehension (psychomotor learning), and application (cognitive learning). The traditional teacher-centric can only help address the knowledge domain, but a student-centric method was more effective at teaching to the comprehension and application domains (Wong & Day, 2009).

With three domains implemented, students receive a more holistic educational experience that teaches them to think and apply their knowledge base to some real-life experiences that occur outside of the classroom. Such framework differentiates the instruction from the knowledge base that is the project foundation for some more challenging learning exercises that take place in the forms of application, analysis, and synthesis automatically.

The senior capstone course is a way for students to utilize their prior knowledge. While working their way up Bloom's learning theories, students need to learn new knowledge through real life problems. The upper levels of the domain needed students to take their knowledge up to the levels of application, analysis, synthesis, and evaluation. The upper level involves critical thinking and problem solving which are both key characteristics of the senior capstone course.

Category 2: Re-interpreted Bloom's Taxonomy Theory of Learning

In Bloom's original taxonomy, the knowledge area included both noun aspects and verb aspects, and this ultimately makes knowledge area different from other areas. "Unlike the original Taxonomy that was unidimensional, this anomaly was eliminated in the revised Taxonomy by allowing these two aspects, the noun and verb, to form separate dimensions, the noun providing the basis for the Knowledge dimension and the verb forming the basis for the Cognitive Process dimension." (Anderson et al., 2001, p. 3). In the reinterpreted knowledge categories, there are four subcategories: factual knowledge subcategory that contains knowledge of terminology and knowledge of specific details and elements; conceptual knowledge subcategory that contains knowledge of classifications and categories, knowledge of principles

and generalizations, knowledge of theories, models, and structures; procedural knowledge subcategory that contains knowledge of subject-specific skills and algorithms, knowledge of subject-specific techniques and methods, knowledge of criteria for determining when to use appropriate procedures; metacognitive knowledge subcategory (a newly added category) that contains strategic knowledge, knowledge about cognitive tasks, including appropriate contextual and conditional knowledge, and self-knowledge (Anderson et al., 2001). Quotation marks needed for direct quote, where does it begin?

To support the cognitive process dimension, the original total number of categories was kept but with some major updates. Knowledge was kept as the first category but renamed as remember. Comprehension was renamed as understanding, application, and analysis. Evaluation was retained but was also renamed using their verb forms as apply, analyze, and evaluate. Synthesis was renamed as create and switched places with evaluation. Overall, all the original subcategories were replaced with the term “cognitive processes.” Figure 14 shows the original and the re-interpreted Bloom’s Taxonomy.

Original and Re-interpreted Bloom's Taxonomy	
Original	Re-interpreted
Knowledge	1.0 Remember – Retrieving relevant knowledge from long-term memory. 1.1 Recognizing 1.2 Recalling
Comprehension	2.0 Understand – Determining the meaning of instructional messages, including oral, written, and graphic communication. 2.1 Interpreting 2.2 Exemplifying 2.3 Classifying 2.4 Summarizing 2.5 Inferring 2.6 Comparing 2.7 Explaining
Application	3.0 Apply – Carrying out or using a procedure in a given situation. 3.1 Executing 3.2 Implementing
Analysis	4.0 Analyze – Breaking material into its constituent parts and detecting how the parts relate to one another and to an overall structure or purpose. 4.1 Differentiating 4.2 Organizing 4.3 Attributing
Synthesis	5.0 Evaluate – Making judgments based on criteria and standards. 5.1 Checking 5.2 Critiquing
Evaluation	6.0 Create – Putting elements together to form a novel, coherent whole or make an original product. 6.1 Generating 6.2 Planning 6.3 Producing

Figure 14. Original and Re-interpreted Bloom's Taxonomy.

Higher education research, retention, and assessment are areas that will continue to evolve, and the case is also true in the area of capstone courses. “Instructional technologies and the changing delivery of student services will affect the content and character of these courses in the future” (Henscheid & Barnicoat, 2001, p. 7). The re-interpreted categories of Bloom's learning taxonomy can serve as a solid conceptual framework for capstone courses.

Senior capstone courses are often used in higher education as a formal way of running assessment to support students learning outcomes and course delivery pedagogy. Careful attention to students' learning can help create a climate of caring and engagement that supports students' own commitment to their learning. Henscheid finds that among the 707 regionally accredited higher education institutions, almost half of these institutions use capstone courses as a major part of their assessment program. It provides a venue for "assessing how successfully the major has attained the overall goals" (Wagenaar, 1993, p. 214). Students enrolled in the senior capstone course often highlight both curriculum strengths and weaknesses of their accredited major. To design effective tools for assessment, the student learning outcomes must be defined clearly. Even when the learning outcomes are being served as the primary object of assessment, the basic purpose of the evaluation is to adjust elements of the academic plan so that student learning will be improved (Stark & Lattuca, 1997).

Category 3: Bloom's Mastery Learning Theory

Bloom started a series of studies in the 1960s on the differences of students' individual learning and found out teachers have strong influences on students' successes. However, though all teachers use much the same way to teach students at different levels, these little variations in teaching resulted in big differences in student learning. Bloom then suggested teachers use assessment as a learning tool to provide feedback and to guide the correction process instead of just using assessment as an evaluation tool. This research resulted in Bloom's publication of mastery learning (Bloom et al., 1971). According to Guskey (2007), "Bloom believed that all students could be helped to reach a high criterion of learning if both the instructional methods and time were varied to better match students' individual learning needs" (p. 9). Through this formative classroom assessment combined with learning correction process, Bloom proposed that teachers should differentiate their way of classroom instruction to reach all students'

learning styles, thus meeting the diverse needs of different groups. Bloom believed nearly all students should be able to learn well and master the objectives and learning goals (Bloom, 1976).

After Bloom's mastery learning theory, there are numerous researches done in different settings. Although the settings are all different, they are all true to Bloom's original idea and include two essential elements: 1) the feedback, corrective, and enrichment process; and 2) instructional alignment (Guskey, 1997). Feedback by itself does not really help with the learning, it needs to be paired with corrective actions such as activities that offer guidance to students on how to solve problems. In addition, for learning to be effective, there must be a good alignment with the four major components in the learning process: learning goal, instruction, feedback and correctives, and proficient learners. These essential elements tied closely with the senior capstone course where student-learning outcomes can be greatly improved based on the feedback received from mentors, as well as the corrective process, happening after receiving feedbacks.

Category 4: The Twenty-First Century Learning Theory

This research was also framed in the Twenty-First-century learning theory. Trilling and Fadel (2009) posited that learners in the twenty-first century are required to have different skill sets from those in the 20th century to be successful in the global society. Technology education offers rich connections, problem solving, critical thinking, cooperation and collaboration with others, and practical engagement in real-world activities (Snape & Fox-Turnbull, 2011). Projects of a technology nature often require shared processes and cooperative work frequently. The skills needed for cooperative and collaborative situations relate to those identified in the framework for twenty-first-century learning significantly (Partnership for 21st Century Skills, 2009).

Summary of twenty-first-century learning theory characteristics include:

- Technology builds on students' existing knowledge and skills

- Technology requires students to work cooperatively and collaboratively with others
- Technology develops actual needs or problems, and with multiple solutions
- Technology provides opportunities for students to show initiative and take more responsibility in the process
- Technology offers opportunities for a wide range of people in the community to provide various input
- Developments are advanced by sharing ideas, presenting concepts, and evaluating possible solutions
- Students should experience the satisfaction of developing a wide range of learning outcomes
- Students' ideas should be accepted and valued
- The teacher's role is to motivate, encourage, support, and provide feedback to students
- Teacher's knowledge, experience, and skills provide input to assist in refining ideas, selecting resources, and achieving quality in products, as well as guiding students towards viable solutions
- Teacher supports, guides, challenges, and learns with the students, interacting with their thinking and helping to clarify ideas (Ministry of Education, 1995, p. 16).

The knowledge evolution is changing the way to senior capstone course works, and all higher education institutions have the responsibility to well prepare graduates to take advantage of the opportunities that will be available to them. The students are motivated to develop new skills and knowledge using technology that can be transferred to understand other learning situations. Research on technology usage in education shows that academic achievement can be greatly increased when learning technologies are integrated with quality learning experiences (Cisco Systems & Metiri Group, 2006). Higher education institution teaching methodology needs to change if students are to develop skills needed to survive in the 21st century.

“As more schools and educational programs embrace problem-and design-oriented

learning projects, educators, parents, and civic leaders are discovering that students are capable of doing much more than anyone thought they ever could” (Trilling & Fadel, 2009, p. 155).

Ahmadi (2011) reported that institutions that are rich in educational technologies are best suited for the project-based capstone. It allows students to problem solve real-world applications using the most advantaged educational technologies.

Summary of Literature Review

The literature review provided a solid foundation for the study. It consisted of a summary of key sources in three major categories: senior capstone course, learning outcomes and employability skills, and capstone course instructional methods. The key sources for category one senior capstone course include: capstone course overview, the different types of senior capstone courses, the goals of senior capstone courses, the purposes of senior capstone courses, senior capstone course advantages and limitations, capstone course structure and development, and capstone course curriculum and framework. The key sources for category two learning outcomes and employability skills include: student learning outcomes, collaborative learning, experiential learning, project-based learning, transfer of learning, service learning, and employability skills. The key sources for category three capstone course instructional methods include: project portfolio-based capstone, service learning capstone, and industry-sponsored capstone. All the key sources had great contribution to the understanding of the research question being studied. The gaps existing in the literature were also identified. In addition, the literature review pointed the way in fulfilling the need for future research. Towards the end of this chapter, the conceptual framework including Bloom’s taxonomy theory of learning, re-interpreted Bloom’s taxonomy theory of learning, Bloom’s mastery learning theory, and the Twenty-First-century learning theory are introduced. This complete analysis led to the qualitative-based research question. The next chapter explains the full research design and research methodology.

CHAPTER THREE

This was a research study involving the learning outcomes of the senior capstone project, and the qualitative data secured from the research data was the focus of this research. The study examined qualitatively students' employability skills and learning outcomes in the areas of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning through an examination of the industry/community organization professionals' perceptions and insights.

Data collected for this study are from a semi-structured interview methodology (Merriam, 2002). The methodology followed the qualitative paradigm of investigation as described by Lincoln and Guba (1985) and Merriam (2002). Merriam made a point that "qualitative researchers are interested in understanding how people interpret their experiences, how they construct their worlds, and what meaning they attribute to their experiences" (p. 5). A qualitative research approach was chosen as it gave the researcher the capability to use stakeholders' perspectives to better understand the senior capstone project through rich dialogue from individuals who had direct experience with college senior capstone projects. In addition, the qualitative approach can help provide detailed research-based descriptive recommendations that are well beyond what questionnaire-based research effort might provide - for faculty members to use in planning for the future development of new computer science capstone course curriculum or for evaluating/enhancing existing capstone curriculum. In the terminology of qualitative based study, this effort strengthens the study's transferability, or the ability of the findings to be applied to some other similar situations (Lincoln & Guba, 1985).

The focus of this chapter is to define the research methodology used for this study. This chapter includes details about the research traditions, research design, and sample population for the study. The researcher also outlines the sources of data, the way in which the data were

collected, the procedures for sample data collection as well as the data analysis. The research reliability and validity are also examined to ensure the researcher took appropriate measures and extra cautions to validate the research results. The ethical considerations are explained at the end of the chapter.

Research Tradition(s)

When analyzing the research methodologies of quantitative, qualitative, and mixed methods, the researcher decided to choose a qualitative methodology for this research to better answer the research questions. Merriam (2009) emphasized that the qualitative, interpretive, or naturalistic research paradigm defines the methods and techniques most suitable for collecting and analyzing data. When comparing the quantitative method with the qualitative method, the qualitative method “places more emphasis on the study of the phenomena from the perspective of stakeholders” (Lapan, Quartaroli, & Riemer, 2012, p. 3). Cox (2012) further posited that the qualitative research method was more appropriate when it comes to studying educational experiences such as capstone project experience.

Quantitative research measures the difference between variables with large sample population sizes and uses deductive reasoning in the data analysis (Kisely & Kendall, 2011). On the other hand, the qualitative method intentionally uses smaller sample sizes to acquire in-depth understanding of the research question. The data analysis in qualitative research is inductive (Kisely & Kendall, 2011). Looking at the research focus from the theoretical perspective of Cresswell (2013), it is obvious that a qualitative study can help answer these research questions surely for such an inquiry. The qualitative information collected was designed to reveal insight into the senior capstone project that was likely to best answer all three research questions. To obtain a deeper understanding of the learning outcome, employability skills, the phenomena of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning,

and Service Learning, this study was best analyzed through qualitative methods. “The purpose of qualitative research is to understand or explain behavior and beliefs, identify processes, and understand the context of people’s experiences” (Hennink, Hutter, & Bailey, 2011, p. 35).

The interview technique was then selected for this study to meet the requirements of open communication and sharing of input/experiences in an informal environment for a qualitative method. Interview method can be used in a wide variety of contexts; however, researchers typically use this combination to gain insight into interviewees’ personal experiences in a basic interpretive study. Therefore, this method is normally associated with comprehending how participants understand and perceive a specific case. In communicating participants’ understanding, they describe and act their experiences in how they handled the case naturally. Rhinas (2006) pointed that when the individual interview is compared to other methods such as the group interview, it does not allow participants to change their actual opinion based on external influence.

A basic interpretive study is a solid choice of method for assessing the responses to the research questions proposed in this study. Creswell (1998) mentioned that one can investigate qualitative research from a philosophical and theoretical stance. In addition, Merriam (2002) supported Creswell’s idea and asserted that the basic interpretive qualitative research method is considered as the easiest to understand method and most accurate method for the stated purpose. This type of study is more appropriate when the researcher wants to understand and acquire a sense of the meaning people have constructed around their experiences. Patton (1985) presented the fact that the qualitative research approach represents an attempt to explore the situational uniqueness as part of a unique interaction and context. The basic interpretive study can really help the researcher to uniquely explore the experiences without attempting to predict the actual

future as the interpretive study offers a wide data collection and data analysis tools set. The aim of this research was to collect information about the learning outcome of the capstone course from the point of view of industry/community professionals, and the basic interpretive design provides the interview methodology as the ideal tool for collecting all the data needed to address the research question. The tool is adaptive, responsive, and is widely accepted as it offers researchers the capabilities for both verbal and nonverbal communication by information processing at the time of collecting data. In addition, when accuracy is required, researchers can clarify the data/information with respondents. In short summary, this study was best formulated in the presence of literature, thereby making the techniques more reliable and authentic (Merriam, 2002).

There are a number of methods available to collect data for this research; however, all of these methods have one common characteristic that all the data comes from the participants directly. Therefore, the basic interpretive study design was more appropriate to the situation of this study in which the goal was to collect the input rather than developing a new theory. Rhinas (2006) indicated that the interpretive study is a purely qualitative methodology aimed at collecting the experiences of the participants to affirm the stated facts. This research study relied largely on the inputs from industry/community IT professionals. The basic interpretive design, therefore, fits into the landscape very well. Overall, this research only attempted to determine the usability and area of improvements of the capstone course for computer science students based on the input from industry/community professionals.

Research Questions and Propositions

The three research questions focused on the students' learning outcomes acquired through the senior capstone project process. This study analyzed industry/community professionals' perceptions of how they believe a senior capstone project phenomenon facilitated

the acquisition of learning, which included Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning. The study accomplished the purpose statement through the following three research questions:

Research Question (RQ1) - What would the industry/community leaders expect to see in the area of learning outcomes and employability skills when the computer science capstone project is initiated, developed, contributed, and partnered with organizations to include real-world problems?

Research Question (RQ2) – Which, if any, essential learning outcomes and employability skills identified by industry/community information technology (IT) professionals should be enhanced in capstone courses to support Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning?

Research Question (RQ3) – Which aspects of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning contribute to enhanced employability skills?

Using the lens of industry/community organization professionals, the researcher used the data collected as part of the study to address the research questions, giving insight, meaning, and the future room of improvements to the senior capstone project. The instrument used in this research was a well-planned semi-structured interview (Appendix A, Appendix B). The research questions were investigated through an analysis of the perceptions of research participants on the learning outcomes and employability skills acquired through the senior capstone project. The stakeholders' perceptions made the learner outcomes of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning more meaningful to this study. A better understanding of the students' educational learning outcomes gained

through the senior capstone project experience was acquired through the analysis of the collected qualitative data. There is existing research on the learning outcomes from the viewpoint of educators and students; however, industry/community organization stakeholders' insights and perceptions were needed to better understand the educational phenomena of the senior capstone course.

Research Design

Maxwell (2013) posited that every good qualitative research design must be precise and definite; it must be analyzed from every single angle explicitly given the fact there is no standardized structure for qualitative research design. According to Merriam (2009), there are five qualitative research designs, which are phenomenology, grounded theory, ethnography, narrative analysis, and critical qualitative. The phenomenology study design was most appropriate for this research because the purpose was to examine the learning outcomes and employability skills computer science students gained through senior capstone courses when the courses are partnered with industry/community organizations through real-world problems. Merriam also pointed that the research design must be consistent with the study's purpose. The purpose of a phenomenological study design is to examine a lived experience through in-depth interviews, and therefore, could be a good fit for this study. On the other hand, a narrative analysis research design would not be a good choice since the research was not a linear series of events. Neither critical analysis design nor ethnography would provide the information to research the phenomena. A historical design was also not appropriate for this research based on the relatively short existence of industry/community partnered and real-world problem based senior capstone projects.

The methodology used for this research is an in-depth interview session with industry/community organization professionals. When using conventional research methods such

as scientific procedure, quantification, or discovery of laws, it would be difficult to gather the thought processes and the actual feelings of the participants. Based on the explorative nature of the research questions, the qualitative methodology was effective in that the researcher was able to gain a deeper understanding of the phenomenon being studied. The interview strategies for gathering data best addressed the research questions, and the routes were developed to guide thirteen participants. Routes were semi-structured, so participants had the freedom to define the phenomenon from their own unique point of view (Merriam, 2002). Merriam also posited that such an interview type promotes the flexibility of questions but gathers specific data from participants at the meantime. Specific interview questions are located in Appendix A.

Population and Sample

Eldredge, Weigel, and Kroth (2014) pointed that the population represents a pool of the eligible individuals to act as the research participants. This research study utilized sample populations from among the industry organization professionals and community organization professionals that had well-established experience working with college students on real-world problem based senior capstone projects. In addition, the study utilized the group's extensive backgrounds in project coordination and project management.

A sample is a selected portion of the population set aside for an in-depth study (Strauss & Corbin, 1990). The study utilized 13 participants as the sample size. The 13 participants were selected from the state of Illinois for an in-depth interview given their extensive background in working with senior capstone projects.

Sampling Procedure

This study used purposive sampling procedure, in which the 13 participants were interviewed. Purposive sampling is a method in which researchers use their own judgment to select participants based on the study criteria (Bluhm et al., 2011). Such sampling procedure

helps to define the candidates' criteria selection. All participants must have one-year minimum experience working with college students on real-world problem based senior capstone project in the area of information technology. The ones who lacked the qualifications were excluded from the research.

The candidates who made up the population for this research first received the informed-consent forms. These individuals were then given adequate time to decide if they wanted to participate in the recorded interview as their participation was voluntary. The candidates were also given documentation about the research questions and the purpose of the research, so they can decide if they wanted to participate in the study. Upon agreement, a signature from each of the participants in the study was secured as part of the informed consent. The detailed interview time and location were then confirmed with the participant. In addition, a follow-up email was sent to the confirmed participants to remind them about their upcoming interview.

Data collection was conducted using interview notes, interview recordings, nonverbal communication, and participant observations (Onwuegbuzie, Leech, & Collins, 2010). The interview ranged from twenty minutes to one hour twenty-five minutes and the recorded interview audio files were transcribed into textual files. The draft textual files were then reorganized into a word document with responses listed under each research question (Appendix A). The participants' perceptions were then analyzed using a five-step data coding process as well as cross-referenced with audio recording to ensure data accuracy.

Instrumentation

Strauss and Corbin (1990) posited that instrumentation is a data collection method in scholarly research. Researchers conducting qualitative research often serve as the instrument for data collection since the researchers develop the needed research instrument based on the

research problem statement (Yin, 2011). This researcher developed a semi-structured interview as the main instrument for data collection.

During the data collection process, the researcher conducted eight face-to-face interviews and five online conferences due to the distance between the researcher and the participants. Each interview was recorded using WebEx, and the interviews lasted between twenty minutes to one hour twenty-five minutes. The recorded meeting was available shortly after the interview was conducted for the researcher to download as an MP4 file. The MP4 files were then submitted to Temi for audio transcription service. Figure 15 shows the conducted WebEx meetings occurred during the month of October 2017 with all 13 participants.

NANA LIU's Personal Room-20171...	39.34MB	10/18/17 3:49 pm	1 hour 25 minutes	MP4	  
NANA LIU's Personal Room-20171...	9.49MB	10/12/17 2:45 pm	20 minutes	MP4	  
NANA LIU's Personal Room-20171...	12.71MB	10/11/17 12:28 pm	27 minutes	MP4	  
NANA LIU's Personal Room-20171...	15.72MB	10/11/17 11:51 am	34 minutes	MP4	  
NANA LIU's Personal Room-20171...	13.05MB	10/11/17 11:12 am	28 minutes	MP4	  
NANA LIU's Personal Room-20171...	15.93MB	10/10/17 11:19 am	28 minutes	MP4	  
NANA LIU's Personal Room-20171...	16.78MB	10/10/17 10:41 am	32 minutes	MP4	  
NANA LIU's Personal Room-20171...	24.09MB	10/6/17 11:14 am	27 minutes	MP4	  
NANA LIU's Personal Room-20171...	29.26MB	10/6/17 10:41 am	34 minutes	MP4	  
NANA LIU's Personal Room-20171...	67.73MB	10/5/17 4:57 pm	38 minutes	MP4	  
NANA LIU's Personal Room-20171...	38.84MB	10/5/17 3:57 pm	23 minutes	MP4	  
NANA LIU's Personal Room-20171...	33.65MB	10/5/17 2:17 pm	22 minutes	MP4	  
NANA LIU's Personal Room-20171...	68.38MB	10/4/17 11:36 am	43 minutes	MP4	  

Figure 15. Conducted WebEx interviews.

The semi-structured interview questions, field notes, and WebEx conference were used as data collection tools. The open-ended semi-structured interview questions allowed the participants to freely describe their experiences and perspectives. Follow-up questions were also used to obtain further clarifications and explorations.

Wiles, Crow, Heath, and Charles, (2008) pointed out it would be the researcher's responsibility to make sure that participants would not be harmed in any way during the entire data collection process. To protect participants' confidentiality, the researcher coded each participant with a participant's identification number so their personal information would not be revealed.

Validity

The traditional validity criteria find their roots in a positivist tradition and positivism has been defined by a systematic validity theory. Within the systematic validity theory, validity was defined as the result of other empirical conceptions such as truth, reason, fact, objectivity, and evidence to name just a few (Winter, 2000). Joppe (2000) defined what validity is in qualitative research:

Validity determines whether the research truly measures that which it was intended to measure or how truthful the research results are. In other words, does the research instrument allow you to hit "the bull's eye" of your research object? Researchers generally determine validity by asking a series of questions, and will often look for the answers in the research of others. (p. 1)

Validity can be considered as "construct validity". Such constructs mean the initial research question and research hypothesis determines how the appropriate data is to be collected. Regarding validity, whether the measurement means are accurate, and whether the measurement is actually measuring what it is supposed to measure becomes critical.

Validity checks occurred throughout this research. The researcher made the whole research process transparent to all the interview candidates to ensure only the interested candidates were interviewed. The researcher also confirmed with the participants about their experience with senior capstone projects to ensure only the candidates with enough experience and background were interviewed. In addition, the participants were assured of their privacy and confidentiality. All these assurances greatly improved the study validity.

Thomas and Magilvy (2011) listed dependability, credibility, transferability, and confirmability as the four main components of the research validity. Dependability means the ability of another researcher to repeat and follow the same path that the investigator of this study took. This study achieved dependability through specific research purpose, careful participants' selection, well-articulated interview questions, and the detailed data analysis process. Other researchers who have interest in similar areas can follow the same path. Creditability stands for the revealed experiences in a study. The participants were asked to confirm the validity of the interview transcripts that were provided by the researcher. This double-checking process in which the participants view the preliminary analysis would allow the researcher to find any missing information. In addition, this researcher examined individual transcript and searched for response similarities. All these actions help with promoting research truthfulness and validity. Transferability means the ability to transfer the research findings to another group of participants. This research only focused on getting the feedback from the industry/community organization professionals, other stakeholders were excluded from the study. The research can be transferred to include other groups of participants such as faculty mentors, students, and parents. Confirmability means the establishment of dependability, credibility, and transferability within a research. This research was able to achieve confirmability by including a final interview question that is designed to gain new insights from the participants.

The researcher played a big portion in the process given the nature of qualitative studies. Merriam (2002) explains that qualitative research assumes the researcher's attitudes and biases may impact the study result. Researchers working on a qualitative study might affect the interplay between data and construct usually by the application of a test in order to validate the investigation. With more than 15 years of experience working as an educator in the higher

education field, the researcher has great insight into the capstone course curriculum, As a Senior Project faculty mentor, the researcher was fully aware of the possible biases brought to this research. However, the researcher was determined to not influence the results of the study or ethics used throughout the research. Guillemin & Gillam (2004) mentioned the importance of ethics in qualitative research:

By this, we mean the researcher's willingness to acknowledge the ethical dimensions of research practice, his or her ability to actually recognize this ethical dimension when it comes into play, and his or her ability to think through ethical issues and respond appropriately (p. 269).

Realizing the possible problems could help the researcher with preparation when actual problems arise.

Reliability

Reliability refers to the consistency of either measurement or design (Vogt, 2007). Kirk and Miller (1986) identified reliability as three types: the degree to which a measurement remains the same, measurement stability over time, and measurements similarity of a given time period. Joppe (2000) defines reliability as:

The extent to which results are consistent over time and an accurate representation of the total population under study is referred to as reliability and if the results of a study can be reproduced under a similar methodology, then the research instrument is considered to be reliable. (p. 1)

Hence, it is the researcher's responsibility to prove the research instrument's internal consistency, repeatability, and therefore, reliability. It was essential that the researcher kept reliability in focus throughout the research. The reliability required the researcher to self-assess to ensure no personal bias tainted the research's reliability. The role of the researcher in every qualitative research is quite important as the researcher serves as the main instrument of data collection as well as data analysis. The following was an attempt to disclose the researcher's background in an effort to neutralize the possible bias and to guard against unintentional

influences of researcher's past experiences. The researcher has more than 15 years of experience in the higher education field as an educator, subject matter expert, program architect, and curriculum developer. The researcher has spent the past five years working as a faculty mentor for computer science major real-world problem based senior capstone projects. Such experience has allowed the researcher to see the greater learning outcomes of senior capstone course project when it is partnered with the real client on the real project in the nonacademic setting. The researcher's professionalism allowed the researcher to ethically select a group of participants to participate in the phenomenon being studied, create a group of authentic interview questions, perform careful interviews, collect data, coding data using a detailed five-step procedure, as well as report findings in an unbiased professional way. The researcher focused solely on the participants' individual experiences, not on the researcher's own experience.

Researchers build reliability and validity into each qualitative research by rigorous observation, well-structured interview questions, well-articulated interviews, and accurate data analysis (Seldman, 2012). The semi-structured interview questions were the instruments used in the data collection. All the interview questions were peer-reviewed by the researcher's dissertation committee as well as the researcher's colleagues to assure a quality instrument for data collection. Reliability can also be enhanced by member checking that allowed the participants to review the data collected for accuracy and authenticity (Merriam, 2009). Interview participants were presented with the organized interview transcript for review to avoid misinterpretations and misconceptions, therefore establishing the reliable facts about the learning outcomes and employability skills of the senior capstone project.

Additional reliability procedures included comparing the information to the findings of previous research of capstone course learning outcomes. Also, the perceptive information the

researcher collected was typologically organized identifying the themes. The perceptions were then analyzed by the researcher to explore key concepts. This research used all the above strategies to improve the level of reliability and trustworthiness.

Data Collection

The main source of data collection for this research was the interview process. Carefully constructed interview questions (Appendix A), aligned with the research questions (Appendix B), were followed during the actual interviews. A list of 18 potential participants was identified based on their experience working with college students on real-world problem based senior capstone projects. Out of a total of 18 such prospects who were reached by email, 15 confirmed back that they would be able to participate the study, two rejected the invitation indicating they were about to leave their current job and were busy transitioning, and one never responded back. Out of the 15 agreed candidates, the researcher was able to schedule the exact time and location of the interviews for 13. Of the remaining two candidates, one candidate never responded to the second email inquiry about setting up the detailed interview schedule, and the other one indicated she only had limited exposure to the subject area being studied. Therefore, these two candidates were excluded from the interview. Thirteen of the interviews were eventually conducted during the month of October 2017. Upon participants' confirmation of the interview schedule, eight of the interviews took place in person due to the importance of meaningful relationship creation while the remaining five interviews were conducted through online video conferencing via WebEx. Face-to-face interaction provides a meaningful type of communication as this method provides instant response to the interview questions being asked. In addition, there were some other advantages as well. Opdenakker (2006) pointed out:

An advantage of this synchronous communication is that the answer of the interviewee is more spontaneous, without an extended reflection... the interviewer must concentrate much more on the questions to be asked and the answers are given. Especially when an

unstructured or semi-structured interview list is used, and the interviewer has to formulate questions as a result of the interactive nature of communication (p. 3).

Social cues were other advantages when researchers conduct the research using the face-to-face interview method. Face to face interview techniques allowed both researcher and participant to observe many of the non-verbal cues, and these non-verbal cues can eventually lead to some additional questions that are not included in the original question list.

The context of the interviewee's behavior is yet another major part of a phenomenological study. Seidman (1998) stated that it is an assumption that participants take the different meaning from their own experiences and that meaning affects the way they allow that experience to influence them during the in-depth interviewing process. Because the primary goal of this research was to study the learning outcome of capstone courses from the viewpoint of the participants, the meaning of the participants' experiences is then of extreme importance.

Prior to the actual interview, the researcher emailed both the interview questions and the informed consent form to participants, so they had time to think about the questions. Two participants requested to reschedule the interview, so they had enough time to prepare the answers. On the interview day, the researcher first talked about the detailed interview process, the research purpose, participants' rights, and confidentiality guarantee with each participant. The participants were also instructed that the interview would be interactive in a relaxed way given the fact that the interview questions are semi-structured questions. The researcher also ensured that all participants were aware that the interview would be audio recorded using WebEx and transcribed shortly afterward. Participants all understood that they would receive the interview transcript once it was available, and the participants would review and comment/correct if necessary and revert back to the researcher for comments to be considered. The researcher used Temi to transcribe the audio files to textual documents.

A semi-structured interview is one of the most common interview forms and is considered as a useful tool in exploring the research goal. The interviews were conducted using the semi-structured approach with a fairly open framework that promoted focused two-way conversational communication. Using this type of data collection method, the researcher worked out a set of interview questions beforehand and intended the rest of the interview to be conversational. Boud, Cohen, and Sampson (2014) summarized the benefits of semi-structured interview method:

- Many researchers like to use semi-structured interviews as the interview questions can be prepared ahead of time
- The semi-structured interviews also allow informants the freedom to express their own point of views using their own terms
- The semi-structure interviews can provide more reliable qualitative data that can help address the research question
- The semi-structured interview encourages more openly two-way conversational communication
- Often the data obtained from semi-structured interviews will provide more than just answers. It provides the reasons for the answers and this provides the opportunity for deeper learning.
- When individuals are interviewed face- to-face they may more easily discuss some sensitive issues.

This study utilized open-ended interview techniques in an effort to individualize the research process. The researcher could change the order of the prepared interview questions and even reword the questions. When participants were not clear about the interview questions, the researcher could give explanations and even leave out questions that seemed redundant. In another words, not every single interview question was designed ahead of time, the majority of the interview questions could be created during the actual interview process. This way, both the researcher and interviewee had the flexibility to probe for details. The main point was to get the

participants to be able to talk openly and freely while making sure the researcher was getting the in-depth information needed to conduct the research. Much of the emphasis was placed on thinking about the interview process and the designing of the interview and follow-up questions.

Maxwell (2013) states:

The development of good interview questions (and observational strategies) requires creativity and insight, rather than a mechanical conversation of the research questions in an interview guide or observation schedule, and depends fundamentally on your understanding of the context of the research (including your participants' definitions of this) and how the interview questions and observational strategies will actually work in practice (p. 101).

This suggests the necessity of carefully designing authentic interview questions in an attempt to glean valuable information from participants' lived experiences in relation to the learning outcomes of capstone projects.

Data Analysis

As indicated earlier, the semi-structured interview is the main instrument used in data collection. Such approach produces a considerable amount of textual data for data analysis in a later stage. Creswell (2013) observes, "the process of data collection, data analysis, and report writing are not distinct steps in the process - they are interrelated and often go on simultaneously in a research project" (p. 182). This type of ongoing data collection and management is reflected in the qualitative research process and involved a great amount of time reading, transcribing, annotating and analyzing transcripts from the interviews.

The final version of the transcription first was coded to protect participants' privacy and confidentiality then the responses get re-organized under each interview question. The researcher adopted the five-step method for textual data analysis of McCracken (1988) since it is one of the most useful methods for data analysis of long interviews. However, the researcher also acknowledges that there are also several other qualitative researchers have contributed to her

understanding of textual data analysis in the area of coding category, identifying themes and structuring data.

Every step in McCracken's (1988) five-step analysis represents a high level of generality.

- During the first step, the transcripts were read carefully by the researchers. Short notes are taken to try to capture what the respondent is discussing. At this initial stage, the focus is on sorting out important information from the big pool of unimportant material.
- During the second analysis stage, observations made in the first stage are developed into preliminary interpretive categories based on the initial notes gathered in the transcripts and the conceptual framework used to guide the study. Free coding started at this stage too. Some broad labels and coding interview text are created for further review.
- During the third stage, a thorough examination of preliminary codes is conducted so connections and pattern codes can be developed. McGracken (1988) stated that "A field of pattern and themes should be rising into view at this stage" (p. 45).
- During the fourth stage, the researcher can start making the determination of basic themes by examining memos made by the researcher and comments made by the participants. A theme is defined by Ely, Anzul, Friedman, Garner and Steinmetz (1991) as "a statement of meaning that runs through all or most of the pertinent data, or one in the minority that carries heavy emotional or factual impact" (p. 150).
- During the final stage of data analysis, themes from all participants are fully examined to delineate predominant themes. These predominate themes can then serve as research question answers and analytic conclusions are eventually reached.

In summary, the researcher started the annotation process that led to the coding process.

After coding and identifying significant statements, themes were developed in an attempt to reduce the amount of textual data into a more manageable package. These themes directly related to the goals of the research and the analytic conclusions..

Ethical Considerations

The ethical considerations applied throughout the whole research process included giving an informed consent form to the participants prior to the interview and explaining the

participant's right to withdraw from the research. Permissions were sought from Colorado Technical University's Institutional Review Board (IRB). Within the research proposal, the researcher guaranteed the human subjects protection. All participants received an informed consent form with explanations of the research questions, research hypothesis, and the purpose of the research. Participation in this research was completely voluntary and stakeholders who volunteered to participate could withdraw at any time from the research. The consent form was signed by each participant before the interview began.

The *Belmont Report* was maintained throughout the process to ensure the highest level of ethical considerations. The three principles: respect for persons, beneficence, and justice should be maintained during the research process (Strause, 2013). Any conflict of interest identified that had the potential of compromising the research would be eliminated as soon as it was detected by the researcher.

Confidentiality of the privacy of the participants was also maintained for the person-to-person interviews. The recorded WebEx meeting links were made private and were only available to the researcher. When the study was completed, all recorded WebEx meetings were deleted from WebEx cloud storage and stored locally on a flash drive. The researcher will store the flash drive safely and destroy the flash drive after a period of seven years.

In addition, the research was conducted to exclude all forms of bias including sex, education, and race. The researcher conducted interviews using semi-structured interview questions by focusing on the participant's responses solely while staying neutral during the process. Biases could also occur throughout the research due to the researcher's preexisting knowledge and experience with the topic (Chenail, 2011). The researcher has extensive experience and preexisting knowledge in the subject area being studied, and this could be an

attraction toward a specific participant. The researcher decided to stay objective in the data collection process as well as data interpretation process to eliminate all bias. The researcher also performed self-assessment to ensure no personal bias tainted the research's reliability.

Summary of Chapter Three

In summary, the qualitative methodology of this study examined industry/community organization professionals' perceptions of the learning outcomes and employability skills achieved through the completion of the real-world problem based senior capstone project. The semi-structured interviews were used as the primary source of data collection as it not only promoted a relaxed two-way conversational communication but also allowed participants the freedom to express their own point of views using their own terms. In addition, the collected data provided more than just participant answers as it also secured the reasons for the answers that provided the opportunity for deeper learning for the researcher.

The purpose of the study was to determine if the real-world problem based senior capstone project can promote students' employability skills and enhance the learning outcomes in the areas of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning by examining industry/community organization professionals' insights. After the data collection process, the researcher used the five-step method for textual data analysis, so themes can emerge, keywords can be collected, and the three research questions can be fully addressed. While presenting a summary of the process of collecting data along with how the data were analyzed, this chapter also examined the validity and reliability of the study. The results are discussed in Chapter Four.

CHAPTER FOUR

Chapter Four presents the data that were collected from the interview process and reflects the research finding. The purpose of this qualitative study was to investigate the learning outcomes of the real-world problem based senior capstone course from the perspectives of industry/community professionals. It was also the research objective to discover if any essential learning outcomes and employability skills identified by industry/community IT professionals can be enhanced in capstone courses to support Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning. In addition, the study was also aimed to find out which aspects of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning contribute to enhanced employability skills.

To address all the research questions, the researcher conducted a combination of face-to-face interviews and online video conferences via WebEx using semi-structured interview questions. This chapter starts with an introduction of participants' demographic information followed by the data collection process comprised of the interview process. The interviews were transcribed, and data analysis was performed to form 13 themes. Finally, all the themes that emerged from the data analysis are discussed and the chapter ends with a summary.

Participant Demographics

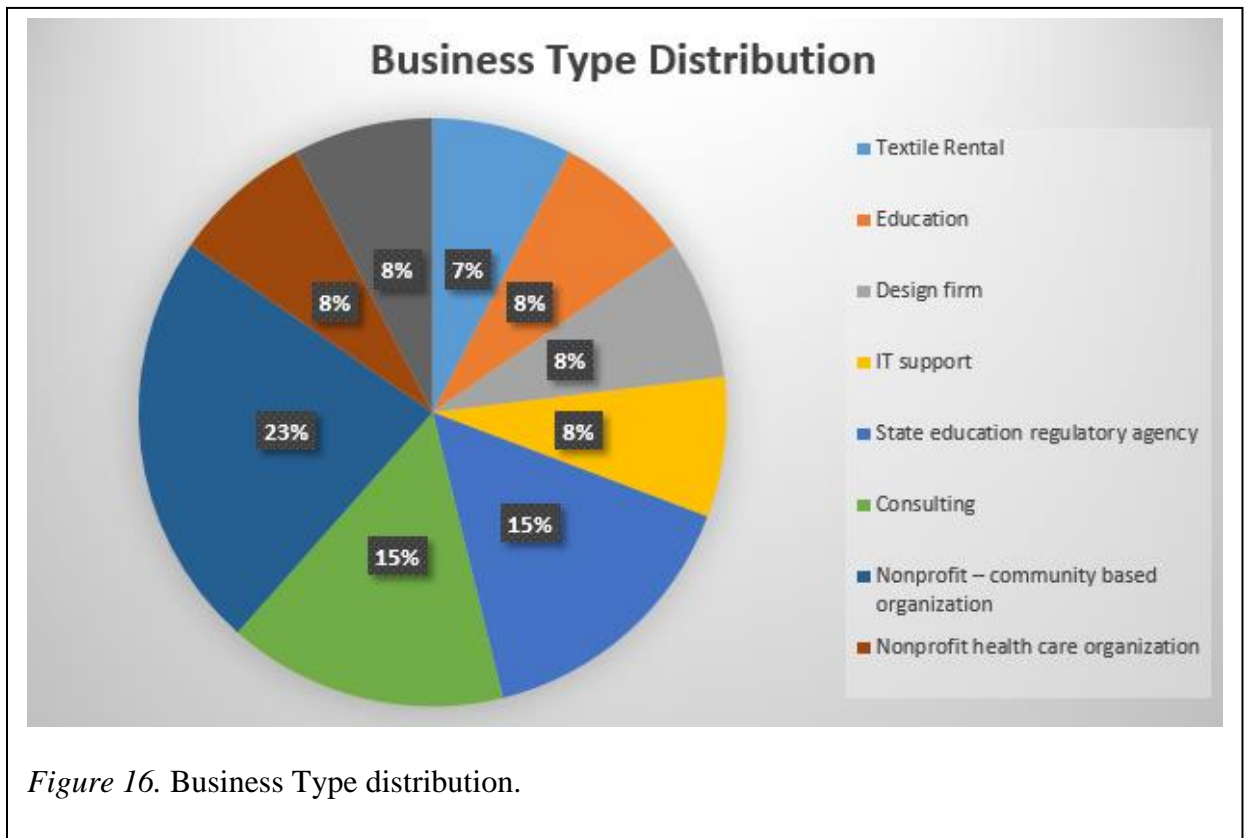
This study examined the learning outcomes of senior capstone from the perspectives of industry/community professionals. It is critical to select the participants. Marleny (2015) pointed out that a researcher must identify and select participants who have experience in the related study area and whose experience is in line with the research questions. In view of this, the participants' demographics profile was sliced by organizational association, job title, and the number of years' experience working with college students on real-world problem based senior

capstone courses. A total of 13 participants were interviewed. These participants include a president, information technology (IT) consultant, director of technology, director of marketing, Client/intermediary, IT director, faculty chair, web developer, database developer, graphic designer, marketing assistant, executive director, accounting manager, and program director. The detailed participant demographics are shown in Table 1.

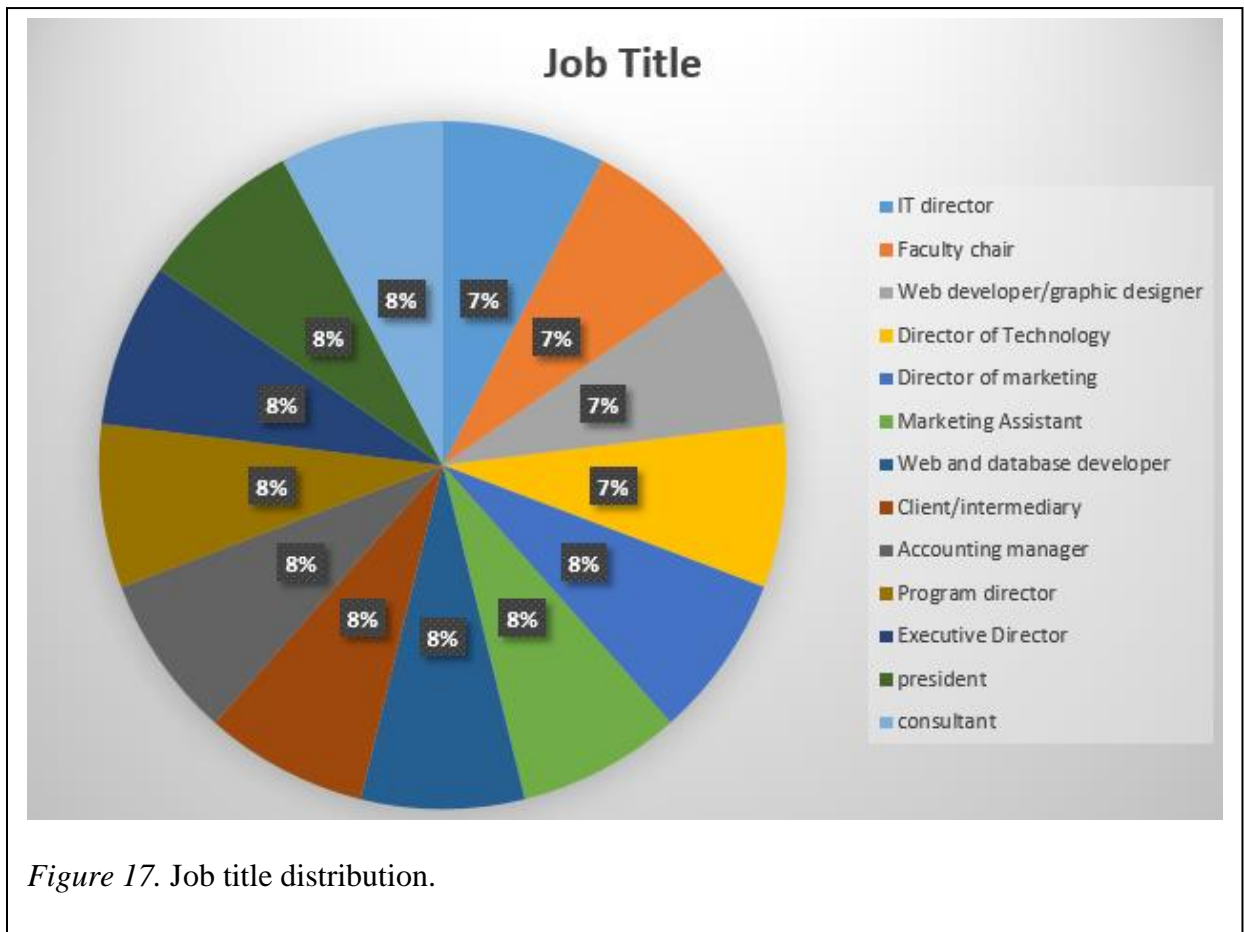
Table 1. *Participant Demographics*

Participant Code	Gender	Role	Business Type	Highest Education	Years of Experience working on senior capstone
P1	M	IT director	Textile rental	B.S.	2
P2	M	Faculty chair	Education	Ph.D.	5
P3	F	Web developer/graphic designer	Design firm	B.S.	1
P4	M	Director of technology	Project Management and IT support	B.S.	2
P5	F	Director of marketing	Consulting	B.S.	1
P6	F	Marketing assistant	Consulting	B.S.	1
P7	Male	Web and database developer	State education regulatory agency	B.S.	2
P8	F	Client/intermediary	State education regulatory agency	M.S.	2
P9	F	Accounting manager	Nonprofit community-based organization	B.S.	1
P10	M	Program director	Nonprofit community-based organization	M.S.	12
P11	M	Executive director	Nonprofit community-based organization	M.B.A.	3
P12	F	President	Nonprofit healthcare organization	M.S.N.	1
P13	M	Consultant	Telecommunication	Ph.D.	2

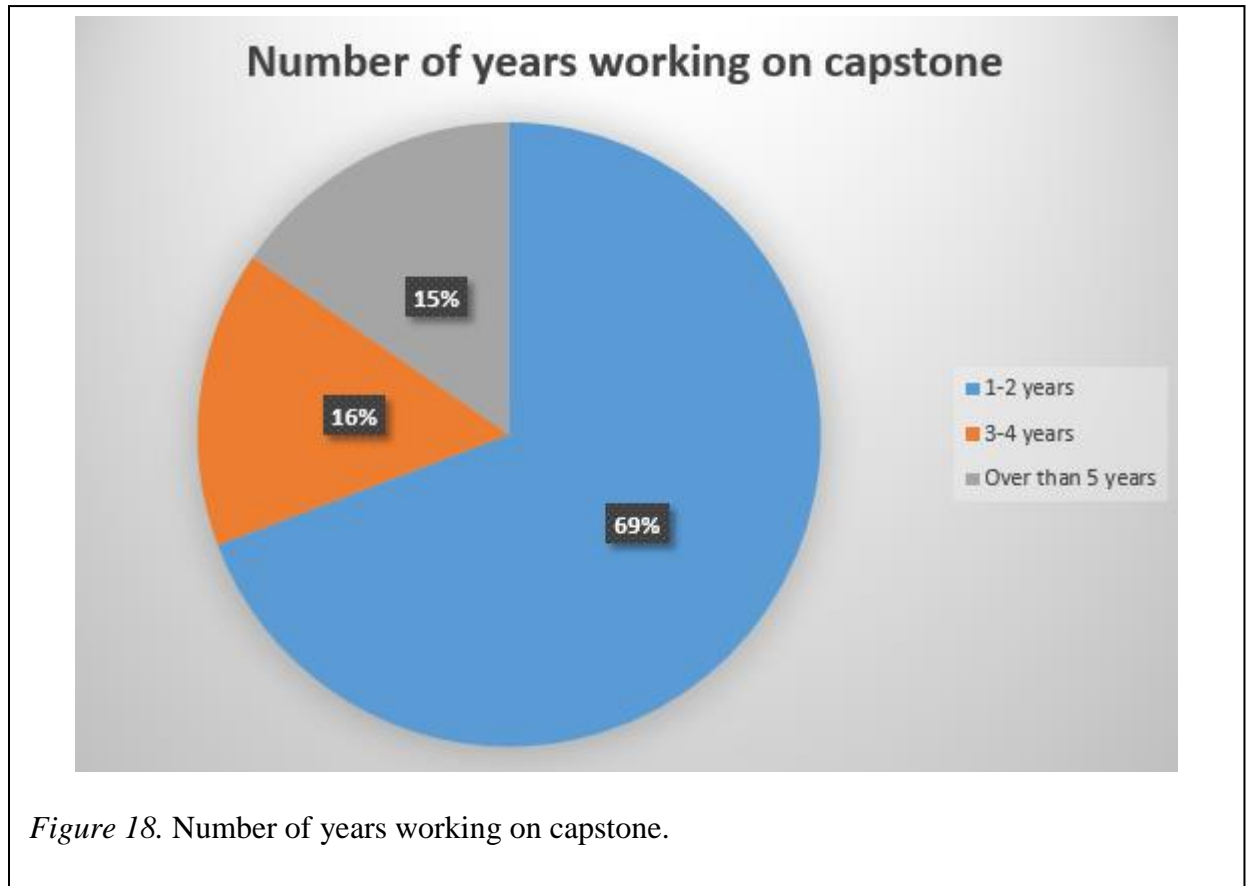
Only industry/community professionals that had a minimum one-year experience working with students in capstone project were included in the research to ensure the data reliability. The participating professionals came from various business backgrounds: textile rental, education, design firm, IT support, consulting, state education regulatory agency, nonprofit community-based organization, nonprofit healthcare organization, and telecommunication. The 13 participants consisted of seven males and six females. Out of the total participants interviewed, two have Doctor of Philosophy (Ph.D.) degrees, one holds a Master of Business Administration (M.B.A.) degree, two have Master of Science (M.S.) degrees, one holds a Master of Science in Nursing (M.S.N.) degree, and the remaining participants have Bachelor of Science (B.S.) degrees. The various business backgrounds and job titles of the participants resulted in-depth insights into responses to interview questions. The distribution of the participants' business background is shown in Figure 16.



The distribution of the participants' job title is shown in Figure 17.



The number of years the participants had working with senior capstone is shown in Figure 18.



Presentation of the Data

The rationale of the study was to investigate the learning outcomes of senior capstone project from the perspective of industry/community sponsors. The three primary research questions that were addressed in the study were: what would the industry/community leaders expect to see in the area of learning outcomes and employability skills when the computer science capstone project is initiated, developed, contributed, and partnered with organizations to include real-world problems; which, if any, essential learning outcomes and employability skills identified by industry/community IT professionals should be enhanced in capstone courses to support Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of

Learning, and Service Learning; and which aspects of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning contribute to enhanced employability skills. It was the objective of the research to address all questions through the data collected from the interview process. Fifteen interview questions were carefully designed to address the three research questions. The data were collected from 13 total interviews, five interviews were conducted over online video conferencing WebEx meetings, and eight interviews were conducted face-to-face. The interviews were audio recorded and transcribed using Temi for fast processing afterwards. The researcher also spent considerable amount of time to fix the transcription manually to ensure a high level of data accuracy. The interview transcriptions were coded to ensure participant privacy and confidentiality. The data coding process started immediately after data collection.

Data coding is a systematic process to categorize qualitative data to facilitate data analysis (Denzin & Lincoln, 2005). This process consists of short phrases to capture the qualitative research essential elements (Seldman, 2012). Coding analysis can lead to the activity to identify common themes that address the needs of the research from the interview data (Silverman, Lazar, Cao, Caldeira, & Erez, 2009). The theme is defined by Ely, Anzul, Friedman, Garner and Steinmetz (1991) as “a statement of meaning that runs through all or most of the pertinent data, or one in the minority that carries heavy emotional or factual impact” (p. 150).

The researcher used the following five steps in the data coding and analysis process:

- During the first step, the researcher read the transcripts carefully. Short notes are taken to try to capture what the respondent is discussing. At this initial stage, the focus is on sorting out important information from the big pool of unimportant material.
- During the second analysis stage, observations made in the first stage are developed into preliminary interpretive categories based on the initial notes gathered in the transcripts and the conceptual framework used to guide the study.

Free coding also started at this stage. Some broad labels and coding interview text are created for further review.

- During the third stage, through examination of preliminary codes, the broad labels started to connect with interview questions and research questions, and patterns are developed. In addition, the themes started rising into view at this stage.
- During the fourth stage, the researcher started making the determination of basic themes by examining memos made by the researcher and comments made by the participants. The researcher also started to connect the basic themes with the research questions.
- During the final stage of data analysis, themes from all participants are fully examined to delineate major themes. The developed themes were then investigated against the interview questions and the keywords under each theme are extracted from the short supporting descriptions. These major themes and keywords can then serve as research question answers and analytic conclusions are eventually reached.

Figure 19 shows the relationship between research questions, interview questions, and themes.

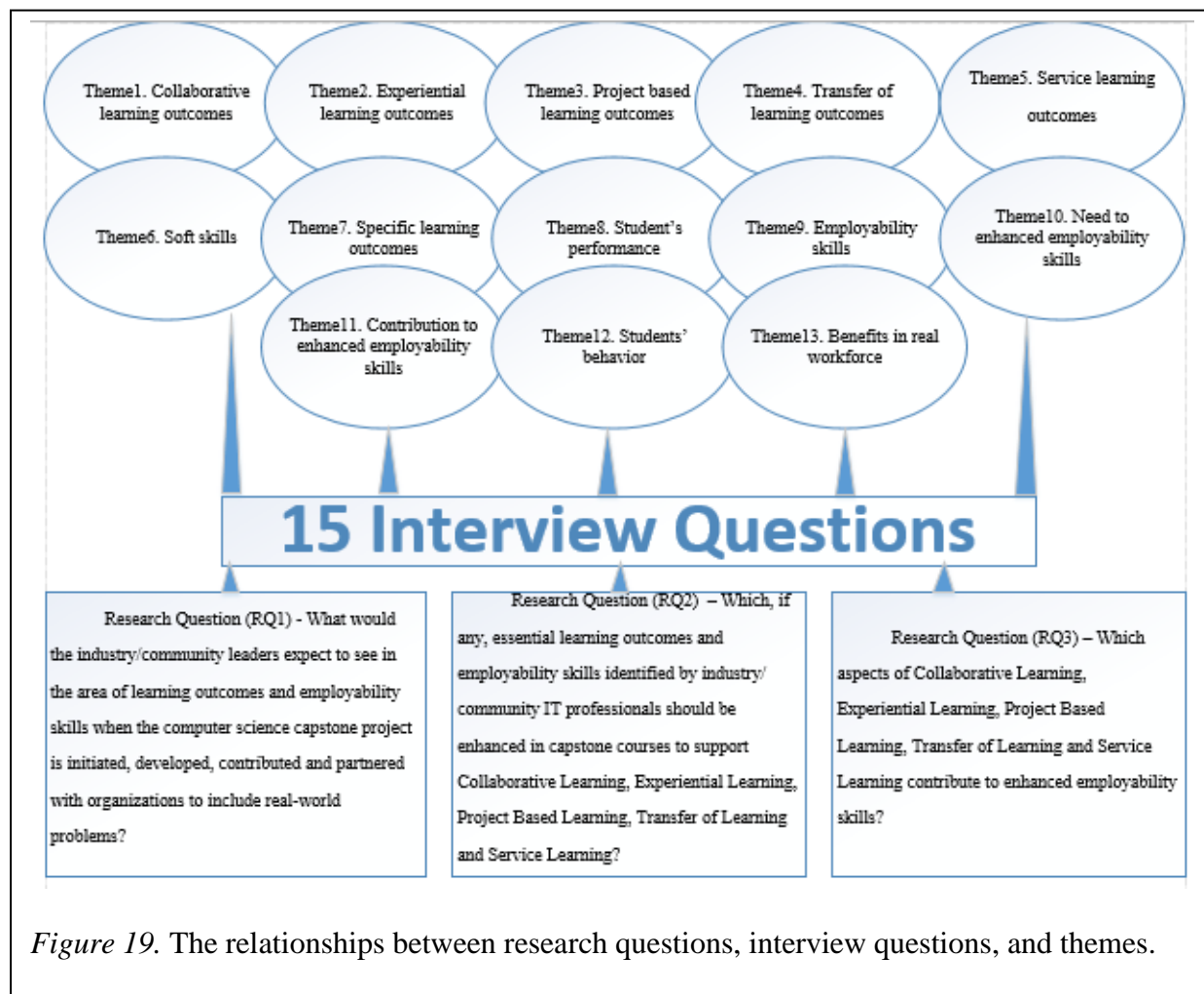


Table 2 provides the major themes and the associated interview questions.

Table 2. *Theme overviews and the associated interview questions*

Themes	Associated interview questions
Collaborative learning outcomes	What kind of learning outcomes in the area of Collaborative Learning would you expect to see?
Experiential learning outcomes	What kind of learning outcomes in the area of Experiential Learning would you expect to see?
Project based learning outcomes	What kind of learning outcomes in the area of Project-based Learning would you expect to see?
Transfer of learning outcomes	What kind of learning outcomes in the area of Transfer of Learning would you expect to see?
Service learning outcomes	What kind of learning outcomes in the area of Service Learning would you expect to see?
Soft skills	Besides Collaborative Learning, Experiential Learning, Project-based Learning, Transfer of Learning, and Service Learning, are there any other soft skills (such as interpersonal skills, information skills, analytical skills and behavioral skills) that are expected to achieve? Any additional comments on the learning outcomes besides all the categories mentioned above?
Specific learning outcomes	Have you or have you not witnessed any specific learning outcomes that students have acquired that indicate this was the result of real-world problem-based capstone project? Please describe that instance.
Students' performance	Are students better, the same, or worse in the area of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning as a result of the real-world problem based senior capstone project? Describe specific examples that you have witnessed to support your reasoning.
Employability skills	What would you expect to see in the area of employability skills as a result of a real-world problem based senior capstone project? Will the whole experience eventually assists students on career choice?

Themes	Associated interview questions
Need to enhance employability skills	Are there any essential employability skills that should be enhanced in order to better support the learning outcomes?
Contribution to enhanced employability skills	Which aspects of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning contribute to enhanced employability skills? How has the senior capstone project influenced students' ability to take ownership of their learning?
Students' behavior	Which aspects of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning contribute to enhanced employability skills? How has the senior capstone project influenced students' ability to take ownership of their learning?
Themes	How, if at all, did completion of the real-world problem based senior capstone project influence the way students process information and their creative or imaginative behavior because of the senior project? Did students become more or less responsible for their learning after the whole industry/community project partnered capstone experience?
Benefits in real workforce	Do you feel that the lessons learned from the senior capstone project will eventually benefit students when they enter the real workforce? Why or why not? What observations have you made to justify your answer?

Table 3 provides the associated interview questions in alignment with research questions.

Table 3. *Theme associated interview questions in alignment with research questions*

Theme associated interview questions	Alignment with research questions
What kind of learning outcomes in the area of Collaborative Learning would you expect to see?	RQ2 & RQ3
What kind of learning outcomes in the area of Experiential Learning would you expect to see?	RQ2 & RQ3
What kind of learning outcomes in the area of Project Based Learning would you expect to see?	RQ2 & RQ3

Theme associated interview questions	Alignment with research questions
What kind of learning outcomes in the area Transfer of Learning would you expect to see?	RQ2 & RQ3
What kind of learning outcomes in the area of Service Learning would you expect to see?	RQ2 & RQ3
Besides Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning, are there any other soft skills (such as interpersonal skills, information skills, analytical skills and behavioral skills) that are expected to achieve? Any additional comments on the learning outcomes besides all the categories mentioned above?	RQ1
Have you or have you not witnessed any specific learning outcomes that students have acquired that indicate this was the result of real world problem-based capstone project? Please describe that instance.	RQ1
Are students better, the same, or worse in the area of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning as a result of the real-world problem based senior capstone project? Describe specific examples that you have witnessed that support your reasoning.	RQ1
What would you expect to see in the area of employability skills as a result of a real-world problem based senior capstone project? Will the whole experience eventually assist students on career choices?	RQ1
Are there any essential employability skills that should be enhanced in order to better support the learning outcomes?	RQ3
Which aspects of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning contribute to enhanced employability skills? How has the senior capstone project influenced students' ability to take ownership of their learning?	RQ3
How, if at all, did completion of the real-world problem based senior capstone project influence the way students process information and their creative or imaginative behavior because of the senior project? Did students become more or less responsible for their learning after the whole industry/community project partnered capstone experience.	RQ3

Theme associated interview questions	Alignment with research questions
Do you feel that the lessons learned from the senior capstone project will eventually benefit students when they enter the real workforce? Why or why not? What observations have you made to justify your answer?	RQ3

The preliminary coding report generated 13 major themes. The themes and their associated research questions are presented in Table 4.

Table 4. *Thirteen theme subjects and research question alignments*

Primary Theme No	Theme subjects	Research Question Alignments
Theme 1	Collaborative learning outcomes	RQ2&RQ3
Theme 2	Experiential learning outcomes	RQ2&RQ3
Theme 3	Project-based learning outcomes	RQ2&RQ3
Theme 4	Transfer of learning outcomes	RQ2&RQ3
Theme 5	Service learning outcomes	RQ2&RQ3
Theme 6	Soft skills	RQ1
Theme 7	Specific learning outcomes	RQ1
Theme 8	Students' performance	RQ1
Theme 9	Employability skills	RQ1
Theme 10	Need-to-enhanced employability skills	RQ3
Theme 11	Contribution to enhanced employability skills	RQ3
Theme 12	Students' behavior	RQ3
Theme 13	Benefits in real workforce	RQ3

The following section organized the findings based on each individual theme. The identified 13 major themes, associated interview questions and research question alignments are presented first. Next the organized responses of the participants are listed under each theme, and finally, the keywords under each theme are extracted and summarized from the re-organized short supporting descriptions from the participants' responses.

Presentation and Discussion of Findings

Fifteen interview questions were asked of the 13 participants. As a result of the interviews, all 13 interview transcripts were analyzed using a five-step approach and a total of 13 major themes were identified. Following is a presentation of the data analysis results from the responses and emerged themes.

Theme 1:

Collaborative Learning Outcomes

Associated interview question:

Q2 - What kind of learning outcomes in the area of Collaborative Learning would you expect to see?

Alignment with the research question:

RQ2 - Which, if any, essential learning outcomes and employability skills identified by industry/community IT professionals should be enhanced in capstone courses to support Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning?

RQ3 - Which aspects of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning contribute to enhanced employability skills?

Table 5 contains all participants' responses of theme1.

Table 5. *Theme 1 responses*

Participant No.	Responses
Participant 1	For me, I expect to see people making goals, start thinking are these achievable goals, putting deadlines to those goals, and working to make those deadlines. The delegation, the effort put into it all matters. There is people management involved as well. We assign task based on students' career path and students are working with people with skill sets based on their job not something they are trying to learn. For students to get plugged into that, when task are assigned to students, they have to be able to do them and collaborate with the team. Some of that was to manage the people. That's my job. If somebody is not holding their responsibilities, there apparently is a team collaboration issue.
Participant 2	Collaboration can only be achieved in a team environment. I've seen most of the growth and development of the students working at team projects rather than individual work and build skill and then learning how to interact in a business environment. Most students don't have that kind of background, so, it's a really good experience for them to actually interact with outside business and see how they develop a product and drive a budget. When student collaborate within a team environment, part of the process is to mix and match different skill sets based on their strengths and weaknesses so that they can be successful as a group rather than a disjointed approach where each person kind of does their own thing. So it's learning how to maximize the minimum.
Participant 3	Every part is critical and if someone is having a hard time working in a team, someone would need to fill in the blank. I think everyone needs to be involved, not only the students but also the sponsors. How students interact with us and how students communicate with us is important since students never worked in a real work environment.
Participant 4	For the technology industry particularly, collaborative working is the key. Collaborative working kind of drives the whole process with coming up an idea and been able to trouble shoot.

Participant No.	Responses
Participant 5	We found each student being able to bring their strengths and their knowledge together and participate as a group in a team environment and helping elevate the experience and share the outcomes. Being able to bring all kinds of experiences and being able to work together as a team helps everybody build their skills and meet the needs of the project together.
Participant 6	Sure. I think the collaborative learning outcome was highly valuable and great in this fly with Butch O'Hare mobile device game. It was collaborative learning because from my understanding the students broke up by 11 students and 11 students divided themselves into smaller groups which I think was helpful. It might have been a little disorganized if everybody was doing it their own way, you know too many cooks in the kitchen might result in a little chaos, a little disorganization, and maybe not a clear path of what their end goal would be. So I think the students utilizing collaborative learning, and it allowed for a clear approach so our goals are met. The students working in these smaller groups and therefore had a better output based on this collaborative learning style.
Participant 7	I would expect the students to communicate effectively and work in harmony with one another to achieve the ultimate goal or result which would have, in our case, would have been the completion of the IBHE web refresh. And I think as a result of that collaborative learning there ends up being what I would like to call an equalizing effect. So in other words there may be individuals with a stronger skill set in certain areas than others. And by collaborating together on those who had the stronger skills could build up or enhance those with the weaker skills. So that again not all can accomplish the goal.
Participant 8	OK. I thought they were all really friendly and eager to assist us with our web design project. I thought that they engaged well and they sought out solutions to the problems that we expressed that we were having. They offered us good alternatives. You know sometimes they offered solutions that we didn't even know we needed. And they presented their ideas well professionally, especially when they were here in Springfield doing their formal presentations. And occasionally I thought we had issues with deadlines. I mean and I understand that that sort of thing happens because you know you run into glitches and things happen. And so we got the stuff that we needed shortly before we had our meeting and we weren't able to test it fully. But I think we did what we could with the limitations that we had time and budget and especially since we weren't able to compensate the students or especially pay for any of the technology. You know, they were kind of limited in what they could do. You know they also didn't have access to our mainframe. That was another limitation though they were

Participant No.	Responses
Participant 9	<p>limited to tools that they could use freely, or tools that they could utilize to differ. And I think they did kind of an excellent job of being able to put together things without a lot of resources. I would expect that they would learn how to be good team players to work together to achieve the goals on their particular piece of the product and how to split the work between all the members of the team so that they could best utilize their team's strengths in order to get the job done. And I imagine they also learn quite a bit about time management and how to deal with the unexpected setbacks that may have happened because I know in some of the meetings they talked about how they had been up late fixing things and doing things so that they could have it done in time for our meeting, and I certainly remember that and appreciated that. And I'm sure that's going to come up again when they're in the real world. However, when you have group work you have different people with different motivations and different skill levels and sometimes some people do more of the work and sometimes people do less of the work. But ideally everybody's doing something and everybody learns something.</p> <p>We had several teams working for us. The first team is very hands on. When they are in my office, I don't exactly remember their names but there was like three of them there and they were working together very close. It is very cool to see them working collaboratively in a team. They were helping each other by showing the system when one didn't know exactly what it was. This is an experience for them what a real world is. I also see that team effort when they were presenting the final project to us, and you can just see they were collaborating with each other and worked on different aspects of the project. They invested in their own learning based on their past knowledge. Our project certainly challenges the students and I think they learned team-working skills for resolving issues. I thought it was a great experience for them, and they are having the real fun. I can see the great teamwork that they are learning after each other.</p>

Participant No.	Responses
Participant 10	We had three teams working for us and each team behaved different. The first team is very active in team communication and always get back to us. They seem to work very well in the team environment. The limitations were that scheduling was highly challenging. These students are serious about finishing their credentials and their projects so they can work in the field. The first team has a great student leader and made all the communication and collaboration smooth. So after that it's very easy to see the amount of collaboration actually depending on the personality and the motivations.
Participant 11	I would expect them to work on an identified project, implement research based on the information phase. Research the information, gathering the relevant information, talk to the right people about the project to make sure they understand that together. Put together what the deliverables are and put a timeline for it. The work needs to be divided and assigned to who's going to do what specific task.
Participant 12	We expect some form of communication, some form of collaboration, some form of follow through and follow up on what's happening and when it will happen. Some information sharing and do what you said you will do.
Participant 13	I would expect being here, looking to work collaboratively. I would expect the team to be organized. I would think self-organize is more likely to be wanted to expand. And certainly the way that team operated. I would expect to see leadership skills. There must be a point of contact for the project and then the others to work together with that person. This person would be leading and driving and making that happen. I would want the team to be early in making sure there was an understanding of what team needs to accomplish. I expect the team's commitments and what was essentially an idea of what is their plan to accomplish that. Once student committed on something that they were attempting to do or committed to do what's not possible, I would expect them to raise that flag early on, as early as possible. I also expect the collaboration between the students with the teacher to document the issue.

Participants' responses have been reorganized into short supporting descriptions. The keywords are factored out. The supporting descriptions and associated keywords are shown in Table 6.

Table 6. *Participant No, supporting description, and keywords of theme 1*

Participant No	Supporting descriptions	Keywords
Participant 1	Making goals; start thinking if they are achievable goals; putting deadlines to those goals; working to make those deadlines; the delegation and the effort all matters; people management involvement; be able to do the task when tasks are assigned; and collaborate with the team.	Making achievable goals Putting deadlines to the goals Project management Team collaboration
Participant 2	Team environment is expected for collaboration; interact in a business environment to see how they develop a product and drive a budget; mix and match different skill sets in team; know each ones' strengths and weaknesses; and learning how to maximize the minimum.	Team collaboration Interaction in the business environment Mix skill sets Know member strength Know member weakness Learn maximize the minimum
Participant 3	Everyone needs to be involved; the ability to fill in the bank in the team; and the ability to communicate.	Team member involvement Fill in blank in team Communication ability
Participant 4	Drive the whole process; come up with ideas; and been able to trouble shoot.	Drive the process Come up with ideas Trouble shooting ability
Participant 5	Bring strengths and knowledge together; participate as a group in a team environment; and help elevate the experience and share the outcomes.	Bring strength together Bring knowledge together Teamwork Elevate experience Share the outcome

Participant No	Supporting descriptions	Keywords
Participant 6	Smaller groups were helpful; and a clear approach to meet the goals.	Small group environment Meet the goal
Participant 7	Communicate effectively; work in harmony with one another; achieve the ultimate goal; and utilize equalizing effect so individuals with a stronger skill set could build up or enhance those with the weaker skills.	Effective communication Work in harmony Achieve the goal Balance the skills
Participant 8	Learn how to be good team players; work together to achieve the goals; split the work between all the members of the team; utilize their team's strengths; have good time management; learn how to deal with the unexpected setbacks; and everyone doing something and everyone learns something.	Team playing skill Achieve the goal Split the workload Utilize the strength Time management Deal with the unexpected Share workload
Participant 9	Work collaboratively in a team; helping each other; work on different aspects of the project; and invest in their own learning based on their past knowledge.	Team collaboration Help each other Work on dynamic aspect Invest on learning
Participant 10	Active in team communication; always get back to clients; work very well in the team environment; have a great student leader who made all the communication and collaboration smooth; and the amount of collaboration actually depending on the personality and the motivations.	Active team communication Follow up with the client Team leadership Positive personality Motivation
Participant 11	Work on an identified project; implement research based on the information; research the information; gather the relevant information; talk to the right people about the project to make sure they understand; put together the deliverables; put together a timeline; and the work needs to be divided and assigned to who's going to do what specific task.	Work on the identified project Implement research result Gather information Put together deliverables Have a timeline Divide workload fairly Assign specific task

Participant No	Supporting descriptions	Keywords
Participant 12	Some form of communication; some form of collaboration; some form of follow through and follow up on; some information sharing; and doing what you said you will do.	Communication Collaboration Follow through Follow up Information sharing Do as promised
Participant 13	Being here; work collaboratively; be an organized team, expand self-organization; leadership skills; project leader must be a point of contact; project leader would be leading, driving, and making that happen; make goals for accomplishment; have commitments; raise the flag as early as possible when problem arise; and good collaboration between the students and the teacher to document the issue.	Being here Work collaboratively Be organized Leadership skill Goal for accomplishment Have commitments Raise flag early for issue Collaboration between the students and the teacher Document the issues

Aggregated data from this interview question generated one theme and 57 unique keywords. This theme was generated based on the various learning outcomes the participants pointed in the area of collaborative learning. The summarized keywords associated with theme 1 are listed and also clustered in Figure 20:

Theme 1: Collaborative learning outcomes

- Making achievable goals
- Putting deadlines to the goals
- Project management
- Team collaboration
- Business environment interaction
- Mix skill sets
- Know member strength

- Know member weakness
- Maximize the minimum
- Team member involvement
- Fill in blank in the team
- Drive the process
- Come up with the ideas
- Trouble shooting ability
- Bring strengths together
- Bring knowledge together
- Elevate experience
- Share the outcome
- Small group environment
- Meet the goal
- Effective communication
- Work in harmony
- Balance skills
- Team playing skills
- Achieve the goal
- Split workload
- Utilize strength
- Time management
- Deal with the unexpected
- Share the workload
- Help each other

- Work on dynamic aspect
- Invest in learning
- Active team communication
- Follow up with the client
- Team leadership
- Positive personality
- Motivation
- Work on the identified project
- Implement the research result
- Gather information
- Put together deliverables
- Put together the timeline
- Divide workload fairly
- Assign specific task
- Follow through
- Follow up
- Information sharing
- Do as promised
- Being here
- Work collaboratively
- Be organized
- Goal for accomplishment
- Have commitments
- Raise flag early for issues

RQ3 - Which aspects of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning contribute to enhanced employability skills?

Table 7 contains the participants' responses of theme 2.

Table 7. *Theme 2 responses*

Participant No.	Responses
Participant 1	I really want students to have note-taking skills for experiential learning. When you experience something, you have to work based on that and note taking skills is going to be very important. Putting the notes together help students follow through with that task. Being a manager, I can't tell you how many times we are talking about objectives and I see people sitting there knotting their head. I say you better take out a pen, tablet, your cell phone, or something to take notes. I even wish people to take out their iPhone and press record and then go back listen to it.
Participant 2	Again, they are acquiring knowledge. What the students are taking away with is a skill that they ordinarily won't get in a classroom especially in the area of communication, personality, interest conflict, all sorts of different social interaction that are not a part of everyday coursework. From an experiential standpoint really the real world problem based senior capstone project is the only way that you can learn these things.
Participant 3	When students are getting feedback from us, they interact with us and do their own research and then get back to us with their proposal. When they do their research, they might find out what they learned at school can't cover the subject area we want them to solve. Students will have to learn new technology on their own and test this knowledge during development. For this learning outcome, I would expect students to provide timely feedback, communicate effectively with sponsor and be able to learn new things.
Participant 4	I think the majority, if not all, of all the students that came to my environment, never touched the hardware. They only had done simulation and online exercises through virtual environment. They never touched or implemented the real-world stuff. When I bring the kids over to see the million-dollar Cisco server and router, many of them are even afraid to touch it. To be honest with you, a lot of the knowledge, the kids already have. I think experiential learning is getting over the fear and be ready to jump into the pool. I think the students get the most of the experiential learning when they learn about the scenario and be comfortable dealing with it.

Participant No.	Responses
Participant 5	When I observe the students being interviewed for our documentary I really saw and heard their responses of what they say they experienced in this project. And my first impression was they took a lot of pride in their work. They were quick to point out the focus that they had in moving this game forward implementation. And they expressed how they learned together and felt stronger in their personal skills because of learning together as a group. So, from the kids themselves I saw them comment and take pride in that development of their skills.
Participant 6	Well we expected and we did end up seeing this was the case that the students came into our meet and greet day where they were able to utilize feedback from actual passengers and engagements of people utilizing the web based games. So, I think that was very important for them, and I expected them to actually take that feedback along with our feedback during the process, and which they did and they truly visualized it from a visual standpoint through either our web conferences or at the actual physical meet and greet. They were able to physically see people's interest of what excited them, what may be the negatives of the gaming, and what improvements they needed. And I think they really looked at these suggestions and used them as suggestions and recommendations to improve on their work. So, I think they used it. It's experiential learning as in a positive way. And I think it is important for the students to use experimental work learning when testing and developing their own skills that along with their own work.
Participant 7	I would expect to see the students grow from their experience by applying what they learn from the classroom and the IBHE project too. Not only are future projects that they would work on in their respective industries but also with family and friends. And the reason why I say that is you know this capstone project along with the collaborative learning, hopefully would give them the ability to communicate more effectively and utilize the team building skills to build better relationships.

Participant No.	Responses
Participant 8	Well I think based on the length of time that the students worked with us I don't know if they got the full effect of experiential learning because they turned the product over to us, but we weren't able to communicate with them about any issues we discovered or improvements we may have recommended or been able to praise them for the innovations that they created that we discovered that we thought were really cool. I think I mean this is a limitation with the educational process. I mean if it were a bit more long range where we were able to use the system that they designed and provide them with feedback they might have had a better ability to kind of reflect and draw conclusions and test their knowledge about the subsequent performance of the product that they produced. But with the given limitations, I'm certain that they learned a lot and as the limitations of the real-world project that they got something out of it. They may not have gotten everything out of it, but it was the best we can do.
Participant 9	I think experiential learning means really learn from the real-world hands on project and transfer what they learned from the textbook into the real world. I think students experienced a lot of hands on from our project and they offered many useful solutions.
Participant 10	They want it. They should be able to do it. It was all right there ready for them to run with it. We expect them to apply the knowledge in this new real-world project setting to even develop new skills to get the job done. This whole experience will shine on their resume. They can discuss this experience during an interview.
Participant 11	I would expect that once they work on the project, they will specify what they are going to do with their professors and how to do it. In coming back and doing it, when they run into problems, going back to their professors to get solutions. Put those solutions to problems and make it work. They would gain experience in that process.
Participant 12	I think with students doing experiential learning, they are going out to the community practicing a learning that is outside the classroom. We want the students to be involved, we want to students to do the work and study the history of the organization and study the committee member and knowing who you will be working with, what you are doing, and why are you doing what you are doing.
Participant 13	They went into a real-world situation and get to practice what they learned from school. I think they're very much able to see where there was significant deviation, and from that, practice the right way to do things.

Participants' responses were reorganized into short supporting descriptions. The keywords are extracted out. The supporting descriptions and associated keywords are shown in Table 8.

Table 8. *Participant No, supporting descriptions, and associated keywords of theme 2*

Participant No	Supporting descriptions	Keywords
Participant 1	Note-taking skills; and be able to follow through the task.	Note-taking Follow through
Participant 2	Acquiring knowledge; and taking away skills especially in the areas of communication, personality, interest conflict, and all sorts of different social interaction.	Knowledge acquisition Social interaction
Participant 3	Provide timely feedbacks; follow up with proposal; communicate effectively; the ability to learn new technology; and the ability to test knowledge during development.	Timely feedback Follow up Communicate effectively Knowledge acquisition
Participant 4	Getting over fear; be ready to jump into the pool; learn about the scenario; and be comfortable dealing with it.	Fearless Scenario handling ability
Participant 5	Took pride in the work; and learned together and feel stronger in personal skills.	Proud of the work

Participant No	Supporting descriptions	Keywords
Participant 6	Take user's feedbacks; take client's feedbacks; look at these feedbacks and use them as suggestions and recommendations to improve the work; and learning when testing and developing their own skills.	Gain feedback from different entities Effective use of the feedback Make recommendations Develop the skills
Participant 7	Grow from their experience by applying what they learn from the classroom, the ability to communicate more effectively; and utilize the team building skills to build better relationships.	Grow experience Apply knowledge Utilize team skill Build better relationships
Participant 8	Able to communicate with client about any issues after the project is turned over to client; have ability to reflect and draw conclusions and test their knowledge about the subsequent performance of the product; learn about the limitations of the real-world project; and get something out of the project.	Effective follow up communication Reflect knowledge Draw conclusions Test knowledge Learn about limitations
Participant 9	Learn from the real-world hands on project; transfer what they learned from the textbook into the real world; experience a lot of hands on; and offer useful solutions.	Offer useful solutions
Participant 10	Apply the knowledge in the new setting; develop new skills; and can discuss this experience during interview.	Develop new skills

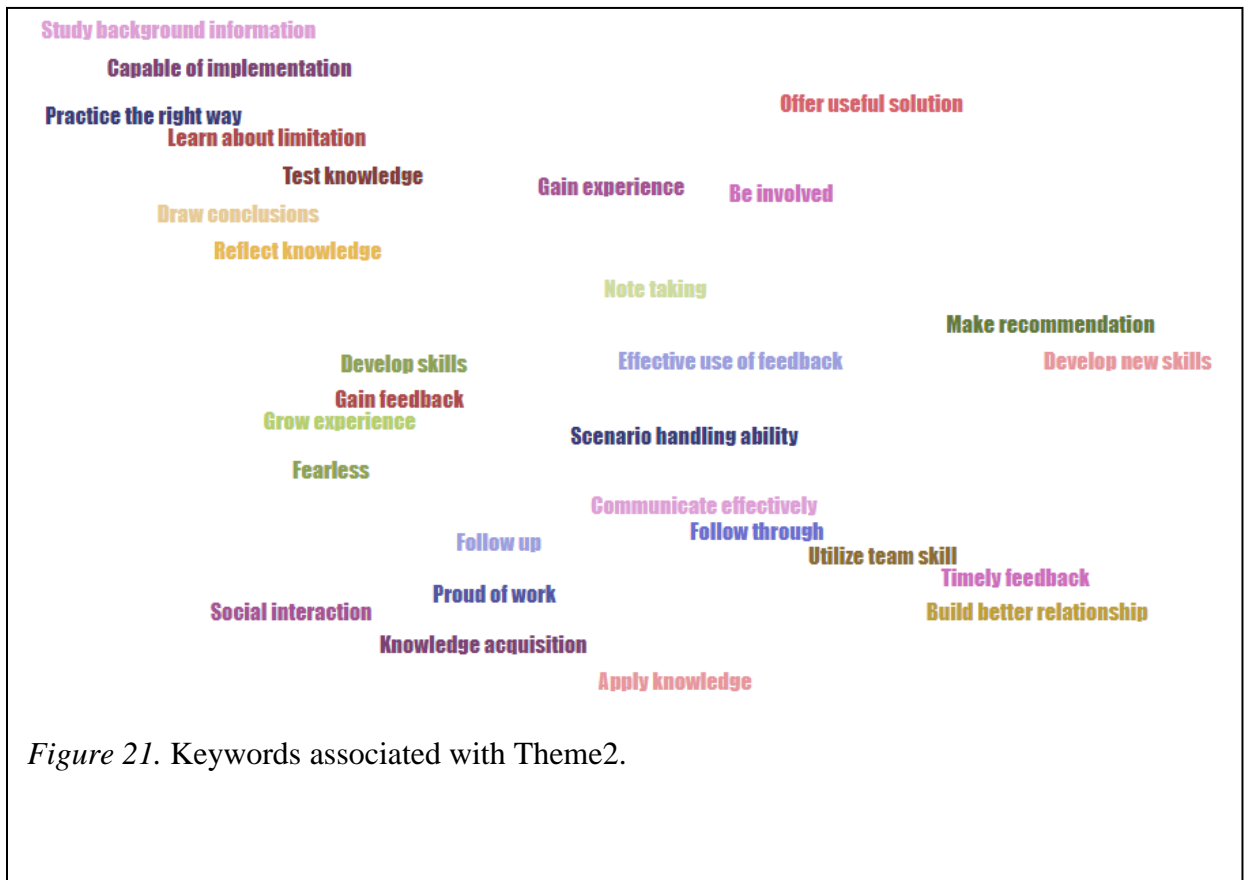
Participant No	Supporting descriptions	Keywords
Participant 11	Specify what they are going to do with their professors; know how to do it; go back to their professors when they run into problems to get solutions, put those solutions to problems; and make it work so they would gain experience in that process.	Capable of implementation Gain experience
Participant 12	Going out to the community practicing learning; be involved; do the work; study the history of the organization; study the committee member; knowing who you will be working with; what you are doing; and why are you doing what you are doing.	Be involved Study the background information
Participant 13	Practice school knowledge; see the deviation between school knowledge and real-world knowledge; and from that practice the right way to do things.	Practice the right way

Aggregated data from this interview question generated one theme and 29 unique keywords. This theme was generated based on the various learning outcomes the participants pointed in the area of experiential learning. The summarized keywords associated with theme 2 are in Figure 21:

Theme 2: Experiential learning outcomes

- Note-taking
- Follow through
- Knowledge acquisition
- Social interaction
- Timely feedback
- Follow up
- Communicate effectively
- Fearless

- Scenario handling ability
- Proud of the work
- Gain feedback
- Effective use of the feedback
- Make the recommendation
- Develop skills
- Grow experience
- Apply knowledge
- Utilize team skill
- Build better relationships
- Reflect knowledge
- Draw conclusions
- Test knowledge
- Learn about limitations
- Offer useful solutions
- Develop new skills
- Capable of implementation
- Gain experience
- Be involved
- Practice the right way
- Study the background information.



Theme 3:

Project-based learning outcomes

Associated interview question:

What kind of learning outcomes in the area of project-based learning would you expect to see?

Alignment with research question:

Research Question (RQ2) – Which, if any, essential learning outcomes and employability skills identified by industry/community IT professionals should be enhanced in capstone courses to support Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning?

Research Question (RQ3) – Which aspects of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning contribute to enhanced employability skills?

Table 9 contains the participants' responses of theme 3.

Table 9. *Theme 3 responses*

Participant No.	Responses
Participant 1	<p>I'm a big fan of project-based learning, I do think it brings milestones, shows you the critical path. There is also the technology. You know when you talk about project-based things, there are lot of different technology out there to help to keep your project on task. For example, Microsoft Project, the Visual Studio implementation, the GitHub, things like that. The other side is you are learning different methodology, and how they would assist you with your project development life cycle. From that, especially from educational background setting, you are now moving to say, "what preferences do you like to work on". Some of the project development life cycles are cross overlap. There's still the goals; there's still the deadlines. Identifying those markers, those critical path, those objectives that students need to hit for the overall goals, defining what the project is, learning about the scope, and all the challenges. There are so many things that can be defined as project components even though they are not always defined that way. You start looking at those things and it will help you to diagnose a lot of issues you probably face.</p>

Participant No.	Responses
Participant 2	<p>From project start to end, students need to understand the whole process. I think the learning outcome is that students need to learn how to go through a project. I have a plan, but then there may be a need to modify the plan. When they're moving through the project, they may bump into something that they thought was possible that turned out was not possible, and they have to find an alternative way to do it. There might be something that is cost prohibitive maybe a number of things, which change the aspect of the project. And having that fluidity and ability to redefine the project to meet the eventual end goal is the greatest thing that they get out of the project.</p>
Participant 3	<p>Our project is real world problem, and it certainly challenges the students. We present our goals to students, and students are able to narrow it down to something that is doable during their 16-week course period. This means they can correctly collect clients' requirements and come up with a reasonable proposal. Our project didn't have a chance to move the testing and maintenance stage but students get experience with the first half of the project development life cycle. I think I want to see the ability to effectively collect sponsors' requirement, do proper analysis, come up with a reasonable proposal, and well communicate with sponsors during each step of the development.</p>

Participant No.	Responses
Participant 4	A lot of the senior projects I partnered with are hard to fit into the whole project development life cycle. So, you know we had a group that came over and did analysis, we had a group that did pre-configuration, we had a group who did installation, we had a group that did maintenance, and I don't think I actually had a group that did the full cycle. But with that said, you still go through your individual check off list, and planning, and implementation stages. So, I think a lot of students are taking on information that one group of students left out and then also learning how to transfer it. Even in real world scenarios, there will be left over jobs that need to be picked up and executed the right way. From the technology perspective, the best part of project-based learning is that of how to deal with the constantly changing environment. It is rare that you get to experience the whole development cycle, most likely, you just walk into one stage of the development and learn to be part of it. Our project is just so large and can never be implemented during one senior project course period.
Participant 5	In this case, I think the real-world hurdles and changes that happened during the process of building the game, meeting our clients demands in an ever-changing environment was a good way for the students to see how this really works in the real-world. They learned the need to consider all audiences not just their personal needs to complete the class. The schools need to make sure that they are providing the complete learning process, not just the client's needs. We're providing a game that will expose and build awareness for our concessions, which was our major concern. But then students also need to consider meeting the needs of the passengers and the users of the game, so they had to really look through the eyes of each audience participant who was going to be using this product.

Participant No.	Responses
Participant 6	So, I think the students were motivated to begin with because it was not only selection based but also they knew from the beginning that this was a great project that they were incorporating into their senior capstone. So, I think immediately they felt the motivation because they kind of felt special in a way. They all positively started their project implementation by quickly adapting to what was on hand, what was provided to them, and then they soon became comfortable enough to approach the clients which would be the marketing side of the concession for the Chicago Department of Aviation. So, I think that during the project development lifecycle they grew, and then they also grew in their work, which showed based on, as previously stated, their feedback that they received from the passengers. So, I think they were motivated to learn not only internally but it was also external entities that came out and helped motivate them to fully put in their best work.
Participant 7	OK, well again I think what I've answered for the first three can somewhat be summarized into this as well, based upon the collaborative efforts. I would expect to see growth not only from a theory standpoint but practical growth as well. Because if individuals are highly motivated, I would assume they are, because they're working in their field which is their respective fields of choice. The learning process that they would go through technique, and the techniques learning could help them to not only accomplish the task at hand which again was the IBHE refresh and would give them invaluable tools to use in the future. So I would see, I would expect to see a progressive growth from the beginning of the project to completion.

Participant No.	Responses
Participant 8	OK, given that we had three different groups of students working with us on the redesign project, I don't know that any one group was able to see the whole project developmental lifecycle. But within the segments that they were working on, if we define that as the life cycle, then I'm sure they learn how to troubleshoot the problems that arose unexpectedly from what they were doing and they communicated with, as well as, clients. I mean we always got an answer back from them and we certainly appreciated it that they were able to explain the problems that they encountered and offer solutions and work around with what we were seeking. You know, for us whose the client, the whole thing was kind of the life cycle, but for them, they each had their individual part which you could all know which you could define as the life cycle. So hands-on, I suppose, is the perspective that you wanted to take with that question.
Participant 9	Again, we are not at a final stage yet. I'm assuming from the start to finish base, they were able to build the system from the ground up. Project learning to me is that you have to be really focus on what you are doing. That would be a good learning experience for them if they really focus and concentrate on the project objectives.
Participant 10	So, yeah, I think we have the expectations for a very good outcome for them, and their project-based learning should be a classic project. I would expect them to take all requirements that we put up and then try to achieve the goals. I would expect students to be accountable for their assigned tasks. They should have a deeper understanding of what they are learning through this real-world project. I would expect to see them use this experience as another shining star on their resumes. They should be able to have a very solid experience as long as the end result met our expectations.

Participant No.	Responses
Participant 11	From a standpoint of being delivered the end product, we are involved from the start. And as you said, the start of it would need students to meet with us to make sure we both agreed with the project. We would then expect them to work with their professors on how to do it. It is not their professor's job to do it; it is the student's job to do it. Because what they are trying to learn is how to do a real-life project when they are employed. That's what the experience-based learning is all about, and it should be quite helpful to them. They have to keep us informed of the status of the project. Then I know where they are, and what they're working on, and what they're doing. So, they leave college and are working for a company, those same expectations would be made once you are out of school. I think that was pretty much my answer.
Participant 12	We want students to be good learners, be motivated, be able to accept what they are going to do and how they are going to do it with their leadership and then present it to the organization. We would like students to submit a project proposal, then follow through with the organization and make things happen. Sometimes with the collaboration through the senior project, students might just want to be done with an "A", and we are left with a beautiful project without implementation due to lack of follow ups.
Participant 13	Our project is too large to do in the timeframe of the senior capstone course. However, the project has been divided into different stages so it can be done in the given timeframe. So I think it is very good to get students into project-based learning. I expect students to think about the project scope. If the project is too big and not doable within the limited timeframe, I want students to go back to their sponsor and propose a reasonable project scope.

Participants' responses are reorganized into short supporting descriptions. The keywords are extracted out. The supporting description and associated keywords are shown in Table 10.

Table 10. *Participant No, supporting description, and associated keywords of theme 3*

Participant No	Supporting descriptions	Keywords
Participant 1	Brings milestones; shows the critical path; use technology to help to keep project on task; learn different methodology to assist with project development life cycle; met the goals; met the deadlines; identifying markers, critical path and objectives to hit for the overall goals; defining what the project is; learning about the scope and all the challenges; and looking at other not defined project components to diagnose issues.	<p>Bring the milestones</p> <p>Show critical path</p> <p>Learn different methodologies</p> <p>Met the goal</p> <p>Identify critical path</p> <p>Objective to hit the goal</p> <p>Define project</p> <p>Learn about scope</p> <p>Identify not-defined components</p> <p>Diagnose the issue</p>
Participant 2	Understand the whole process; learn how to go through a project; make the plan; modify the plan; find alternative solutions; and have fluidity and the ability to redefine the project and meet the end goal.	<p>Understand the process</p> <p>Going through the project</p> <p>Plan the project</p> <p>Offer alternative solutions</p> <p>Redefine the project to meet the goal</p>
Participant 3	Narrow down the goals to a reasonable level; collect clients' requirement; perform proper analysis; come up with proposal; and communicate well with sponsors.	<p>Narrow down the goal</p> <p>Collect requirements</p> <p>Perform analysis</p> <p>Come up with the proposal</p> <p>Communicate with the client</p>

Participant No	Supporting descriptions	Keywords
Participant 4	Go through individual checklist; planning and implementation; take on left over information; pick up the left over project; and learn to deal with the constantly changing environment.	Go through the checklist Plan implementation Take over project Deal with changing environment
Participant 5	Meeting clients' demands in an ever changing environment; and need to consider all audiences not just personal needs.	Meet with the client demand Consider the audience's needs
Participant 6	Increased motivation about real world project; felt special in a way; start project implementation by adapting to what was on hand; become comfortable to approach directly to client; grew in knowledge during the project development lifecycle; and motivated to learn from both internal entities and external entities.	Increase motivation Adapt to situation Direct approach to the client Grew in knowledge Learn from internal and external entities
Participant 7	Growth not only from a theory standpoint but practical growth as well; use the techniques learning as invaluable tool to use in the future; and a progressive growth from the beginning of the project to completion.	Grow practically Use technique as the tool Make progressive growth
Participant 8	Learn how to troubleshoot the problems that arose unexpectedly; learn to communicate the unexpected problems with clients; be able to explain the problems with clients; and be able to offer solutions and work around.	Troubleshooting Communicate the unexpected Explain the unexpected to the client Offer work around

Participant No	Supporting descriptions	Keywords
Participant 9	Focus on what you are doing and really focus and concentrate on the project objectives.	Focus on the objective
Participant 10	Project should be a classic project; take all requirements; try to achieve the goals; be accountable for their assigned tasks; have a deeper understanding of what they are learning; use this experience as another shining star on their resume; and have very solid experience when the end result met client's expectations.	Be accountable Try to achieve the goal Have deeper understanding Have solid experience Meet the client expectations
Participant 11	Meet with clients to make agreement; work with their professors on how to do it; and have to keep clients informed of the project status.	Make agreement Keep the client informed
Participant 12	Be good learners; be motivated; be able to accept what you are going to do and how you are going to do it with leadership; be able to present it to the organization; submit project proposal; follow through with the organization; and have good follow ups skills to make things happen.	Be acceptable Keep leadership informed Follow through Follow up
Participant 13	Think about the project scope; go back to their sponsor and propose a reasonable project scope.	Planning of the project scope Propose the scope

Aggregated data from this interview question generated one theme and 53 unique keywords. This theme was generated based on the various learning outcomes the participants

pointed in the area of project-based learning. The summarized keywords associated with theme 3 are in Figure 22:

Theme 3: Project-based learning outcomes

- Bring milestones
- Show critical path
- Learn different methodologies
- Met the goal
- Identify critical path
- Objective to hit the goal
- Define project
- Learn about the scope
- Identify not-defined components
- Diagnose the issue
- Understand the process
- Going through the project
- Plan the project
- Offer alternative solutions
- Redefine the project to meet the goal
- Narrow down the goal
- Collect the requirements
- Perform analysis
- Come up with the proposal
- Communicate with the client
- Go through the checklist

- Plan implementation
- Take over the project
- Deal with changing environment
- Meet with client demands
- Consider audience needs
- Increase motivation
- Adapt to situation
- Direct approach to the client
- Grow in knowledge
- Learn from internal entities
- Learn from external entities
- Grow practically
- Use the technique as the tool
- Make progressive growth
- Troubleshooting
- Communicate the unexpected
- Explain the unexpected
- Offer work around
- Focus on objective
- Be accountable
- Try to achieve the goal
- Have deeper understanding
- Have solid experience
- Meet client expectation

- Make agreement
- Keep client informed
- Be acceptable
- Keep leadership informed
- Follow through
- Follow up
- Planning of project scope
- Propose scope.

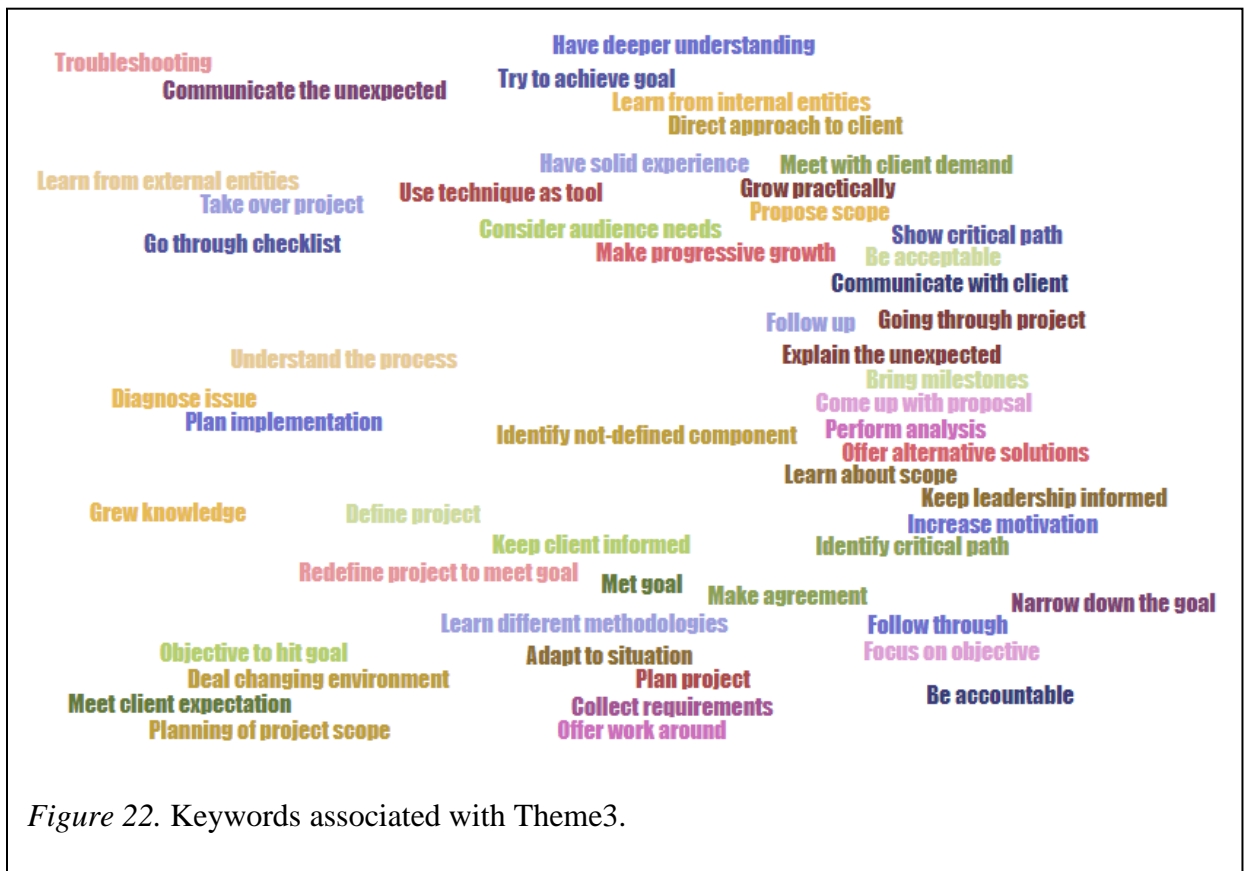


Figure 22. Keywords associated with Theme3.

Theme 4:

Transfer learning outcomes

Associated interview question:

What kind of learning outcomes in the area Transfer of Learning would you expect to see?

Alignment with research question:

RQ2 - Which, if any, essential learning outcomes and employability skills identified by industry/community IT professionals should be enhanced in capstone courses to support Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning?

RQ3 - Which aspects of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning contribute to enhanced employability skills?

Table 11 contains all participants' responses of theme 4.

Table 11. *Theme4 responses*

Participant No.	Responses
Participant 1	The good learning outcome is understanding the topic of study. Did students understand the topic? Did they have a fundamental understanding of what's going on? And I think sometimes we see people do tests well but don't understand well. I imaging it's getting harder and harder to do because there are so many short cuts and ways to do things in the real world now where you don't have to necessarily know how the watch works but can tell the time and sometimes that is a problem. Perfect example, I hired a person as a developer, and he came to the interview with all the skills listed on the resume. During interview conversation, he had all the fundamental knowledge of the skills, but when we plugged him into the real-world situation, he did not understand any of the things he talked about. There are so many fundamental core knowledges that are missing. It's tough to distinguish, did they really understand that. A standard way for industry to do is to check if you have a certification, but in the same sense, there are a lot of certifications that don't really care if you understand what you just passed. They only cared if you answered their questions right.
Participant 2	So obviously they've learned a lot of different programming techniques, and they've learned how to use different applications. Now they're actually applying it to a real-life scenario where they're not just solving a problem and thinking I solved this, but there's actually an actual business entity, which is depending upon the solution to work on an ongoing basis.
Participant 3	For real world application where students are working with real clients, they have to learn from the client and get their feedbacks. The knowledge they received from school can certainly be applicable to the project, but they would be able to apply their knowledge in a broader range if they communicate with sponsors well and take all of their feedbacks into consideration.

Participant No.	Responses
Participant 4	I think it kind of goes back to the experiential learning a little bit. Students have their traditional learning done through taking quizzes, doing labs in the virtual environment, and reading textbooks. That learning sets up all the fundamentals. But when you actually jump into the real industry, you start to practice the actual skills. You learn it by doing it, and it is such a good learning experience to practice all the abstract stuff. When you go to a job, why should I hire you? If you have all the experience in doing real world projects like this, you will be appreciated much more during the hiring process.
Participant 5	I think what was great in this aspect of their experience would probably be realizing that the method that they learn in school which seems to be a smooth path from A to B, from B to C, etc. And then when you practice it in the real world that line or that path becomes a little bit more dynamic and messy, sometimes rushing and then waiting, and then rushing and waiting. and you know it really gives a true experience of understanding the building blocks on how a process works.
Participant 6	I think the outcome of the transfer learning would be that they can attest to what they learned in school and actually apply it to a real-world setting. So I think it's different than a textbook setting, or very different than taking a quiz every week, or taking a test to test their knowledge of what they write or studied in a book. I think that they're able to use this collection of knowledge and actually apply it in a real-world setting, and they were also able to work with clients as well. So, I think that they could see feedback, that maybe, although they necessarily thought was appropriate for the game, the client may not think so. They have to kind of understand and meet the client's needs rather than their personal needs or desires. So, I think the transfer of learning was great and this flies with Butch O'Hare project that allows the students to link their classroom learning in a true business setting.

Participant No.	Responses
Participant 7	Yes. And I also got to add on that I would expect if the students have received a thorough and well-prepared instruction and have comprehended those instructions. Well I would expect to see significant growth from the students. So, for instance they came into this capstone project knowing very little of anything of what IBHE expectations were. But once we were able to sit down and discuss our goals of IBHE and what we wanted to accomplish, then by working together with knowledge transfer between the students that would allow them to again not only grow as individuals but also to accomplish the task at hand. And I wanted to add with one additional note, transfer to practice equals experience. And repetitive experience equals growth. So again, that's what I would expect to see.
Participant 8	I would think they would have used everything they learned in the classroom to work on the project with us, and they probably had to really think about some of the knowledge that they had and kind of shift it in order to get it to apply to our project. Considering our limitations of technology time and budget because I'm sure that you know in the classroom they're kind of presented with sort of idealized that are perfect, and they worked correctly. Then they come into a project like ours which is kind of a big mess that's been maintained by a lot of different people, and they've got to kind of pick that apart and what they've learned now has to be adapted to this project. So, I think they probably did a great job, and probably had to do a lot of thinking outside the box in order to get their knowledge to meet our objectives. So that's the quality in product. Our product probably fit into this category. We take the product to help our community.
Participant 9	Coming from academic environment, you learn this theory, you learn that theory, but in real world environment, you would have to be able to transfer the theory into real application to the actual hands-on. The hands-on should be a better learning experience than the textbook. There are always many paths that lead to the ultimate outcome, and you have to know there is more solutions out there to help you achieve the goal.

Participant No.	Responses
Participant 10	I fully understand that practical hands-on is taken from theory to application. This is an all hands-on project we're talking about. I mean there was theoretical. I thought it was a perfect opportunity for all of that to come together for them, so they can test their classroom knowledge. You know the transfer of learning and real-world experience; I think it's unique that they are in a major that allows them to actually have that experience which is great unlike many other majors where you don't get to do that application. One thing I can't speak at: the individual student as a whole especially the first group that came in. Yes, no doubt about it, I thought they were very capable of applying it. We didn't get to see all the way through though. But you know, I think that it's more individual based.
Participant 11	What you learn in a classroom is theoretical, what you learned on a team environment is reality. Well the reality is you run into problems because you do not anticipate. So, in the classroom setting, everything is nice and works perfectly. In the real world, it doesn't work like that. What happens is you go to implement the problem, you might fail, and you need to find out why you failed. You have to develop a plan to fix the failure. You have to test the fix and make sure it works. In the end, you have to deliver the final product that works and the client, us, know how it works. So, students need to learn to deal with unfavorable scenarios, and it can come from different areas. You have failures because you didn't design it right. You can have failures if your client disapproves some features. You can have failures if the technology does not work, and you thought it would. There are many areas that you don't see and don't experience in a classroom.
Participant 12	I expect transferring theory into practice, transferring that plan, and implementing it. I also think students are able to make that transfer, they might need some guidance, more involvements from the professor. If the project is associated with a school and is leadership driven, then the person who's giving the grade needs to be a part of it. It will be a blessing to have professor's active involvement in the area of transfer of learning.
Participant 13	Our project is real world setting and certainly is different from the academic setting. I think students did well in transferring their classroom experience into the real-world setting.

Participants' responses are reorganized into short supporting descriptions. The keywords are extracted out. The supporting descriptions and associated keywords are shown in Table 12.

Table 12. *Participant No, supporting description, and associated key words of theme 4*

Participant No	Supporting descriptions	Keywords
Participant 1	Understanding the topic of study; and have a fundamental understanding of what's going on.	Understand the topic
Participant 2	Apply programming technique to solve problem in an actual business entity.	Applying programming technique
Participant 3	Learn from client; get client feedback; and apply knowledge in a broader range by communicating with sponsors.	Learn from the client Get feedback Broad communication
Participant 4	Learn it by doing it; and practice abstract theory.	Learn by doing Practice theory
Participant 5	Differentiate the smooth school learning with ever changing business environment; adapt to the dynamic business environment; understand all the building blocks; and understand how a process works.	Differentiate environment Adapt to business environment
Participant 6	Attest school knowledge and actually apply it to a real world setting; able to use this collection of knowledge and actually apply it; able to work with clients as well; have good understanding or how to meet the client's needs rather than personal desires; and link classroom learning in a true business setting.	Attest knowledge Apply knowledge Able to work with the client Meet the client's needs
Participant 7	The ability to comprehend thorough and well-prepared instructions from client; working together with knowledge transfer of the clients; not only grow as individuals but also to accomplish the task at hand; transfer to practice equals experience; and repetitive experience equals growth.	Comprehend instructions Transfer to practice
Participant 8	Use classroom knowledge and shift the knowledge to apply to project; learn to deal with the dynamics of real world project; do a lot of thinking outside the box; and produce quality product.	Shift knowledge Deal with dynamics Think outside of the box Produce the product

Participant No	Supporting descriptions	Keywords
Participant 9	Transfer the theory to the actual hands on; and be aware of the many available paths that leads to the ultimate outcome.	Transfer the theory to hands-on Be aware of alternatives
Participant 10	Practical hands taken from theory to application; test classroom knowledge; have that experience by doing that application; and be capable of applying knowledge.	Test knowledge Capability of applying knowledge
Participant 11	Find out why you failed; develop a plan to fix the failure; test the fix and make sure it works; deliver the final working product; make sure clients know how it works; and need to learn to deal with unfavorable scenarios.	Learn from failure Test fix Deal with unfavorable scenarios
Participant 12	Transferring theory into practice; transferring plan into implementation; seek for guidance when needed; and have active involvement from the professors.	Transfer the theory Transfer the plan Seek for guidance
Participant 13	Able to transfer classroom experience into the real world setting.	Transfer classroom experience

Aggregated data from this interview question generated one theme and 30 unique keywords. This theme was generated based on the various learning outcomes the participants pointed in the area of transfer of learning. The summarized keywords associated with theme 4 are in Figure 23:

Theme 4: Transfer of learning outcomes

- Understand the topic
- Applying programming technique
- Learn from the client

- Get feedback
- Broad communication
- Learn by doing
- Practice theory
- Differentiate environment
- Adapt to business environment
- Attest knowledge
- Apply knowledge
- Able to work with the client
- Meet the client's needs
- Comprehend instructions
- Transfer to practice
- Shift knowledge
- Deal with dynamics
- Think outside of the box
- Produce the product
- Transfer the theory to hands-on
- Be aware of alternatives
- Test knowledge
- Capability of applying knowledge
- Learn from failure
- Test fix
- Deal with unfavorable scenarios
- Transfer the theory

RQ3 - Which aspects of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning contribute to enhanced employability skills?

Table 13 contains all participants' responses.

Table 13. *Theme 5 responses*

Participant No.	Responses
Participant 1	The biggest thing I would think from service learning is you learn about personalities, and you learn that through service you can come across the kindest, most gentle person and find out that they've come from a very diverse background, or you would sit there and say to yourself there's no way this person came from that hard of a life. And when you see these things it really helps you understand that everybody has a story behind them. You know, and just because you have your perceptions of what that is does not mean that is where they come from, and I think when you do things through service whether it be different people in the community whether it be those that you're helping in the community you definitely learn about different personalities and different backgrounds. And I think it helps for people not to prejudge people because sometimes you're just blown away. You're like, wow, you know I mean. I've heard stories of people that I've met who are just so nice, so kind, and you find out they moved out at 14 with their sister who was 12 and raised them. And you're just blown away by some of these stories. And look what people can do, where they can achieve, and you really learn that through you part of service.

Participant No.	Responses
Participant 2	<p>So trying to get in touch with your community, and I think the vast majority of projects that we do are in high demand so there's a lot of availability for students to work hard for not for profit. The not for profits don't have large budgets to afford professionals with high level programming skills or networking skills whatever. The student helped to bring some of the cutting-edge technology to not for profit. This is a win-win situation since students are getting experience while the nonprofit is getting an upgrade or a correction of any technology issues they have. And I think in the end run for the student, it turned out to be a better experience than working in a traditional for profit. Not for profits tend to have so many issues because of their financial restrictions and students are really forced to work within a very narrow confines of possibilities. I think students are motivated when they go to these places and they see people basically do tireless work for low wages but they're doing it because of the satisfaction that they get in serving, helping another human being. I think that does touch the students and makes them interested in other social services they can do.</p>
Participant 3	<p>The students are creating a game to help entertain passengers' experience, and I think this definitely helps address human needs. Students should be proud with their service learning outcome when more and more passengers start using the game they developed. This gives them a higher degree of satisfaction, and they will be interested in doing more community services.</p>
Participant 4	<p>It works for us since we are not for profit organization, and a lot of it has been operated by volunteers. The outcome of the senior project such as the reconfigured network, the tools for communication, the servers, the computers, and the websites, all benefited the larger community as a whole. Students realized the impact of their work and are often deeply engaged with this kind of community services even after they graduate. We have several students that stayed as volunteers on a regular base after they finished their senior project. I think it would help them to commit to long time service after this experience. I think it also provided some kind of experience for their future career choices.</p>

Participant No.	Responses
Participant 5	I think that the game a lot of it was taking the needs of the client, which was to educate game users about the different concessions at the airport. But the service aspect is delivering that knowledge in a way that is fun for the community. So especially with the trivia level of the game where we take this content and put it in a manner that's fun to learn and helps build a connection with the community about history about our hero Butch O'Hare who our airport is named for. You know even some of the questions talk about the Wright Brothers, it talks about, you know, history and important activities throughout history and providing that as a service to the community but in a way that's fun and interactive and learning. And then also benefits again our main goal which was to talk about our concessionaire. So, it was a fun way to help customers or people learn without even knowing that they're learning right now. I would say that the game the students built certainly has contribution to the community.
Participant 6	I think the collaboration with a local education entity along with government entity of the O'Hare International Airport brings those two different divisions together. The students can see how much the government values local entities by actually utilizing the youth of Chicago, which I think was great. I think many of the passengers realized what the students did. It was a student-built game. So, I think that was also important for passenger engagement and public engagement to know that this was specifically coordinated with students. So, I think it's impressive for people to know that and to see the product of these talented students puts a very good name and reputation on the education community of Chicago.
Participant 7	OK. Well I would expect to see stronger communities first of all because the students are engaged with their respective communities to be able to bring a positive influence on those respective communities. And in our case because they were working on the IBHE refresh, all education communities associated with Illinois benefit from the collaborative effort of the students. Also, I wanted to make note that you know often times we may not even think of it along these lines but by their positive example a lot of the students who one could assume come from various backgrounds and ethnicities, social statuses, etc., and by them leading the project, by them being a positive example, going to school getting a good education, learning from this capstone project, they could further influence individuals coming after them. So, I just think all around it is a very positive. and it's a very positive influence for the respective communities in Illinois.

Participant No.	Responses
Participant 8	Well, they were helping everybody who's going to be a student in the state of Illinois. Hopefully you know that we've got this website that is meant to assist anybody who's seeking higher education in Illinois. So that definitely touches a large group of people. And I thought they were doing the project for free, and our agency had no resources considering Illinois had no state budget, and we weren't able to provide them with any technical logical resources that might have assisted them. I think it definitely meets the definition of service learning and I think they gained valuable experience about working within limitations, and perhaps work around that they can use when they don't have a budget. Because they may run into that in the real world that they're going to have clients who, you know, have worthy endeavors but they don't have the budget to pay for all the fancy bells and whistles of software and stuff. So, I think they did us a great service because we could we certainly can't afford to have people; we can't afford to pay anybody to do our website.
Participant 9	Working for a non-profit, you will be appreciated more. We are not like industry, they expect, and we appreciate everything that's given to us. I think this project has helped the community. We need the extra push to get things up and running. Prior to the capstone project, we have no proper website, network and application running. The servers and the laptops were donated to us by another company, and it is never configured correctly to function the way it should be. Due to students' effort, we were then able to get it up running. It is kind of awesome as we do not have any fulltime IT person in our organization. Students now have more involvement in the community, and they are more aware of this youth education issue in the community. They will have deeper understanding of community service involvement and are likely to contribute for future involvement. It is a great project for them and for us obviously.

Participant No.	Responses
Participant 10	<p>We work in a community that is devastated. At our office, we are serving people that are in the major economic challenges. We train them on job skills and life skills, so they become productive citizens. We need to be able to share data to communicate in a 21st century way, to be able to collect data and share data within our staff and within our community. I had a student in the last month that told me at one point in time he and his family were begging for money, and now he's making \$33,000 a year out of our efforts here. We need to be able to report to the state government, the county, and the city that we need to be able to have data we need to track data seamlessly. When our website and network goes down, it's really hard for us to do that. So that's a place where the students doing project-based learning, having this capstone experience can come in and have a really meaningful experience because through their education, through their service, they're serving the community in ways that are very meaningful. Again, they can brag about it as they go to seek employment. So, you know, we deal with basic human needs. I mean we deal with hunger, we deal with homelessness, we have a food bank, we provide clothing, and diapers in addition to what we actually try to do which is education job skills and life skills to be productive citizens. So, I don't know if students knew that or not that all that was going on here. Students' projects allow us to have better website and better infrastructure. We can do our operations and data management more efficiently. And when you're a small nonprofit and you have no money for that, so really it is just a huge impact because we touched the lives of hundreds of people in the community, and then they touch more people out of the way. So, I expect some positive impact on students' education; there will be a higher chance for greater community service involvement after they graduate.</p>
Participant 11	<p>The work they get to us makes the organization better, that's serving the use of that. These college students into a working environment have advantages over those college students who do not have that kind of experience. We deal with dysfunctional families, we deal with homeless, we deal with youth education, and there are not many social workers. So, when students are here working, they are helping to make us a better organization societally. When people go to our websites, they will find more useful information. They are using technology to make this more efficient, so we are spending less money on our end. They are making an impact by doing this project that we can't afford at all. What students learn is not everybody has advantages in life. So hopefully it will give them a desire to be a greater part of society. When people are talking about youth that are homeless, they will understand that, and they will know that they want to be a bigger part of the community to make some contributions.</p>

Participant No.	Responses
Participant 12	Service learning is exactly what it sounds like; it's got to be the good. Sometimes we do a lot of things, but they don't do any good, they just happen. Agreed upon learning outcomes are if it is a great product, our organization should be getting that product as an outcome at the end. What kind of outcome is should be in your service agreement. All students did a great presentation, but there are always some students that are more engaged while there are also some students who don't do a lot of driving. So, I think there is a lot of value to what they are doing but only the highly engaged ones will have more learning outcomes, they will be able to get jobs and be able to demonstrate competency. During the job interview, they can say I helped, I led a project that generated a real usefulness. Other may say they are part of the project, but who really drove it will be able to answer more questions.
Participant 13	Our project would cost a lot of money if we hire professionals. But students are able to help us get it done through a capstone project. Senior capstone doesn't necessarily have to be in a business setting, it can be done in the community setting too. Students find it's cool to do project that has contributions to the community. They provide some arms and legs and minds to address the problem, that gets them very motivated because by doing so they could be making a difference, and they're making a difference in a way of giving back to society versus if you're doing a project for a company with the hope of getting a job offer. When students are set off to accomplish something that's worth doing, and they do it right, do it well, and they're successful. I think there's a lot of satisfaction that one gets from doing such project that support service learning. That really does. I think that builds them up and makes them feel better about themselves and therefore promoting good citizens.

Participants' responses are reorganized into short supporting descriptions. The keywords are extracted out. The supporting description and associated keywords are shown in Table 14.

Table 14. *Participant No, supporting descriptions, and associated keywords of theme 5*

Participant No	Supporting descriptions	Keywords
Participant 1	Learn about personalities and learn about different background.	Learn personalities Learn background
Participant 2	Bring some of the cutting-edge technology to not for profit; make a win-win situation by helping nonprofit getting an upgrade; and gain an interest in social services.	Bring cutting edge technology Help with upgrade Gain interest in social services
Participant 3	Help address human needs; gain a higher degree of satisfaction; and gain interest in doing more community services.	Address human needs Gain satisfaction Gain interest in community service
Participant 4	Provide benefit to the large community; deeply engaged with community service even after graduate; commit to long time service; and provide experience for future career choices.	Provide benefit to community Engage with community service
Participant 5	Delivering that knowledge in a way that is fun and interactive for the community; and make contribution to the community.	Deliver knowledge in a fun way Make contribution to the community
Participant 6	Sense how much the government values local entities; see the importance of public engagement; and learn to put a good name and reputation on the education community.	Sense the importance of public engagement Learn to put up reputation
Participant 7	Bring positive influence to those respective communities; make stronger communities; setting up good examples for others to follow; and further influence individuals coming after them.	Bring positive influence Make stronger communities Set up good example Further influence individual
Participant 8	Project that has a wide affect that touches a large group of people; and working within limitations.	Work with the limitations

Participant No	Supporting descriptions	Keywords
Participant 9	Provide the help to the community; have more involvement in the community; have deeper understanding of community service involvement; and are likely to contribute for future involvement.	More community involvement Deeper community service understanding Make future contribution
Participant 10	Serving community through education; project make an impact in the community; and higher chance for greater community service involvement after graduate.	Make impact Future post-graduation service involvement
Participant 11	Doing the work by making client a better organization societally; having a desire to be a greater part of society; want to be a bigger part of the community; and want to make some contributions.	Have desire Make societal contribution Eager to make contribution
Participant 12	Service learning has got to be the good; if it is a great product, our organization should be getting that product as an outcome at the end; outcome should be in your service agreement; and it needs to generate a real usefulness.	Deliver the product Make service agreement Generate real usefulness
Participant 13	Students find it's cool to do a project that has contributions to the community; by doing so they're making a difference in a way of giving back to society; there's a lot of satisfaction that one gets from doing such project that support service learning; and I think that builds them up and makes them feel better about themselves and therefore promoting good citizens.	Giving back to community Gain satisfaction Greater satisfaction Promoting good citizen

Aggregated data from this interview question generated one theme and 33 unique keywords. This theme was generated based on the various learning outcomes the participants pointed out in the area of service learning. The summarized keywords associated with theme 5 are in Figure 24:

Theme 5: Service learning outcomes

- Learn personalities

- Learn background
- Bring cutting edge technology
- Help with upgrade
- Gain interest in social services
- Address human needs
- Gain interest in community service
- Provide benefit to the community
- Engage with community service
- Deliver knowledge in a fun way
- Make contribution to the community
- Sense public engagement
- Learn to put up reputation
- Bring positive influence
- Make stronger communities
- Set up good example
- Further influence individual
- Work with limitations
- More community involvement
- Deeper understanding
- Make future contribution
- Make impact
- Future involvement
- Have desire
- Make societal contribution

- Eager to make contribution
- Deliver the product
- Make service agreement
- Generate real usefulness
- Giving back to the community
- Gain satisfaction
- Greater satisfaction
- Promoting good citizen.

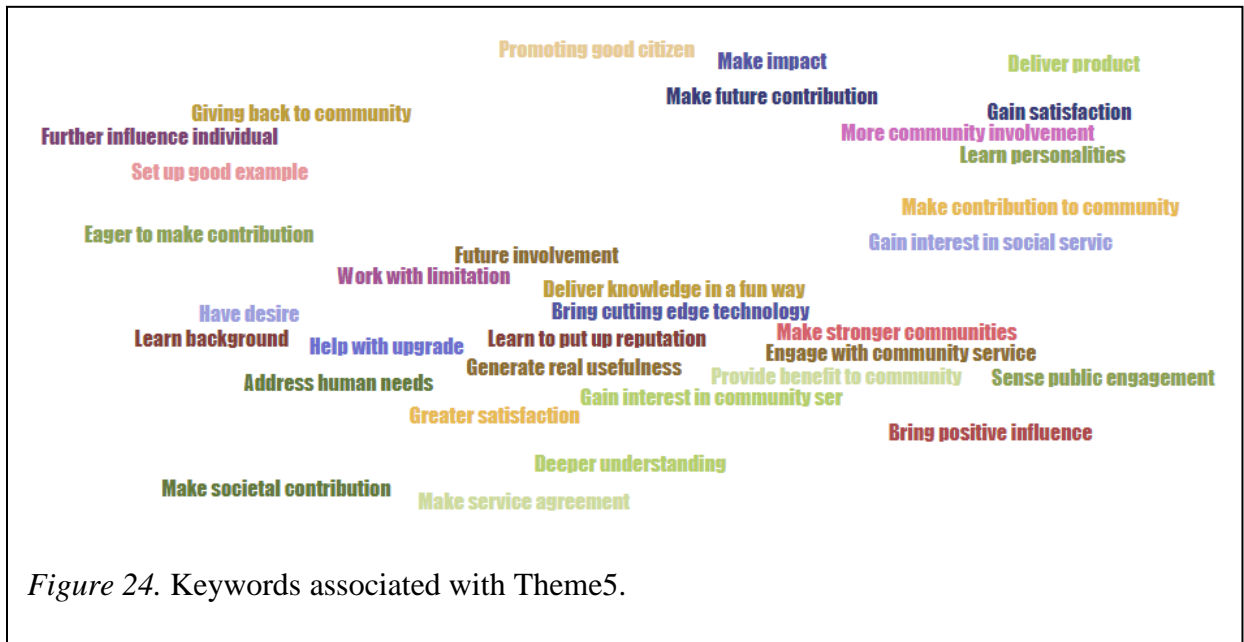


Figure 24. Keywords associated with Theme5.

Theme 6:

Soft skills

Associated interview question:

Besides Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning, are there any other soft skills (such as interpersonal skills,

information skills, analytical skills and behavioral skills) that are expected to be achieved? Any additional comments on the learning outcomes besides all the categories mentioned above?

Alignment with research question:

RQ1 - What would the industry/community leaders expect to see in the area of learning outcomes and employability skills when the computer science capstone project is initiated, developed, contributed, and partnered with organizations to include real-world problems?

Table 15 contains all participants' responses for theme 6.

Table 15. *Theme 6 responses*

Participant No.	Responses
Participant 1	Definitely the interpersonal skills. Students are learning to deal with a boss, learning to deal with team leaders, things like that. So, you know they're learning that, just because they feel one way does not mean it's always the way that something's going to go. And the other big one that I expect to see is that the quantitative skill, that sort of critical thinking, that sort of problem analyzing skills. Students are doing senior capstone with applications that might not always come from their own design. Therefore, they need to be able to dive into those issues and really drill down to the root. I've seen where people fix something, but they didn't fix the problem. And the problem is every time they go to this page they get the error message box. OK so what happened? Well I stopped the error message box from happening or from popping up. That doesn't fix the issue. Help skill is another important soft skill, and I've definitely seen a lot of that out there. The information skills are another big learning outcome. Students must have the ability to deal with new situations, they have to go out and do some self-gathering on that. It helps them when they integrate into smaller environments where they are not going to just be giving the help.

Participant No.	Responses
Participant 2	Right. We talked a little bit about their interpersonal skills, behavioral skills, and there are information skills and analytical skills. You can only get these skills in an actual project where the dynamics are unfolding in real time. You could try to simulate some of it but it's really never the same as having to work in that environment where students are forced to get a project done. If you do a group project in school, you can always pick your group. At the real workforce, you don't get a choice in knowing who they are. The groups are set up based on the skill capabilities of each of the people not whether they're friends or not. And I also think even in some of these cases where friends do get together in a team, it helps them to realize that friendship. It is like a double-edged sword. In these particular situations, a lot of times they don't want to point out faults of their friends, and so they ended up doing all the work while the friend is skating by. So, if you're really want valuable learning, you should not work with friends.
Participant 3	I think one of the best examples is that during the event we had at the airport, I see students actively interacting with all the passengers that came to play the game. This is students practicing how to help others, how to take users' input and how to present a product to users. The communication skills and presentation skills are also involved. They can now comfortably organize their presentation and speaking in front of a large audience.
Participant 4	I think that starting the open line of communication and starting the collaboration is important. For the interpersonal skills, for the first couple of weeks, students need to know about each other and set up a good relationship with each other. I think technology skill is also important. That's because when students come here, they don't necessarily need to know everything, and schools don't teach them everything. So, with technology been such a broad topic, no one knows all the answers, and you would need to go online and doing your own research. Having the ability to be able to research a solution, build upon my technology, and bring upon what they have to brainstorming ideas all falls under the technology skills.

Participant No.	Responses
Participant 5	<p>I think this fly with Butch O'Hare game and the partnership with the Chicago Department of Aviation really tied in a lot of these aspects of learning and business acumen for the students with interpersonal skills. They've really had to work together as a team and take leadership roles in each of their practices. I know that one student said I developed this, and it was referring to one aspect of coding that helped move the game along. And then I learned when we talked to the students that some of their field of study wasn't necessarily game building. But they dived into that learning so that they could move the game together as a project and so they took on additional areas of study in order to work together as a team to reach their common goal. So, this hands-on sharing of the leadership role and learning from each other certainly was a great example of interpersonal skills and leadership skills. As for information skills and sense making skills, absolutely. With building a game you need to understand not only how to collect information but also how to take that information and build a product that will help other people find out information. And then after the game is built, collect again data from how the game was used and implemented throughout its life cycle. So definitely learning to research, learning how to build the tools, to collect information, was all part of these analytical skills. Again, the same thing with the information, they had to understand how to take that information and analyze it to work and fit into building this product. And then when it's used again, how do they take that information about the use of the game and determine how the results were, how many people visited, how many people got to the leader board, and those kinds of tactics to make the game successful. Quantitative skills, of course, analyzing the data and determining what's working, what's not, the kind of traffic to that portion of the site. All of that is built into the program that the students and professors put together, building the technical skills all about data, and writing the code top scores. You know what stories are in what terminals building, the tools that we need, and what we want to use to collect the data. All of that was part of this process. And then finally the behavioral and goal setting skills. I thought the meet and greet event really brought out the social skills and leadership skills. You could see the students when they worked with passengers and explained their part of the building of the game, explained how to play the game, interacted with people, and then talking to the news reporter who was doing the documentary, or the videographer who's doing the documentary. This all gave them a real good experience in social skills and public speaking skills with networking and interacting. And I thought that they really took the challenge. There are even shy ones who were able to get involved and be part of that experience. So, it was very impressive to take your game that you worked on and bring it out to the community.</p>

Participant No.	Responses
Participant 6	I knew for sure I would expect to see an improvement in communications skills both internal and external. The internal skill is when they are working with one another on a collaborative project or working on a team-building project. Those team-building skills on how to work with others that are on different entities so the different groups working together towards one goal, I think, was important. And then their communication skills also improved with the external entities of working with the client side as well. Knowing how to enhance your professional skills when presenting to the client as well. So, I think over the course of the capstone during some of the web conferencing I have heard that some of the students kind of got a stronger voice through the conferences, and others also were able to reach out more often. I also expect their social skills improving, and there is just not enough social skill.
Participant 7	Yes. Yes. Yes. Well I would expect them absolutely to have interpersonal skills because really what's required especially when a group of individuals from various backgrounds get together with various experiences. They get together, and they have to have work in harmony. Accomplish the task at hand. So, it would require some give and take from individuals perhaps some patience, self-control, due diligence, responsibility. These attributes are critical in order to accomplish the task at hand. So those are some skills that I would expect to see from individuals along with analytical skills, perhaps behavioral skills too. And I've already expressed that with self-control, patience, etc. Those will be essential to not only completing that capstone project but also having a future successful career. Analytical skills: they need to be able to troubleshoot. Those are critical as well because oftentimes a client may not thoroughly express their desires, and so often the individuals who end up working on these projects have to be thorough with what they do because they have to. In a sense to ascertain what it is the client wants. Even though their client may not express their desires explicitly so analytical skills definitely come into play there.

Participant No.	Responses
Participant 8	Well I think in particular the soft skills having them come and visit us face-to-face was a good activity for them to do because it kind of allowed them to present their ideas face-to-face. It gave them real world experience, you know, kind of the nervous factor of standing in front of people and having to present their ideas because I know a lot of IT work happens alone, isolated behind a computer. You know having them dress professionally, prepare their presentations, and in particular, I was very happy with the supplemental materials that they supplied. I really appreciated that. The user manuals that they provided were very helpful so that we could have some of that sort, that kind of addresses some of the service after the sale. You know, and they were very kind in showing me how to use that; how to access that where it is. This was the interpersonal skills they presented, and you certainly saw that when they were face-to-face. It was harder to kind of see that over the phone. Yeah, I think the main point was that that face-to-face presentation, I think, that was probably the biggest help with their soft skills. Yeah, because we could see their relationships with each other when they were here face-to-face. And I remember one particular group, who it may have been the second group. that they were extremely dynamic, and they seemed to work extremely well together. I thought these people are really going places because they really had kind of at ease to their manner. They had the interpersonal skills. They had the relationship between the group, and you just knew that they worked well together, and they got stuff done in a timely manner. And they were able to get the problem solved. And you could just see that. And I don't know if that's particularly if they probably brought that to the project, or the project brought that out of them. And definitely showed their talent, showed they're going to be successful.
Participant 9	During presentation, they presented in front of us, and that's public speaking skill. They are knowledgeable on what they are saying. There is an incredible amount of communication taking place. Leadership also plays an important role. So, the interpersonal skills are expected. They also care for themselves professionally.
Participant 10	Yeah, there are soft skills involved in any real project. It's a team environment; our project would be a big project to do for one person. When you're out in the workplace you need to be able to communicate, and the skills are highly important. Communication skills are important. Every team member needs to be able to communicate and be able to work together. Leadership skills, to be able to delegate tasks, be able to take ownership, and keep members in the time frame here is also important. The expectation is, you know, it's real world, and that is what it takes in the real world and feel it's up to me to keep the team. It's not healthy to do everything on your own.

Participant No.	Responses
Participant 11	Working in a team brings a whole range of dynamics. It's going to have team members that do not contribute or are only contributing a little, and this is frustrating. You are going to have some team members that want to be a leader, and really have the leadership skills to do that. And others will do most of the work and are frustrated with their teammates. If I had a suggestion, there needs to be better team building skills. There needs to be something that ensures all made contributions to success, not just a few. And I think the technical part they do well, the teamwork area needs improvement, and they all need to be in collaboration.
Participant 12	Yeah, I think the soft skills are important to have, like friendliness, engagement, and personal appearance. With today's innovative technology, there are many ways to perform communication and collaboration. Technology skills are also important, not only data needs to be analyzed, our website project itself needed lots of technical skills. The project is about the ease, the friendless, and the usefulness. A community focused healthcare website attracts lots of visitors, and it needs to provide lots of information.
Participant 13	The leadership skill stands out. I mean not every single one of the team member need to demonstrate that but somewhere in the team somebody has to demonstrate that skill. Someone needs to be able to organize the team, be a point of contact. Documentation skill is also critical. I expect the team to provide documentation for every procedure. This documentation serves as communication channel for students and sponsors. Analytical skill, either quantitative or qualitative, would be expected. Students also need to have technology ability to analyze data.

Participants' responses are reorganized into short supporting descriptions, The keywords are extracted out. The supporting descriptions and associated keywords are shown in Table 16.

Table 16. *Participant No, supporting description, and associated keywords of theme 6*

Participant No	Supporting descriptions	Keywords
Participant 1	The interpersonal skills; learning to deal with a boss; learning to deal with team leaders; the quantitative skill; critical thinking skills; problem analyzing skills; need to be able to dive into those issues and really drill down to the root; help skill is another important soft skills; information skills is another big learning outcome; students must have the ability to deal with new situations; and they have to go out and do some self-gathering.	Interpersonal skill Quantitative skill Critical thinking skill Problem analyzing skill Help skill Information skill Self-gathering skill Handle new situation skill
Participant 2	Interpersonal skills; behavioral skills; information skills; analytical skills; and friendship skills.	Interpersonal skill Behavioral skill Information skill Friendship skill
Participant 3	Know how to help others; how to take users' input; how to present product to users; communication skills; presentation skills; and speaking in front of a large audience.	Help skill Presentation skill Communication skill Public speaking skill
Participant 4	Communication and collaboration skills; set up a good relationship with each other; interpersonal skills; technology skills; research skills; and know to build upon technology and brainstorming ideas.	Communication skill Collaboration skill Relationship skill Interpersonal skill Technology skill Research skill Building upon skill Brainstorming skill

Participant No	Supporting descriptions	Keywords
Participant 5	Interpersonal skills; work together as a team; take leadership roles; dived into that learning; take on additional areas of study; reach common goal; sharing of the leadership role; learning from each other; information skills; sense making skills; understand how to collect information; take that information and build a product; learning to research; learning how to build the tools; analytical skills; analyze information; fit information into building the product; use information to determine how the results were; quantitative skills; technical skills; behavioral and goal setting skills; social skills; leadership skills; public speaking skills; networking skills; interacting skills; business skills; and negotiation skills.	Interpersonal skill Team skill Team leadership skill Leadership sharing skill Information skill Sense making skill Research skill Analytical skill Analysis skill Information skill Quantitative skill Technical skill Public speaking skill Networking skill Interaction skill Business skill Negotiation skill
Participant 6	Communications skills with both internal and external entities; team building skills; groups working together towards one goal; professional skills; and social skills.	Communication with internal entity skill Communication with external entity skill Group working skill Professional skill Social skill
Participant 7	Interpersonal skill is needed when working together; have work in harmony; accomplish the task at hand; self-control, patience is needed to finish the capstone project; due diligence; responsibility to accomplish task on hand; be thorough with the project; behavioral skills needed for future successful career; and analytical skills needed to be able to trouble shoot.	Interpersonal skill Work in harmony Self-control patience Due diligence Responsivity to accomplish the task Behavior skill Analytical skill Trouble Shooting skill
Participant 8	Face-to-face presentation skills was probably the biggest help with their soft skills; extremely dynamic and work extremely well together; they had the interpersonal skills; they has the relationship between the group; they got stuff done in a timely manner; and they were able to problem solved.	Face-to-face presentation skill Extremely dynamic Interpersonal skills Relationship skill Be on time Problem solving skill

Participant No	Supporting descriptions	Keywords
Participant 9	They are knowledgeable on what they are saying; there is an incredible amount of communication taking place; leadership also plays an important role; the interpersonal skills are expected; and they also care themselves professionally.	Communication skill Leadership skill Leadership skill Interpersonal skill Professionalism
Participant 10	Communication skills are important; every team member needs to be able to communicate and be able to work together; leadership skills to be able to delegate tasks, be able to take ownership, and keep members in the time frame; it's not healthy to do everything on your own; a project leader has to have a certain leadership skill; be able to work together using interpersonal skills; and hold each other accountable.	Communication skill Team working skill Leadership skill Take ownership Time management Interpersonal skill Hold team member accountable
Participant 11	There need to be better team building skills; ensures all made contributions to success; and all need to be in collaboration.	Team building skill Collaboration skill
Participant 12	Soft skills are important to have like friendliness, engagement and personal appearance; using innovative technology to performed communication and collaboration; technology skills are also important; not only data needs to be analyzed; and our website project itself need lots of technical skills.	Friendliness Engagement Personal appearance Digitalized communication Digitalized collaboration Technology skills
Participant 13	The leadership skill stands out; documentation skill is also critical; analytical skill, either quantitative or qualitative, would be expected; and students also need to have technology ability to analyze data.	Leadership skill Documentation skill Analytical skill Quantitative skill Qualitative skill Data analysis skill

Aggregated data from this interview question generated one theme and 57 unique keywords. This theme was generated based on the various learning outcomes the participants

pointed in the area of soft skills. The summarized keywords associated with theme 6 are in Figure 25:

Theme 6: Soft skills

- Interpersonal skill
- Quantitative skill
- Critical thinking skill
- Problem analyzing skill
- Help skill
- Information skill
- Self-gathering skill
- Handle new situation skill
- Behavioral skill
- Friendship skill
- Presentation skill
- Communication skill
- Public speaking skill
- Collaboration skill
- Relationship skill
- Technology skill
- Research skill
- Building upon skill
- Brainstorming skill
- Team skill
- Team leadership skill

- Leadership sharing skill
- Sense making skill
- Analytical skill
- Analysis skill
- Technical skill
- Networking skill
- Interaction skill
- Business skill
- Negotiation skill
- Internal entity communication
- External entity communication
- Group working skill
- Professional skill
- Social skill
- Work in harmony
- Self-control, patience
- Due diligence
- Accomplish task
- Behavior skill
- Troubleshooting skill
- Face-to-face presentation
- Extremely dynamic
- Be on time
- Problem solving skill

- Professionalism
- Take ownership
- Time management
- Hold team member accountable
- Friendless
- Engagement
- Personal appearance
- Digitalized communication
- Digitalized collaboration
- Documentation skill
- Qualitative skill
- Data analysis skill

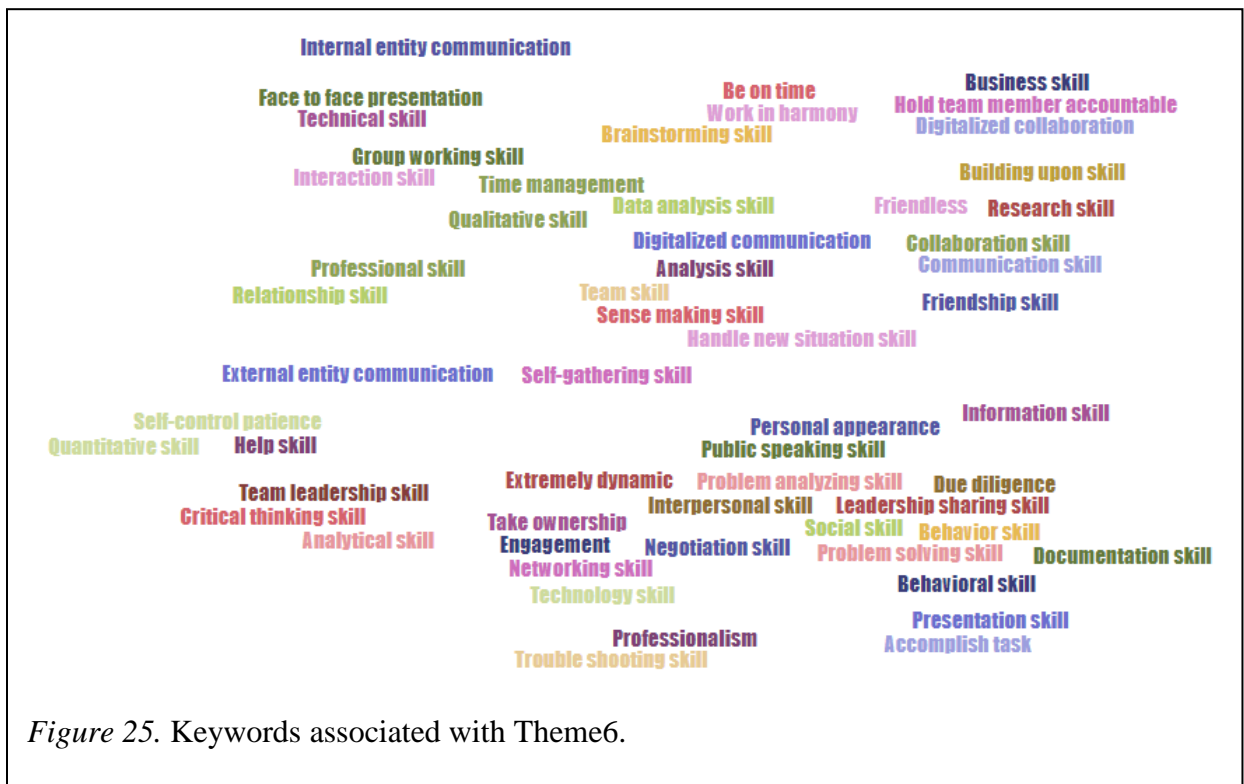


Figure 25. Keywords associated with Theme6.

Theme 7:

Specific learning outcomes

Associated interview question:

Have you or have you not witnessed any specific learning outcomes that students have acquired that indicate this was the result of real world problem based capstone project? Please describe that instance.

Alignment with research question:

RQ1 - What would the industry/community leaders expect to see in the area of learning outcomes and employability skills when the computer science capstone project is initiated, developed, contributed, and partnered with organizations to include real-world problems?

Table 17 contains all participants' responses of theme 7.

Table 17. *Theme 7 responses*

Participant No.	Responses
Participant 1	For me, I witnessed personality and responsibility as outcomes. Students are expected to show how they approach projects, how they meet their deadlines, and how they keep managers informed.
Participant 2	For interpersonal skills, a number of outcomes come in. They can be shy, they can be introverted, and these projects help to bring out the inner being, and they tend to be more interactive. It helps them to really get in touch with what their capabilities are.
Participant 3	I witnessed an increase ability of follow up with clients. During the initial meetings, they barely talk or ask any questions, but during the later conference calls, they were actively engaged with us and presented new ideas and is seeking for feedbacks with timely follow up.
Participant 4	This is kind of flip of a coin, some teams just really come with big motivations while some teams come with little or no motivation. The less motivated teams did not communicate, did not do anything. The more motivated teams were really collaborative and really wanted to do something. So, for the learning outcomes that build upon real world learning experience, the ones who put in the effort will get all the collaboration skills and technology skills back in return.

Participant No.	Responses
Participant 5	Again, I have to say that I wasn't really working hand in hand, but when the students talked in their interview they specifically said because I studied this specific area, but the game needed this kind of focus, it was an opportunity for me to dive into an area that I wasn't familiar with and really gather that research and information, and then make a recommendation on how to handle that aspect of the game. So, they're telling me that this real-world problem-based project help them build their learning skill. And finding out how to collect that information, I think it's really important. It may have been talking to one of their professors who was knowledgeable in that and taking their direction, or it could have been doing online research, seeing what other people are using. So, I think it really not only gave them an opportunity to try something new but how to actually go out and collect that background, and then be able to make a recommendation has helped move our project. So, it's sort of two different ways that they had to challenge themselves in order to meet the needs of the client.
Participant 6	I think once again that the students learned specifically how to work with clients and how to meet their clients' needs. A student would maybe recommend something they deemed important or valuable, but it maybe wasn't necessarily the highlight of our project at the time though. We had to unfortunately communicate with them that yes, we hear your suggestion, we might not need to implement this feature at this time, being we deemed it not necessarily needed at the time. So, I think students learned how to truly treat it as a question and answer-based scenario where they were able to get clarification they needed so that is all effective communication. You could tell they got more confidence with outreaching, with better suggestions. So even if the client side didn't really see those suggestions as needed, it was still great that they had that confidence to say those skills out loud.
Participant 7	Okay. And this question, and I am going to have to say that I probably can't address well based upon the limited exposure that I have with the students. I'm not sure that I can answer that question effectively. However, at a minimum, I think I see their confidence level growing. I also see students' follow-through ability increased towards the end.
Participant 8	Well I would say since I wasn't able to see them before and after. I'm not really the best judge of this question.
Participant 9	I do not know them beforehand, so it is difficult to see any specific outcomes. But I do see the communications among the students.

Participant No.	Responses
Participant 10	The competitive marketplace they're right now in, and technical skills are things in high demand, I think.
Participant 11	I witnessed that they are not doing well for project planning, and I witnessed that they are not good with documenting, I witnessed that they could do better for the status report of the project. I met with them at the start of the project and my next meeting may be to close out the project. So, I witnessed that every team has issues, and any better learning around the team and building team management that kind of thing. I witnessed that we're doing is we're able to acquire and growing their problem solving on occasion. I witnessed that some become natural leaders, that have natural leadership skills. I think that would be primarily my answer.
Participant 12	I think the interpersonal communication skills, about following through, is needed as a learning outcome.
Participant 13	An important learning outcome is to meet the deadline. I expect students to know what needs to get done, and how to find ways to get it done so they know what is a commitment.

Participants' responses are reorganized into short supporting descriptions. The keywords are extracted out. The supporting description and associated keywords are shown in Table 18.

Table 18. *Participant No, supporting descriptions, and associated keywords of theme 7*

Participant No	Supporting descriptions	Keywords
Participant 1	Personality and responsibility to keep manager informed.	Keep leadership informed
Participant 2	Project helps improving interpersonal skills; and students tend to be more interactive.	Interpersonal skills More interactive
Participant 3	Increased ability to do timely follow up with clients; actively engaged with client; be able to present new ideas; seeking feedbacks; and performing timely follow ups.	Follow up with the client Engagement with the client Present new ideas

Participant No	Supporting descriptions	Keywords
Participant 4	More motivated students get collaboration skills and technology skills back in return; and less motivated students won't get good skills.	Collaboration skills Technology skills
Participant 5	Dive into a different study area; make recommendations to clients; finding ways to collect information; conducting online research; meeting the needs of the client; and challenge themselves.	Explore new area of study Ability to collect information Meet the client needs Able to take challenge
Participant 6	Know how to work with clients; know how to meet their clients' needs; know how to get clarification from client; effective communication; and more confidence with outreaching.	Ability to work with the client Meet the client's need Follow through with the client Effective communication Confident outreaching
Participant 7	Confidence level growing by answering client's question effectively; and an increased follow through ability towards the end.	Growing level of confidence Increased follow through ability
Participant 8	None.	
Participant 9	I do see communication among team members.	Team communication
Participant 10	Technical skills are things in high demand.	Technical skill

Participant No	Supporting descriptions	Keywords
Participant 11	Not doing well for project planning; not good with documenting; could do better for the project status report; every team has issues and need better team management; able to acquire and growing problem solving; and some become natural leaders that have natural leadership skills.	Not doing well in project planning Can do better for project status report Need better team management Problem solving skill Leadership skill
Participant 12	The interpersonal communication skill about following through is needed as a learning outcome.	Interpersonal skill Communication skill Follow through
Participant 13	Meet the deadline; know what needs to get done and how to find ways to get it; and know what a commitment is.	Meet the deadline Find way to solve problem Take commitment

Aggregated data from this interview question generated one theme and 29 unique keywords. This theme was generated based on the various learning outcomes the participants pointed in the area of specific learning outcomes. The summarized keywords associated with theme 7 are in Figure 26:

Theme 7: Specific learning outcomes

- Keep leadership informed
- Interpersonal skills
- More interactive
- Follow up with the client
- Engagement with the client
- Present new ideas
- Collaboration skills

- Technology skills
- Explore new area of study
- Collect information
- Take challenge
- Work with the client
- Meet the client's need
- Client follow through
- Effective communication
- Confident outreaching
- Growing confidence level
- Team communication
- Technical skill
- Improve on project planning
- Improve on project status report
- Improve on team management
- Problem solving skill
- Leadership skill
- Communication skill
- Follow through
- Meet the deadline
- Find way to solve problem
- Take commitment.

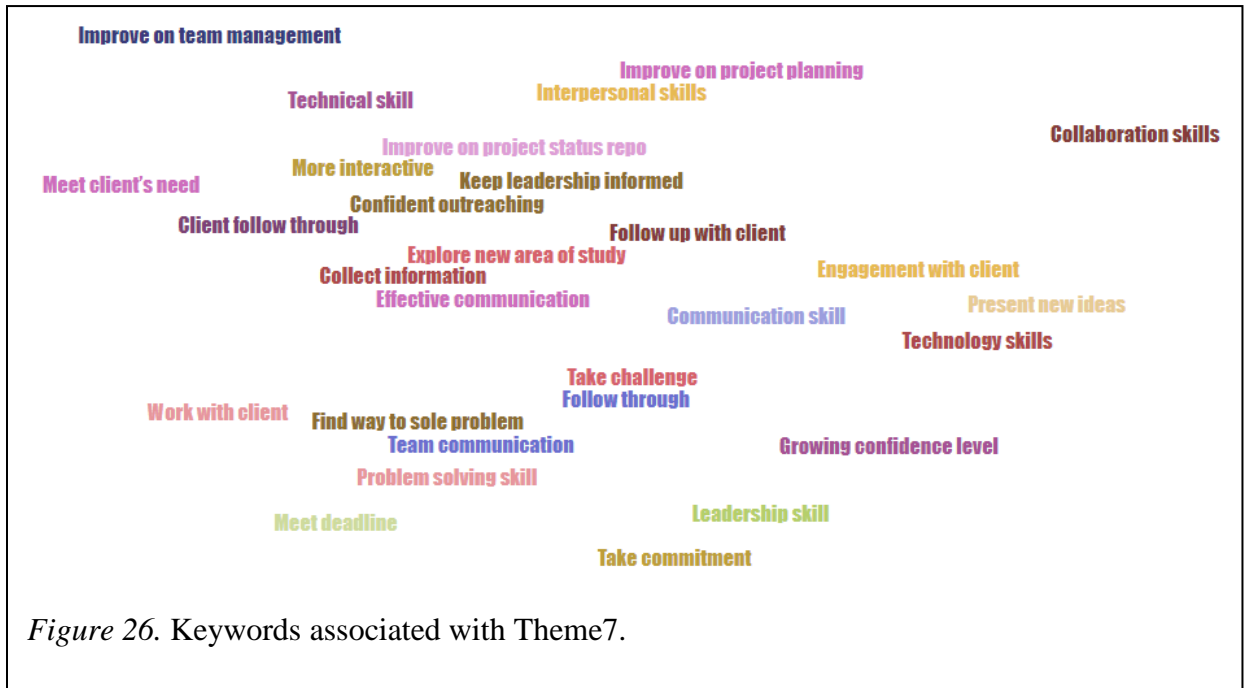


Figure 26. Keywords associated with Theme7.

Theme 8:

Student's performance

Associated interview question:

Are students better, the same, or worse in the area of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning as a result of the real-world problem based senior capstone project? Describe specific examples that you have witnessed to support your reasoning.

Alignment with research question:

RQ1 - What would the industry/community leaders expect to see in the area of learning outcomes and employability skills when the computer science capstone project is initiated, developed, contributed, and partnered with organizations to include real-world problems?

Table 19 contains all participants' responses for theme 8.

Table 19. *Theme 8 responses*

Participant No.	Responses
Participant 1	I think that they're better because they gain some experience. Whether or not that experience is good or bad for them, it's still experience, and it's experience that you can talk about during an interview. It's experience you can describe in your resume; it's experience you can apply to real world situations moving forward. I definitely think that what they gain is the discussion points of the technology. As an IT manager, you see so many buzzwords on everybody's resume. But when you're interviewing after doing a senior capstone project and somebody is asking you about this technology you've listed, and you have real world experience applying it to projects, and you can talk about things that you've done. It's experience. The problem most new students have coming out is everybody wants experience, but you don't have any yet. So, the capstone project at least gives you something you can fall back on for an experience, for a talking point in that interview. That should help separate you from somebody that does not have one. Yeah, in the end it also depends on individual student's motivation. Because if you're the student that sits back in a capstone and lets three other students run the whole project, and you don't have a talking point now because you didn't get involved.
Participant 2	I think in all areas that are better. They are enhancing in all these different areas. You see the growth of the students, you see, and they come and say hi. They've never programmed in a language like this before, and they went on actually learn the language on their own. You know, they learned how to organize and lay a project out. A lot of time getting help from the outside entity with some of those skills. So, I think, it really is for the students who take it seriously, it is truly a growing experience. You know, there are always the students who don't care, and they're not going to get anything out of it. But I don't think that's what you measure, you measure the effect by the students that are using and taking advantage of the opportunities that you're providing. And I have seen a number of students who come out of a senior project and become employed sometimes with that particular organization. Even just having that experience has opened doors to them at other locations.
Participant 3	I think better, for sure. Having gone through the real project, they have chance to interact with sponsors, test their classroom theory in the real development, going through several stages of project development cycle. They got exposed to the real business, which can help them in probably all these areas we talked about.

Participant No.	Responses
Participant 4	Same applies here. Those who put in the effort will obviously become better in all these skills. Those who didn't put in the effort won't get any enhanced skills. So I think it really depends on how much students want to put into the project. That kind of reflects their business career going forward. Life is all about how much you are willing to put into. So, I think for students who put a lot of energy in, they got all those skills. Watching the students doing the senior project, for me, kind of show where the society is going in terms of education. The kids who were able to bring a lot to the table definitely have brighter futures.
Participant 5	Oh well, I think it's that the students get a much better understanding of their field of study by seeing it in real world practice absolutely better. And the reason why I think is that you learn all the theories and the building blocks, and it all seems a little bit common sense but until you actually have to apply those skills and expect to get to the end of the project. And you have to meet the deadlines, meet the needs of the client, and actually see it go forward in the actual environment. You just don't, I mean, you just don't really experience all the little trials through the process when you're reading about it or saying here's my model and here's what I theorize will happen. Here you got to actually implement and get your hands on, and see it, and help move it forward, and see it in real use.
Participant 6	I think that they all have got better and improved with all these areas. I mean, these positive things with all the areas as well in my previous statements or answers. But I think by seeing them physically on the meet and greet day event, seeing how well that they physically presented themselves, I think you could tell that they were collaboratively learning with one another in their group studying. And then I also witnessed them communicating with passengers and actually having a discussion with them about what they would like to see as an improvement. And I think that made them excited to see that others were excited to be playing this game that they actually built and helped build. So, I think all their skills increased in those areas.
Participant 7	I would absolutely say that they would be better hands down. And the reason why is these students, you know, again based upon my limited exposure to them, there are various learning take on when they develop the product. And I can say that initially when we were having those weekly meetings on the phone compared to meeting the students in person and having them demo the product, it seemed like they really grew. You know initially during the audio meetings it seemed like they may have been somewhat timid. And even though they may have been nervous in presenting their project to us onsite, it seemed like they took that experience seriously.

Participant No.	Responses
Participant 8	This is another question I don't feel fully qualified to answer but I would say that they would have to be getting better because of this project. I don't see how this could possibly make them any worse because they are working hard on a real-world project with real world stress.
Participant 9	I would assume they would get better. Our project is hands-on, and the hands-on experience can increase their engagement. It is different than the classroom learning and the knowledge they got through our hands-on project can be transferred to long-term memory. I think our project helped student's problem-solving skills.
Participant 10	And the answer is yes. You know being able to say that, is based on the project outcome. They completed a major project with website, with computer lab of 40 workstations and servers. They can say they are better in all these areas since the add values are gain through your capstone experience. I'm pleased that it has absolute knowledge use. As I said before, taking it from the classroom setting to real world setting makes it on target. There's a whole bunch of good experiences and that they should be featuring in a job interview.
Participant 11	I would say they got better in collaborative learning, experiential learning, transfer of learning, and service learning, probably the same in project-based learning, and nothing would have gotten worse. For collaborative learning, when there are problems, they develop solutions on what they are going to do. For experiential learning, they are learning from the hands-on experience. For project-based learning, there are too many issues with the teams, and that did not get better. Transfer of learning got better because they took what they learned in the classroom and transferred it to the actual project. Service learning would be better because they learned with us, and they have a better understanding of someone having disadvantages, so they need help.
Participant 12	I think people should become better. This type of project is real world problem based with lots of opportunities to learn lots of skills and it can definitely help students to get better.
Participant 13	It can't be worse. I think it really depends on the individual students and team. The more motivated ones will certainly become better as they would have a better understanding of what that was after the whole experience. For the students that did not enjoy it then that would affect their learning.

Participants' responses are reorganized into short supporting descriptions. The keywords are extracted out. The supporting descriptions and associated keywords are shown in Table 20.

Table 20. *Participant No, supporting descriptions, and associated keywords of theme 8*

Participant No	Supporting descriptions	Keywords
Participant 1	Better because they gain some experience; it's experience they can apply to real world situations moving forward; what they gain is the discussion points of the technology; and capstone project gives them something they can fall back on; that should help separate them from somebody that does not have that experience.	Better performance Gain stand out employability skills
Participant 2	Better in all areas; growth in social skills; growth in technology skills; increased ability in organizing and laying out project; increased ability in seeking for help from outside entity; increased employment opportunities; and a true growing experience for students who taking it seriously.	Better in all areas Growth in social skills Growth in technology skills Better project organization skill Increased ability to seek for help True growing experience
Participant 3	Better for sure in learning areas; real exposure to real business; interaction with sponsors; testing classroom theory; and going through several stages of project development cycle.	Better for sure Better client interaction
Participant 4	It depends: motivated students got better and not motivated students stay the same.	It depends on individual motivation
Participant 5	Students get a much better understanding by seeing it in real world practice; learn all the theories and the building blocks; able to apply the skills; expect to get to the end of the project; meet the deadlines; meet the needs of the client; and see it go forward in the actual environment.	Much better Able to apply skills

Participant No	Supporting descriptions	Keywords
Participant 6	All got better and improved with all these areas; well presented themselves during public events; collaboratively learning with one another in their group studying; communicating actively with users; and actively seeking for advice for improvements.	All got better Better at group studying Better at collaborative learning Actively seeking for advice
Participant 7	Better hands down absolutely; take on various learning take on when developing project; excellent mannerisms; and increased level of confidence and public speaking.	Better hands down absolutely Take various learning Increased level of confidence Increased level of public speaking
Participant 8	Have to be getting better since students are working hard with real world stress.	Have to be getting better
Participant 9	Better at these skills; hands-on knowledge can be transferred to long-term memory; and improved problem-solving skills.	Better at these skills Improved problem-solving skill
Participant 10	Better at all learning areas; has absolute knowledge use; taking it from the classroom setting to real world setting make it on target; and feature the experience in a job interview.	Better at all learning areas Gain absolute knowledge use Can transfer classroom learning
Participant 11	Better in collaborative learning, experiential learning, transfer of learning and service learning; the same in project-based learning; and nothing would get worse.	Better at collaborative learning Better at experiential learning Better at transfer of learning Better at service learning Same at project-based learning
Participant 12	People should be better since this type of project offers lots of opportunities and can definitely help students to get better.	People should be better

Participant No	Supporting descriptions	Keywords
Participant 13	Depends on the individual students and team; and more motivated ones become better.	Depends on individual's motivation

Aggregated data from this interview question generated one theme and 26 unique keywords. The duplicated keywords have been removed. This theme was generated based on the various learning outcomes the participants pointed in regards to student's performance. Out of 13 total participants, 11 participants (77%) confirmed that students are better in all areas, two participants (15%) believed that the performance will be based on the individual's motivation. The more motivated ones will get better, and one participant (7%) pointed out that while students will do better in other areas, but they stayed the same in the area of project based learning. The summarized keywords associated with theme 8 are in Figure 27:

Theme 8: Student's performance

- Better performance
- Stand out employability skills
- Better in all areas
- Growth in social skills
- Growth in technology skills
- Project organization skill
- Seek for help
- True growing experience
- Better client interaction
- Individual motivation
- Able to apply skills
- Group studying

- Collaborative learning
- Seeking for advice
- Take various learning
- Increased confidence
- Better public speaking
- Have to be getting better
- Improved problem solving
- Absolute knowledge use
- Can transfer classroom learning
- Better at experiential learning
- Better at transfer of learning
- Better at service learning
- Same at project-based learning
- People should be better.

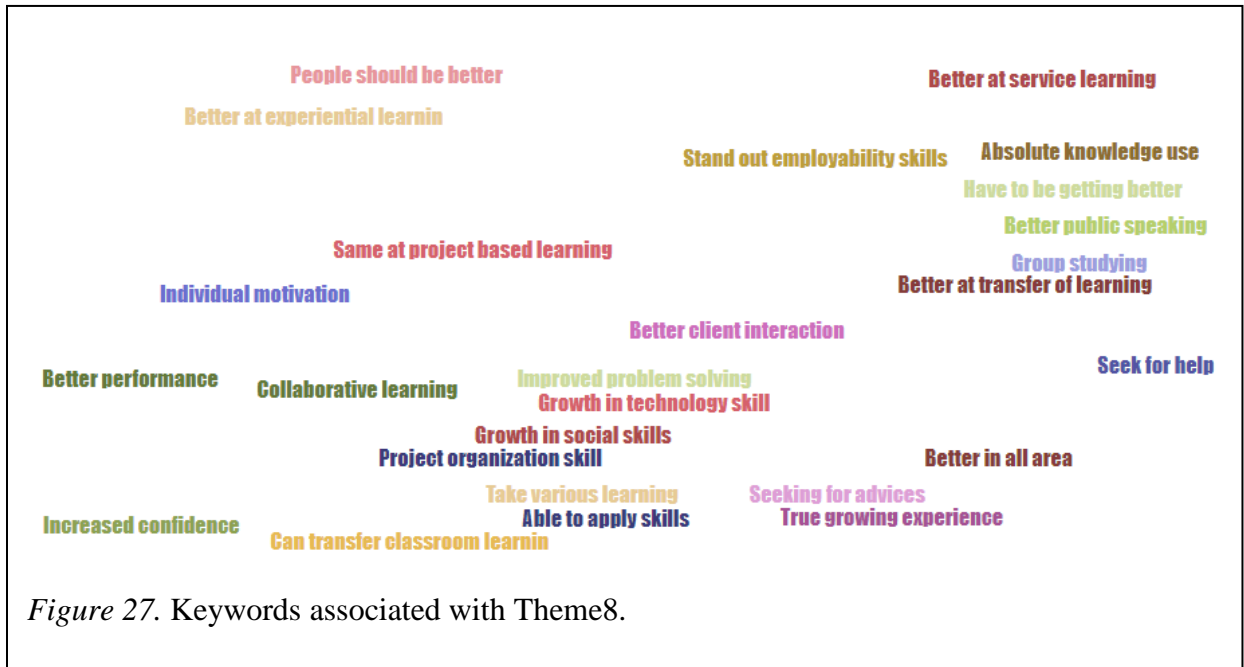


Figure 27. Keywords associated with Theme8.

Theme 9:

Employability skills

Associated interview question:

What would you expect to see in the area of employability skills as a result of a real world problem based senior capstone project? Will the whole experience eventually assist students on career choice?

Alignment with research question:

RQ1 - What would the industry/community leaders expect to see in the area of learning outcomes and employability skills when the computer science capstone project is initiated, developed, contributed, and partnered with organizations to include real-world problems?

The following Table 21 contains all participants' responses for theme 9.

Table 21. *Theme 9 responses*

Participant No.	Responses
Participant 1	I said the communication and the collaboration were the outcomes I would like to expect in the area of employability skills. Now everybody is into the collaboration side and the collaborating can come from anywhere. And there's a lot more technology out there to help facilitate that. So I think I would like students to gain experience in those collaboration techniques. Are you using Skype for business? Are you using video chat? Are you using GitHub or T.F. to share your code? Today's working environment is highly distributed where we see everything to be sort of that shared ride service. And in enhancing that experience only mimics what's going on in the real world.
Participant 2	When students care for a future career, they will be doing internship. I think the senior capstone is more valuable than an internship because it is concentrating a lot more on the team aspect that a lot of internships don't get into. When you do an internship, you're just going to work on what you're assigned to, running around getting people coffee. Even if you are doing something technologically, they give you something you operate in a little narrow window of the world. You don't really have that interaction where you're developing and growing the project. Like I said, all the skills need to be worked on. Soft skills are not just the ability to communicate over the phone to help people, and it has become a societal issue, an educational issue that a lot of the skills that are being left by the wayside. We're so focused on just the technology or just a particular subject matter that we're forgetting about general communication skills, just general societal skill, that decline of subjects like history and literature. While a lot of people want what they have to do with technology, it gives you a perspective of the world around you and how technology fits into that world, and helps you to make decisions as to what you should or should not do. There are ethical and moral consequences to what you're doing and they're not getting those skills anymore.
Participant 3	Students work collaboratively in the real work setting and having strong communication skills. They know how to meet clients' expectations and have good attitudes towards the improvements. They know how to do follow-ups in a timely way.

Participant No.	Responses
Participant 4	Well I kind of touched on earlier. I felt that students have the ability to now go to their employer and sit down for an interview. They will go, hey, you don't have any experience why should I hire you? Now most students will say I just graduated, what experience do you want me to have? Now the kids who did their senior project with us can say, hey, I do actually have that real hands-on experience. I did this project, and I worked for this corporation, now I have referral from this guy. You know I actually wrote referral letters for the students who did a good job to help them landing a job. So the opportunity to put students in a scenario where they can be set up to either pass or fail and either gaining experience or not gaining experience, that'll help them in the job hunting process. So in terms of employability, it is 100% based on how much students are willing to put into their senior project.
Participant 5	I absolutely agree that it will. I think that this was a good example of real world because it was real world. So the needs and the skills that they brought to the table are skills and experiences that future employers will look for when they bring employees to their business. So whether it's leadership team building efforts, research and analysis, meeting deadlines, and all of the things that we've talked about are skills that the students had to actually provide and perform in order to make this project a reality. So in essence, it was a job for them, and they had to approach it as if it was a job that they would be working out in the real world because the expectation, the process, the whole experience was truly a mirror of being in a position or in that career. Maybe some of the students will find they absolutely do not want to be in the game building industry but they like the process of leading a team on a project, and maybe that's the kind of thing that they'll have taken away from this experience. I would think it really solidifies their desire to be in the field, practicing the skills that they've used, and see all of their learning experiences applied to a project that brings them personal value to the employer.
Participant 6	Employability wise I believe that this is a great background and experience to have on their resumes to present because then they could officially attest to their potential supervisors that they used certain skills, and enabled certain knowledge in the real world setting. I think they could possibly get a higher salary from their future employers based on the real life business project on their resumes.

Participant No.	Responses
Participant 7	<p>OK. Well I believe that capstone project will be a catalyst that increases each one of the students' employability skill because while they were learning they were actually receiving my opinion on the job training in their respective skills. So each individual had the opportunity to learn how to manage priorities and expectations. You know, we as an agency, may not have expressed that clearly. Students are also managing each other's personalities. So the students had so many things that they had to juggle and trying to achieve their common goal, and those experiences are, in my opinion exactly, what they had to deal with in real life. So I absolutely think that that capstone project increased their employability, to better support the outcome. I honestly think everything that was the bargain, that counts, not the project itself. Each student tried to apply what they were taught and learned, so from a personal application that they would be well rounded. Again, you know, in regards to their employee abilities, so I think that that capstone project covered a lot of bases. All of the basic employability can be tested out during the project. So what I'm saying is the assignment that they received, the training and guidance that they receive from the IBHE, the communication that they received from IBHE, and then the communication that they had to put forth between each other, those skills, I think, were enough that if they continue to grow, those would be sufficient for them to be employed in a private industry. So I guess what I'm trying to say is that I think that capstone project is developed, or was developed, really well because it gives the students the basics to achieve their desired goals. Along with, I mean, what cannot be underestimated is those interpersonal skills as well because that comes into play on a daily basis in real life. That cannot be underestimated in my opinion.</p>
Participant 8	<p>Know that after you have an experience, you know, you've learned something even if you learned or you did it badly. You know you have learned something. I would expect it to increase their employability skills because they are working on a project that has real world limitations. And as I've said you know we had a lot of limitations and the same is going to be true. You know when they get a job somewhere there's going to be some kind of limitations that they're going to have to overcome. And this would just help them grow their ability to handle things when there is a lack of resources.</p>
Participant 9	<p>Just being able to put hands-on experience on their resume, to me, would be a big sell. You know the experience of coming to help the non-profit to build the infrastructure from the ground up has got to be a good selling point during an interview.</p>

Participant No.	Responses
Participant 10	You can, you've got to get the classroom portion you've got. You've got the training, now you've got a real world experience. On the other side of it you should be able to go to an employer and say, I did this wonderful project Conservation Corps. They are now 21st century operations. Let me tell you about it. It used to be a warehouse, and we've got it up in the 21st century technology-wise. That's my expectation, that it should be. You know, it should be a shining star on their resume and employability highly. That's the expectation.
Participant 11	I think technically, they have the skills needed for a job; their technical skills will get their foot in the door. And then they can learn under the job. If they don't learn, they may not keep the job. When you are working in the corporate field, working in teams, but by yourself, and you have to learn the skill to work in a team. When you are in a team, if you are not doing your fair of share, your team will complain; you will get fired. When you have a resume that I have is this college learning degree and on top of that I have this experiential, it helps with your resume, and it makes you more believable because they know you were done a real world problem. That would be beneficial. There are companies that like your knowledge in your head, the ability to work on the problems, and address the problem, but without team building skills, you can't work on the job.
Participant 12	Like I said, the people that are more driven, more motivated, will be able to gain more employability skills. With a good college degree and with this type of real project, they are easy to articulate when the hiring manager is asking questions during an interview.
Participant 13	The communication is important. Students are committed to the technical work but they also need to understand how to communicate with stakeholders.

Participants' responses are reorganized into short supporting descriptions. The keywords are extracted out. The supporting descriptions and associated keywords are shown in Table 22.

Table 22. Participant No, supporting description, and associated keywords of theme 9

Participant No	Supporting descriptions	Keywords
Participant 1	Communication and collaboration; and gain experience to use technology to help facilitate communication and collaboration;	Communication Collaboration Digitized communication Digitized collaboration
Participant 2	All the skills need to be worked on; team working skills; soft skills; communication skills; and general societal skills.	Team working skill Soft skill Communication skill General societal skill
Participant 3	Collaboration skills; communication skills; meet clients' expectations; have good attitude towards improvement; and the ability to do timely follow ups.	Collaboration skill Communication skill Meet expectation Attitude towards improvement Timely follow up
Participant 4	Gaining real world experience; transfer the experience; and be willing to put effort.	Gain experience Transfer experience Putting effort
Participant 5	Leadership skills; team building efforts; research and analysis; meeting deadlines; meet expectations; and brings personal value to the employer.	Leadership skill Team building efforts Research skill Analysis skill Meet deadlines Bring personal value
Participant 6	Real world project skills and knowledge can result higher salary.	Real world project skill

Participant No.	Responses	Participant No.
Participant 7	Manage priorities and expectations; managing each other's personalities; communication skills with clients; communication skills with team members; interpersonal skills; all the skills gained through capstone are sufficient for students to be employed in a private industry; and capstone project absolutely increased their employability.	Managing priorities Managing expectation Managing member personalities Communication with the client Communication with the team members Increase employability skill
Participant 8	Working on a project that has real world limitation; real world project is going to be some kind of limitations that they are going to have to overcome; and grow ability to handle things when there is a lack of resources.	Work with limitation Grow ability in handling with limitations
Participant 9	Hands-on experience is a big selling point during interview.	Hands-on experience
Participant 10	Be a shining star on their resume; and increase employability.	Increased employability
Participant 11	Technical skills will get their foot in the door; learn under the job; and learn the skill to work in a team.	Technical skill Team skill
Participant 12	More motivated will gain more employability skills; and easy to articulate when discussing the real world experience with hiring manager.	Benefit employment
Participant 13	The communication is important; and students need to how to communicate with stakeholders.	Communication skill with the stakeholders

Aggregated data from this interview question generated one theme and 34 unique keywords. The duplicated keywords have been removed. This theme was generated based on the various learning outcomes the participants pointed to in regards to employability skills. The summarized keywords associated with theme 9 are in Figure 28:

Theme 9: Employability skills

- Digitized communication
- Digitized collaboration
- Team working skill
- Soft skills
- Communication skill
- General societal skill
- Collaboration skill
- Meet expectations
- Attitude towards improvement
- Timely follow up
- Gain experience
- Transfer experience
- Putting in effort
- Leadership skill
- Team building efforts
- Research skill
- Analysis skill
- Meeting deadline
- Bring personal value
- Real world project skill
- Managing priorities
- Managing expectation
- Managing personalities
- Client communication

- Team member communication
- Increase employability skill
- Work with limitations
- Handling limitations
- Hands-on experience
- Increased employability
- Technical skill
- Team skill
- Benefit employment
- Stakeholder communication.

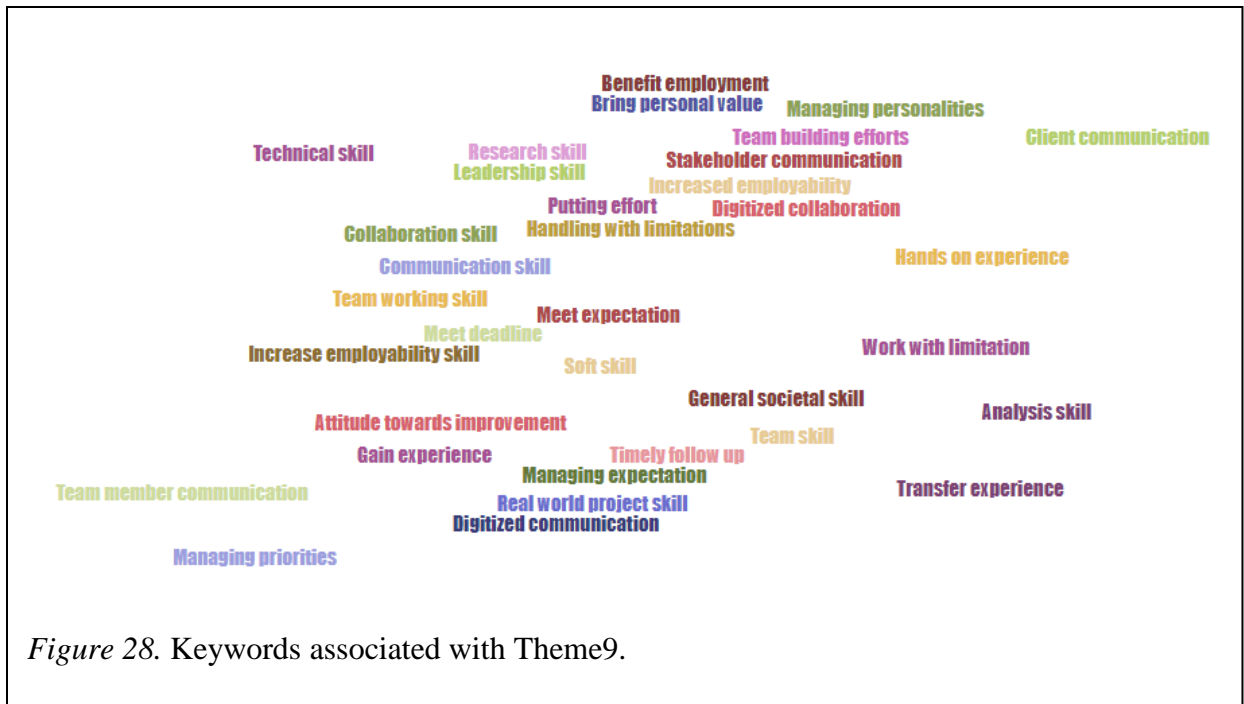


Figure 28. Keywords associated with Theme9.

Theme 10:

Need-to-enhanced employability skills

Associated interview question:

Are there any essential employability skills that should be enhanced in order to better support the learning outcomes?

Alignment with research question:

Research Question (RQ3) – Which aspects of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning contribute to enhanced employability skills?

The following Table 23 contains all participants' responses for theme 10.

Table 23. *Theme 10 responses*

Participant No.	Responses
Participant 1	For employability skills there are not so much outside of all the other ones we've discussed. I mean, I don't see anything new being brought to that board that saying this is something we're missing at this time.
Participant 2	I think all the skills help them get there. If not enough, it should be the polishing of those skills. In other words we should be trying to put more of those skills into the pool before they get there. So when they're in the project, it's kind of like they don't get more out of the project if they have a base. A lot of them were just laying the base, and they really don't get as much out of it as they could.
Participant 3	I would think it is the communication skills. You might be working real hard on something; however, if you don't communicate with clients, you might be wasting your time on some features that might not even need to be considered. The communication needs to be flexible and considerate, and of course, knowing what you are doing. Be proactive and be willing to change things.
Participant 4	When we talk about the IT world, obviously there are a lot of aspects that can be taken into consideration. But there are two points that stand out, one is the ability to understand the problem and find a solution, whether you know or not, you just need to have the ability to be willing to try to look for a solution. The second point is communication and social ability.

Participant No.	Responses
Participant 5	I think in the future we should be adding more direct discussions or opportunities for the students to talk with the client or meet the client, maybe not just on a phone call, but bring them more involved in the beginning so that they have that experience of what boardroom discussions would be like. Maybe give them an experience to say we're bidding on this project. I mean we know already they have the project, but here's what it would be like to bid the project. Because that one step was missing here, we already assumed that your university, your team, has won the contract to build this game. By making them go through the pitch for that would be a great opportunity for them to expand their experience with how businesses analyze and review up a sales pitch. And I just think that might be a great opportunity for them to rock climb.
Participant 6	I would say maybe public speaking skills would better be enhanced. I noticed some students are softer spoken than others, and some are a little clearer speaking. I think public speaking would enhance their skills to project their voices when needed such as speaking over the phone or speaking face-to-face. They all had really good eye contact and mannerisms, but others needed help in public speaking areas. So I think that's an important skill to have moving forward.
Participant 7	Yes. Yes. Yes. I think all of those skills are necessary and beneficial again for the students to be well rounded. So for instance, a student may excel in collaborative learning. However, if they do not have the interpersonal skills, people know they can excel in collaborative learning, you know, working together. But if their interpersonal skills are lacking, that'd be, you know, a great deficiency. And in the real world, for those, the lack of interpersonal skills could actually cost an individual perhaps the loss of a job.
Participant 8	Oh, ok, this kind of goes back to another answer that I gave. The limitation is the deadline of graduation at which point that the students were no longer accountable to us. And this wouldn't be the case in the real world. Once students were employed, they would definitely be accountable to their employer after they've created the product. And what we discovered was there was kind of a limited ability to get any issues errors or problems addressed by the students that we know in post-graduation delivery. And so we were left to kind of fix these ourselves. So as we discussed before, if anything could be enhanced it would kind of be that after the item is created to check in with the client again, and see if their fixes worked, or if there are any other bugs or glitches that were found. It is the follow-through skill.

Participant No.	Responses
Participant 9	From my end, they didn't get to see the project towards the end due to their project timeframe. If they could have followed through the whole project development and seen the end result, that would be a nice thing to them. The follow-through skills can be enhanced. It would be a beneficial thing if they could see the project from the start to the end.
Participant 10	I think leadership skills can be enhanced. You've got to keep things moving forward. It's one thing to talk about, but you've got to make it move forward. You've got to have leadership skills with it too. You've got to drive that project again. It is good if there is leadership, you know that everybody will move in together because one person is dictating everything. You know to promote the good crew leadership is highly important.
Participant 11	All of the things I mentioned about team building and collaborative effort can help enhance the learning outcome.
Participant 12	The leadership skill is easily transferable to the interview process. I think it can be enhanced so more students drive the project and enjoy and benefit the learning outcome.
Participant 13	I think project management skills should be enhanced. There are a number of different ways to do it. The whole idea is that there's a plan, and there's a sequencing here for everyone to follow. I'm very thankful for the teacher to take over the project management; however, I think students should take ownership of that.

Participants' responses are reorganized into short supporting descriptions and keywords are extracted out. The supporting descriptions and associated keywords are shown in Table 24.

Table 24. *Participant No, supporting descriptions, and associated keywords of theme 10*

Participant No	Supporting descriptions	Keywords
Participant 1	Not so much outside of all the other ones we've discussed.	
Participant 2	All the skills help student get there; and need to work on polishing all skills.	Polishing skills
Participant 3	Flexible communication; knowing what you are doing; be proactive; and be willing to change things.	Flexible communication Be proactive Be willing to make change

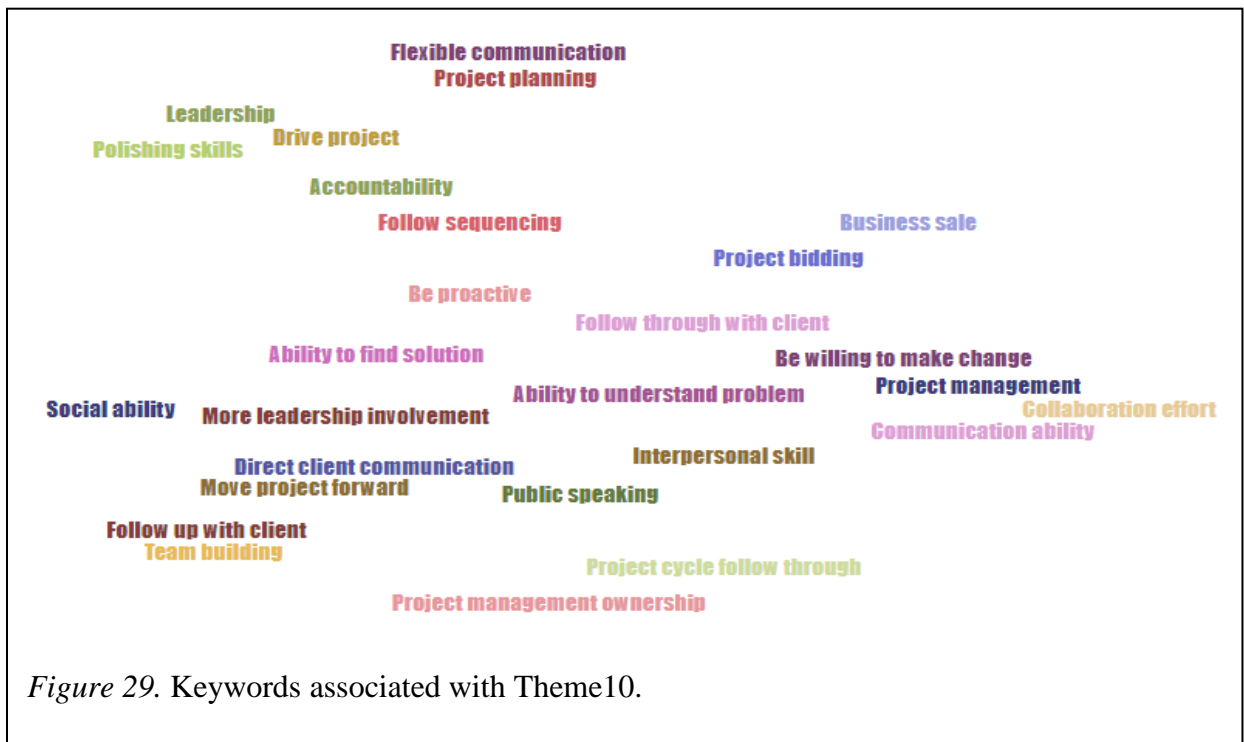
Participant No.	Responses	Participant No.
Participant 4	The ability to understand the problem; the ability to find a solution; communication ability; and social ability.	Ability to understand the problem Ability to find the solution Communication ability Social ability
Participant 5	Adding more direct discussions or opportunities to talk with the client or meet the client; give them an experience on project bidding; and expand their experience with how businesses analyze and review a sales pitch.	Direct communication with the client Project bidding Business sale
Participant 6	Public speaking is an important skill to have moving forward.	Public speaking
Participant 7	All of those skills are necessary and beneficial; and interpersonal skills can be enhanced.	Interpersonal skill
Participant 8	Be accountable after the project is delivered; follow through with client; and follow-up with client.	Accountability Follow through with the client
Participant 9	Follow through skills can be enhanced; and more beneficial if they could see the project from the start to the end.	Follow through with the whole project cycle
Participant 10	Leadership skills can be enhanced; got to keep things moving forward; and drive the project.	Leadership Move the project forward Drive the project
Participant 11	All of the things about team building and collaborative effort.	Team building Collaboration effort
Participant 12	The leadership skill can be enhanced; and there should be more students driving the project.	Leadership More student involvement with leadership
Participant 13	Project management skills should be enhanced; make a plan and have everyone follow the sequencing; and students should take ownership of project management.	Project management Project planning Follow sequencing Take ownership of project management

Aggregated data from this interview question generated one theme and 27 unique keywords. The duplicated keywords have been removed. This theme was generated based on the various learning outcomes the participants pointed in the area of need-to-enhanced employability skills. The summarized keywords associated with theme 10 are in Figure 29:

Theme 10: Need to be enhanced employability skills

- Polishing skills
- Flexible communication
- Be proactive
- Be willing to make changes
- Ability to understand the problem
- Ability to find the solution
- Communication ability
- Social ability
- Direct client communication
- Project bidding
- Business sale
- Public speaking
- Interpersonal skill
- Accountability
- Follow through with the client
- Follow-up with the client
- Project cycle follow through
- Leadership

- Move the project forward
- Drive the project
- Team building
- Collaboration effort
- More leadership involvement
- Project management
- Project planning
- Follow sequencing
- Project management ownership.



Theme 11:

Contribution to enhanced employability skills

Associated interview question:

Which aspects of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning contribute to enhanced employability skills? How has the senior capstone project influenced students' ability to take ownership of their learning?

Alignment with research question:

Research Question (RQ3) – Which aspects of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning contribute to enhanced employability skills?

The following Table 25 contains all participants' responses for theme 11.

Table 25. *Theme 11 responses*

Participant No.	Responses
Participant 1	I'd say the teamwork skill, communication skills, analytical skills contribute to enhanced employability skills. The ones who contributed most to the project have more abilities to take ownership of their learning. So, if there is a team of five, and three did all the work, there's two people that really aren't ready to get out in that workforce, and there might be three people that are ready to plug in right now.
Participant 2	Again, I think all of them contribute to enhanced employability skills. During the industry advisory board meeting, all of them emphasized all of these different types of skill sets and ways in which they expect students and future employees to interact in their work environment. So by deploying these differing skills and using these different types of teaching methodology together, I think it actually enhances each one of them individually.
Participant 3	I think all this learning contributes to enhanced employability skills. But communication and teamwork stand out. A good understanding and real practice of project development life cycle would also help with employability skills.
Participant 4	Experiential learning contributed the most. Technology has been on going, and the actual hands-on learning through actual projects can promote students' learning and researching ability, and this is what a future employer wants.

Participant No.	Responses
Participant 5	I think every single aspect of these learning techniques were utilized, and I can't see that we missed an opportunity to use another tool to build their experience. Well, I mean, the students can probably respond better, but I feel that this was a really wonderful program for everyone, for us as well as for the students.
Participant 6	OK. I think collaborative learning enhances employability skills. Just because a lot of the time in the work force you're not just working alone, you're working with a team of individuals, or you may be working alone but you have to coordinate with other teams and other entities, both internal and external. So, I think the fact that they can get comfortable working in small groups in order to achieve one goal of that group, in order to achieve a bigger picture is important for real life studying, and specifically, with employability.
Participant 7	So, I think all of those skills are essential in order to be successful. And I would also like to say just seeing that based on observance from a distance, I saw where some students really stood out when they demo their product. And what I mean by that is, they displayed charisma. They displayed that as a willingness to answer any questions that we, as an agency, presented to them in a professional manner.
Participant 8	I think all of them. I mean a lot of learning is intrinsic to the person. The more motivated ones that love the problem-solving aspect of computer software design versus those who may see it more as a good career option, the ones that are really have their hearts in it are going to be the ones who most take ownership of their learning and learn a lot. But I think because of the nature of the project, I think everybody is going to be able to learn something, and there's going to be a certain amount of ownership of learning even if it is, you know, more limited. For some students who have more limited skills or abilities or are that type of thing. I think students are going to be more responsible for the learning.
Participant 9	I would think the hands-on may be the biggest factor for making employability skills. They were basically given freewill doing the configuration, they came to us and asked can we do this, can we do that; they basically take ownership themselves for the most part. So I think experiential leaning is the most contributing factor.
Participant 10	Yes, this is such a collaborative learning setting. They all help to improve employability skills. Employers are looking for students to have this kind of real world, hands-on experience. Our project is heavily service learning and project learning influenced. With a real hands-on project like this, you will have lots of sought after skills. Sure, I do believe students take ownership of learning. It is not only an ownership of their learning but also an ownership of society.

Participant No.	Responses
Participant 11	For those team members that were engaged and are highly motivated, my answer would be yes. For the students who lack of motivation that do not show up, they are not engaged in experiential learning.
Participant 12	Like I said earlier, I think they are all contributing to employability skills. When you did a real project for an organization, you practiced team collaboration skills, tested your textbook knowledge, and for sure received a good outcome. When you did something that had a good outcome, you knew you got a lot for what you did. It is good. It makes you employable, more knowledgeable, it makes you a good candidate to be considered, to be hired, and watch you do the same when you are working.
Participant 13	I think the collaborative experiences certainly help enhancing employability skills. It probably is the most important skill. Students are here to learn something, and they were accountable for making something happen. To achieve the success, team collaboration is needed. One of my favorite words is action. We go into a meeting trying to solve an issue; I would be only interested in knowing what the action is. Trying to solve the problem won't be helpful, what I needed to see is the actual action.

Participants' responses are reorganized into short supporting descriptions. The keywords are extracted out. The supporting descriptions and associated keywords are shown in Table 26.

Table 26. *Participant No, supporting descriptions, and associated keywords of theme 11*

Participant No	Supporting descriptions	Keywords
Participant 1	Teamwork skill, communication skills and analytical skills contribute to enhanced employability skills; and the most contributed members have more abilities to take ownership of their learning.	Teamwork skill Communication skill Analytical skill
Participant 2	All of them contribute to enhanced employability skills.	All
Participant 3	All contribute to enhanced employability skills; communication and team work skills stand out; and good understanding of project development life cycle.	All Communication skill Team work skill Project development skill
Participant 4	Experiential learning contributed the most; technology skills; and researching ability.	Experiential learning Technology skill Research skill

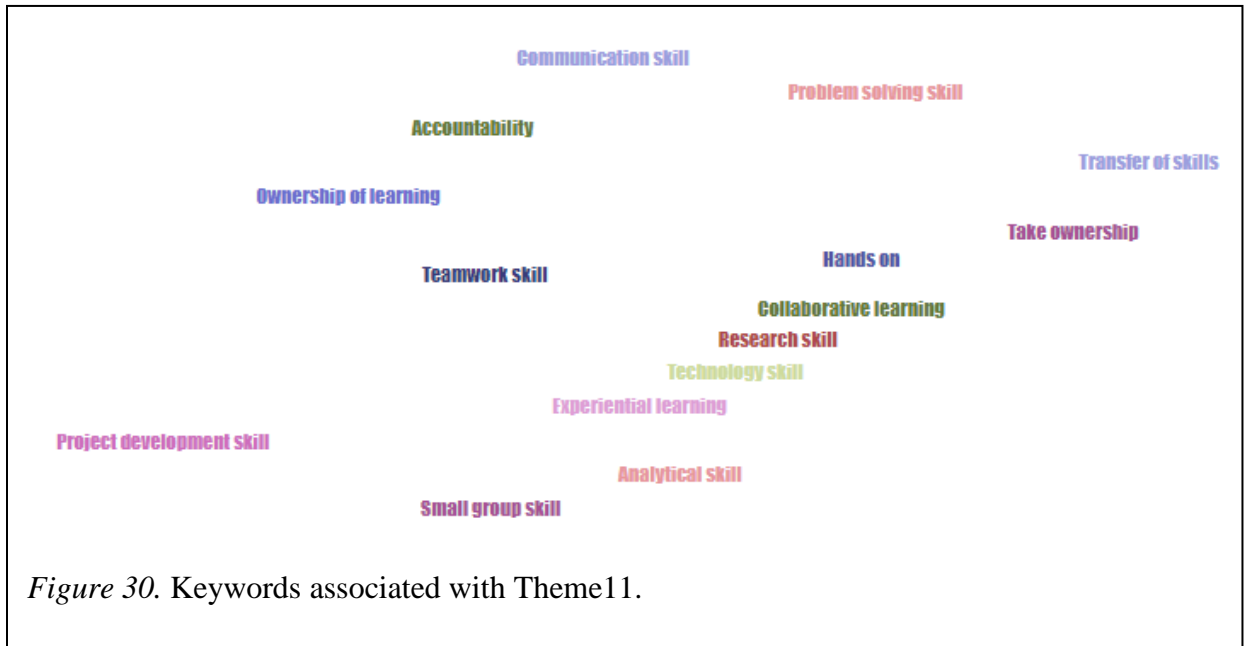
Participant No	Supporting descriptions	Keywords
Participant 5	Every single aspect of these learning techniques was utilized.	All
Participant 6	Collaborative learning enhanced employability skills; and be comfortable working in small groups.	Collaborative learning Small group skill
Participant 7	All of those skills are essential; some students have a willingness to answer questions really stood out.	All
Participant 8	All contribute to enhanced employability skills; and more motivated students can learn a lot.	All
Participant 9	The hands-on maybe the biggest factor; take ownership themselves; and experiential learning is the most contributing factor.	Hands-on Take ownership Experiential learning
Participant 10	All help to improve employability skills; have lots of sought after skills; and take ownership of learning.	All Ownership of learning
Participant 11	Yes, for those team members that were highly engaged and motivated; and no, for students who lack of motivation.	All if students are motivated
Participant 12	All contributing to employability skills; including team collaboration skills and transfer of skills; and it makes you employable, more knowledgeable, a good candidate to be considered.	All Team collaboration skills Transfer of skills
Participant 13	Collaborative experience helps enhancing employability skills; students need to know they were accountable for making something happen; team collaboration is needed; and take actions to solve the problem.	Collaboration skill Accountability Problem solving skill

Aggregated data from this interview question generated one theme and 15 unique keywords. The duplicated keywords have been removed. This theme was generated based on the various learning outcomes the participants pointed in the area of contribution to enhanced

employability skills. Out of the 13 participants: eight believe all skills can contribute to enhanced employability skills; one believes the contributing factors are collaboration skill, accountability, and problem-solving skill; one believes the contributing factors are hands-on, take ownership, and experiential learning; one believes the contributing factors are experiential learning, technical skill, and research skill; one believes the contributing factors are teamwork skill, communication skill, and analytical skill; and one believes the contributing factors are collaborative learning and small group skill. The summarized keywords associated with theme 11 are in Figure 30:

Theme 11: Contribution to enhanced employability skills

- Teamwork skill
- Communication skill
- Analytical skill
- Project development skill
- Experiential learning
- Technology skill
- Research skill
- Collaborative learning
- Small group skill
- Hands-on
- Take ownership
- Ownership of learning
- Transfer of skills
- Accountability
- Problem solving skill.



Theme 12:

Student’s behavior

Associated interview question:

How, if at all, did completion of the real-world problem based senior capstone project influence the way students process information and their creative or imaginative behavior because of the senior project? Are students becoming more or less responsible for their learning after the whole industry/community project partnered capstone experience?

Alignment with research question:

RQ3 - Which aspects of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning contribute to enhanced employability skills?

The following Table 27 contains all participants’ responses for theme 12.

Table 27. Theme 12 responses

Participant No.	Responses
Participant 1	Yeah, I definitely think they do. The real-world problem based senior capstone project let students experience different cultures and different people. The more responsible students will swim while the not so responsible students will sink. These students are more or less responsible for their version. The capstone project trains students to plug into the workforce. While some students think they are about to start the next chapter of their life, the students that are doing real world-based capstone projects already landed on the industry platform.
Participant 2	As opposed to just doing collaborative learning or just doing experiential learning or probably being the learning cats on project use a little bit of all of those, and they help to complement each other. The senior capstone certainly helps the students to be more effective when they get out of school into the real workforce. Some skills like responsibilities and kindness are the things that we don't think of as formal school learning but are critical in their career. They, oftentimes, are just discovering at the point of the capstone; it would be nice if there was a way that the capstone could actually run over the period of their educational process. I know a lot of institutions are trying, but it's very difficult to do. But some of these things would really make their work in school more effective. They don't realize until they actually take the capstone course, and this is a really good example. Think of all the students that can never get anything in on time. They don't show up to class on time. These students can't function in the real world like that. They don't really see that pressure or that need for that level of responsibility. We talked earlier about the social skills, it would be good for some of the things introduced earlier before they got there. Again, I think it would make it a better experience for them because they wouldn't be learning elementary things that they should have learned four years ago. The flip side is you can say by doing these you're at least covering all these things. So, you're at least not turning to a student now and he still isn't aware of his responsibilities.
Participant 3	Yeah, I think so. The real-world application often involves many different technologies, and this motivates students to learn more. Students will find a real-world project is more appealing compared with some other projects. They were exposed to so many aspects of a real-life project, and this can help student nail down a specific area that they want to focus on as a future career.

Participant No.	Responses
Participant 4	Again, it depends on individual's engagement and motivation. The more motivated students will be more creative and more responsible for their future career. Just like when they are taking a class, not all of them will get 100% out of it. The kids who got the desire, who cares more about their education, will become more responsible.
Participant 5	I think that they're more responsible for their learning. Again, you can see all of those little building blocks are now being employed to help move this project to meet the client's demands. And students seem to really dive in and take that challenge, even if they might have felt a little unfamiliar with that aspect of IT but knew that they needed to help the team get to that goal, so they dug their hands in and did what it took to meet the goal.
Participant 6	I think that the capstone project allows them to take responsibility for something they know that that they're responsible for producing, maybe what a client wants specifically. So, I think it definitely does enhance their responsibility for their learning. I think it also enhances their creativity because they can offer new suggestions that maybe we didn't even think about before. So, I think it both increases responsibility for their learning as a whole because a lot of the times they might have to learn something new. They quickly take the time to research something they don't necessarily understand, and then go back and see how that research is helpful when implementing that into the project. And I think it makes things easier if you don't understand it, so that you could simply research it and also rely on one another and maybe talk and use brainstorming with one another to come up with a solution.
Participant 7	Absolutely. Absolutely. And generally speaking, this is my opinion. But again, if a student is in this field, they should really have a desire to learn. Otherwise you know that it can be a waste of time doing it if the heart isn't in it. It can be fruitless. So, the assumption is everyone wants to do. This is also what they're actually going to school for. Now with that being said, I think the stronger individuals who really have the go-get-it- done attitude would excel further because their desire and intensity would be higher, in my opinion, than someone who may be lacking those attributes. I absolutely think that they would become more responsible as a result of this capstone project. However, again, I will revert back to, I think, the ones who benefit the most are the ones who are motivated the most. So again, if an individual actually has the desire to succeed, to win, to get the job done, to be a team player, that individual will absolutely benefit from that capstone experience as opposed to someone who will kind of sit back and let everyone else do the work.

Participant No.	Responses
Participant 8	I think so. Well I would expect that they would become more responsible for their learning having done group work myself in the past. I know that it's hard to know with each individual and the group is equally as engaged in the project as others. So, while some may be more responsible for their learning, others may have relied on the skills of their group partners, and maybe not learn so much, and given that I had limited exposure to the group. I can kind of only speculate about their learning outcomes because I would expect it to be more responsible for their learning.
Participant 9	I would think so; I would think the hands-on certainly helps students on their problem-solving skills and creativity ability in the technology area. They come in and take the ownership of the project, I'm sure they do their own research and learn new technologies, and they should be more responsible for the learning.
Participant 10	Yes. Individuals are going to bury individuals with very little motivations. You know if they get through it, yes. If they complete, absolutely. When it is a real-world project, especially a project that's got a huge human component and society component to it, it can add just a lot of good feeling around it and make them more creative. It's a high-level experience that you know if we had money as a nonprofit we would pay somebody to do so. Such hands-on project will need them to learn a lot of things outside their textbook. And that's part of the investment of your education is that you do that work, and you get that down the road.
Participant 11	Again, it depends on their engagement and motivation. The engaged students will be more creative based on the hands-on experiential learning and be more responsible for learning new technology.
Participant 12	Yeah, I would think so. They know they would have to transfer their learning, learn new knowledge to get the project done. It certainly helps them with their creative behavior because there are always many ways to meet the project specifications. They are more responsible working in a team environment because most of us rarely work alone on our own, you need to have the skills to be part of a team, or collaborative work effort, or some kind of interactive communication.
Participant 13	I think it is going to have an impact, and students should be more responsible. By doing a real-world project, communicating with the customer, they know it is important to keep a project deadline and be more responsible for their project management and project follow through skills. They know how to deal with customer inquiries and try to take care of things well.

Participants' responses are reorganized into short supporting descriptions. The keywords are extracted out. The supporting descriptions and associated keywords are shown in Table 28.

Table 28. *Participant No, supporting descriptions, and associated keywords of theme 12*

Participant No	Supporting descriptions	Keywords
Participant 1	Capstone did influence student's behavior; and more responsible students get more out of it.	Influenced behavior
Participant 2	Student are more effective when they enter into the real workforce; students can demonstrate responsibilities and kindness; and students have enhanced social skills.	More effective Responsibilities Kindness Enhanced social skills
Participant 3	Students have motivation to learn more; and can make future career choice based on the experience.	Motivation about learning Easier to make career choice
Participant 4	More motivated students will be more creative and more responsible.	More Creative More responsible
Participant 5	More responsible for their learning; know how to meet the client's demands; ready to dive in; and take that challenge.	More responsible Meet the client's demand Ready to dive in Ready to take the challenge
Participant 6	Capstone project allows students to take responsibility; it definitely does enhance student's responsibility for learning; enhanced student's creativity; ability to offer new suggestions; increased desire to learn something new, the ability to conduct research, the ability to test the effectiveness of research when implementing that into the project; and the ability to brainstorming with one another to come up with a solution.	Enhanced responsibility Enhanced creativity Ability to offer suggestions Increased desire to learn Increased research ability Brainstorming ability

Participant No	Supporting descriptions	Keywords
Participant 7	Have a desire to learn; have the desire to win; have the desire to get the job done; the stronger individuals who really have the go-get-it-done attitude would excel further; they would become more responsible as a result of this capstone project; and the highly motivated will benefit the most.	Desire to learn Desire to win Desire to achieve
Participant 8	More responsible for learning.	More responsible
Participant 9	Hands-on help with problem solving skills and creativity ability; the ability to conduct research; the ability to learn new technologies; and they should be more responsible for the learning.	Problem solving Conduct the research Learn technology
Participant 10	It will influence students; individuals are going to bury individuals with very little motivations; add just a lot of good feeling around it and make them more creative; need to learn a lot of things outside textbook; and you do that work and you get that down the road.	More creative Learn outside of the textbook
Participant 11	Depends on the level of engagement and motivation; and the more engaged students will be more creative and be more responsible.	More responsible
Participant 12	More creative; know transfer learning; learn new knowledge; aware of many ways to meet the project specifications; have the skills to be part of a collaborative work effort; and have interactive communication.	More creative Transfer learning Meet project specification Collaborative effort Interactive communication
Participant 13	It is going to have an impact and students should be more responsible; students know how to keep a project deadline; be more responsible for project management; be responsible for project follow through; students know how to deal with customer inquiries; and know to take care of things well.	More responsible Keep deadline Better project management Project follow through Deal with the customer inquiries

Aggregated data from this interview question generated one theme and 31 unique keywords. The duplicated keywords have been removed. This theme was generated based on the various learning outcomes the participants pointed in the area of collaboration learning. The summarized keywords associated with theme 12 are in Figure 31:

Theme 12: Student's behavior

- Influenced behavior
- More effective
- Kindness
- Enhanced social skill
- Motivation about learning
- Easier to make career choice
- More creative
- Meet the client's demand
- Ready to dive in
- Ready to take challenge
- Enhanced responsibility
- Enhanced creativity
- Ability to offer the suggestion
- Increased desire to learn
- Increased research ability
- Brainstorming ability
- Desire to learn
- Desire to win
- Desire to achieve

- Problem solving
- Conduct research
- Learn technology
- Learn outside of the textbook
- Transfer learning
- Meet project specification
- Collaborative effort
- Interactive communication
- Keep deadline
- Better project management
- Project follow through
- Deal with the customer inquiries.

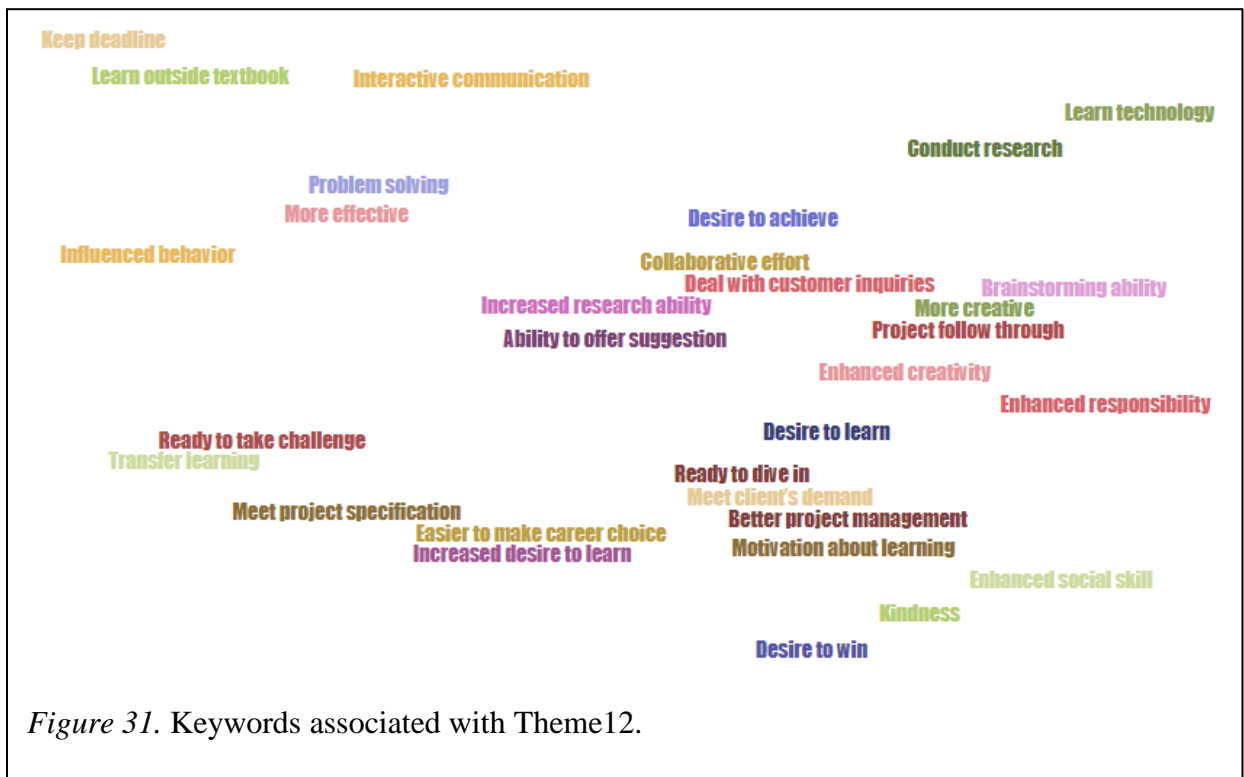


Figure 31. Keywords associated with Theme12.

Theme 13:

Benefits in real workforce

Associated interview question:

Do you feel that the lessons learned through the senior capstone project will eventually benefit students when they enter the real workforce? Why or why not? What observations have you made to justify your answer?

Alignment with research question:

RQ3 - Which aspects of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning contribute to enhanced employability skills?

Table 29 contains all participants' responses for theme 13.

Table 29. *Theme 13 responses*

Participant No.	Responses
Participant 1	Yeah, I definitely think that it's going to benefit them because students now have a communication topic during the interview, which differentiate them from other candidates who do not have that talking point. When candidates have similar experience, it's really going to be those sort of soft skills we talked about – the quantitative skills, the interpersonal skills, and the communication skills. Students need to be able to talk about when they failed, how they communicate, and what environment they would like to work. And you know, some of these things that are definitely things you can apply from the real world based senior project experience. The senior project experience let students gain a ton of real life situations that they can discuss during an interview. From my personal experience with dealing with students with real world problem based senior capstone project, I want them to have an idea that technology is the easy part of the project while people are the difficult part, and they get a real experience with that.
Participant 2	I mean they're actually in the workforce, the real-world problem based capstone puts them into workforce. And this fact makes it much different than other courses they're just doing for passing. We can see a lot of this with our engineering students since engineering students are often doing internal projects that are not real-world problem based. These internal

projects often lack real wisdom or real understanding of the actual business environment. They failed to figure out what true costs are, how people are going to use it, since they don't have a feeling for that because they're not interacting. So just the fact that they're in that environment and this experience would not help them when they are interviewing.

Participant 3 Yeah, I think so, definitely. The school project may not be as complicated as a real-world project. Students learned many different aspects of how to execute a real-world project, how to communicate with working professionals, and how to deal with the real business entity. All these hard skills and soft skills will benefit them.

Participant 4 Yes, I do, if they put in work effort, the senior project will benefit them when they are in real industry setting. Every experience matters, whether it is good or bad, it is a learning experience. I don't believe in making mistakes, I only believe in your ability to learn to remember and to move on.

Participant 5 OK, well yes, I think they did learn, and it will benefit them in the real world. I hope they do point to this project in their portfolio. And you know, in their interviews this was something that really gave them real world experience like an internship, or a first job, or might have more than an internship. If this was a first job, it would be unlikely that you would be left alone and said you've got to make this part work, you probably have more help on that. So, this was really for you to get through the process. And I think that was a really important part of the game that we wanted to have a credit page that gave recognition to the students because we recognized that they functioned as a company. I could've went to a company and said, we need a game, but we went to the students and said, hey, we want the students to build this for us because we think it will not only give a good product to our passengers, promote our concessionaires, but it's a great partnership with the educational community and helping them get real world experience that will further their career path and benefit the community as a whole.

Participant 6 Yes, I feel like a lesson learned will eventually benefit the students when they enter the workforce because it is one great experience that they could actually show their product. So, I think that's great. And then the observation I've made to justify this is that they have lots of images of themselves at the meet and greet event, they have video footage of them at the meet and greet event. These are the living proof, and they could attest to the different aspects that they actually put into the game. So, and I think it's impressive for their real-life experience. Future employers would find impressive working with such a large entity like O'Hare International Airport.

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- Participant 7 OK. And I would say, yes, but you know I'm kind of on repeat right now because I think I've answered it in other questions. I think it will benefit them because of the collaborative effort. So often when we get real world jobs, you know, we have to work with people and sometimes, or I should say often, our personalities may not go well. So, this capstone project allowed the students to see what it was like to be assigned a task and have to complete that task and rely upon others that may not have had the same experiences and backgrounds that we do, in order to accomplish sets of goals. So, I look at it as being an excellent learning experience that they can apply in their future careers.
- Participant 8 I'd say absolutely. I think they will because each project has unique issues and problems that you know you don't realize you're going to run into until you're in the middle of it. You know your trouble shooting problems on the fly, maybe at the last minute having to come up with work around when things don't work as they are expected, and you expect them to. So, and I think, I saw that quite a bit. You know when we were having our phone interviews and they'd say, well you know this didn't quite work as we expected it to so then we had to do this. And so you know we had to delay delivery of this part, but you know, we're working on this. And so, you know, I did see quite a bit of that as we were working through the projects. And I think that'll definitely help them when they join the workforce.
- Participant 9 Definitely. I think any experience you have, and you carry forward to the actual job would be beneficial. Anything you learned from one job to the next job would be helpful. The team effort, the problem solving, can be carried forward to the future.
- Participant 10 I believe they will benefit from their experience, and the work that we have all each other with. They get to practice their technology skills, teamwork skills, communications skills, collaboration skills, and leadership skills. These are all the skills the real industry is looking after. For me personally, I have 20 years of documents that I want to back up. Without the server the students configured, I won't be able to do that.
- Participant 11 Overall, yes. The problem-solving skills, the project development skills, and the project implementation skills all helped. There is one thing you learn from the book, and there is another thing to actually do it, so the actual doing of it can benefit students when they are employed.
- Participant 12 I think so. I think our project is similar to projects running in the real workforce. The senior capstone is a closure of students' education path. The teamwork, the collaboration, the sense of responsibility, the increased communication, and the project usefulness will all benefit students.
-

Participant 13	Yes, I think definitely. They have seen the impact of their work. This is different than the academic curriculum where they just practice a scenario, and they know they can master. This is real world environment and totally different than answering the questions of the book. Our work is valued, and that means students get to use the form of value. I think they absolutely feel good about that and can talk about their project during interviews.
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Participants' responses are reorganized into short supporting descriptions. The keywords are extracted out. The supporting descriptions and associated keywords are shown in Table 30.

Table 30. *Participant No, supporting descriptions, and associated keywords of theme 13*

Participant No	Supporting descriptions	Keywords
Participant 1	Definitely going to benefit students, good communication topic during interview, differentiate from other candidates without the talking point; and soft skills make them stand out with candidates with similar experience.	Benefit students in workforce Good interview communication topic Differentiate from other candidates Soft skills
Participant 2	Benefit students since capstone is executed in the real workforce; students have a real understanding of the actual business environment; and this experience helps with interviewing.	Benefit students in the workforce Real understanding of the business
Participant 3	Definitely benefit students; students learned how to execute a real-world project; how to communicate; and how to deal with real business entity.	Benefit student in workforce Project execution Communication Deal with business entity
Participant 4	It does benefit when students put effort in; and all experience, whether good or bad, is still a learning experience.	Benefit the student with effort
Participant 5	They did learn, and it will benefit them in the real world; and highlight point in students' portfolio.	Benefit the student in the workforce Highlight point in the portfolio

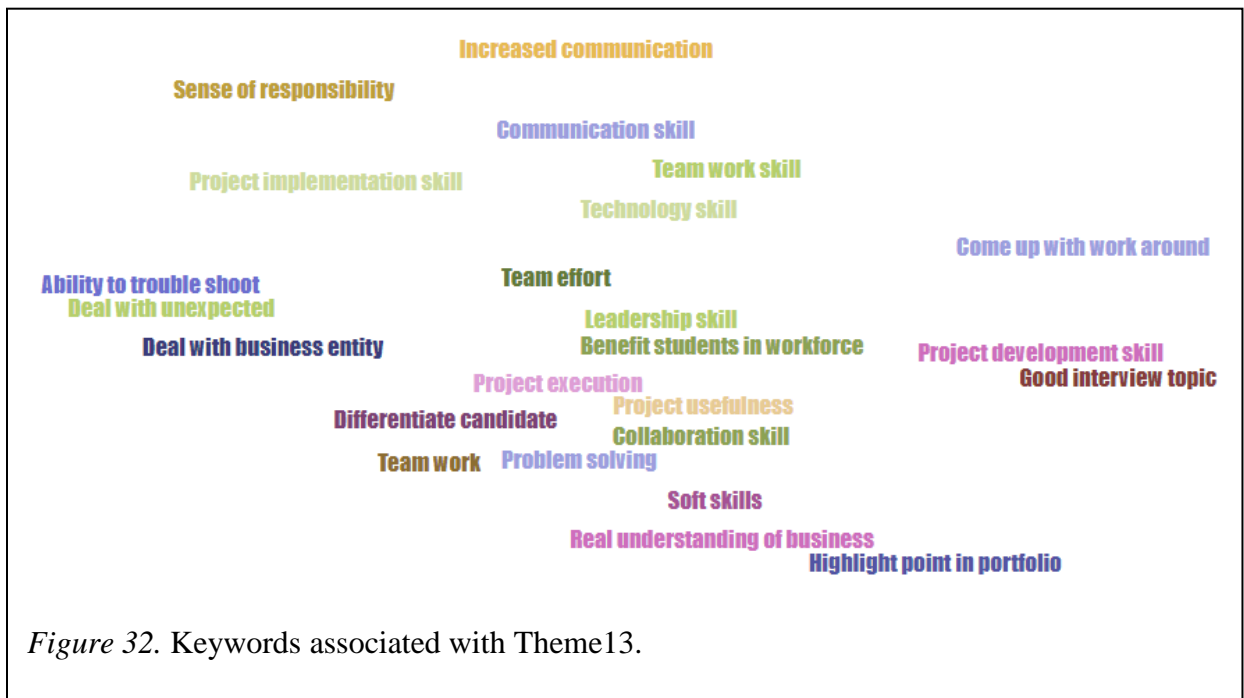
Participant No	Supporting descriptions	Keywords
Participant 6	It will benefit the students; students have living proofs to show to employers; and future employers would find impressive that students worked with such a large entity.	Benefit the student in the workforce
Participant 7	It would benefit students due to the collaborative effort.	Benefit the student
Participant 8	Absolutely benefit students; learn to deal with the unexpected issues; learn to trouble shoot problems on the fly; and come up with work around.	Absolutely benefit the student Ability to deal with the unexpected Ability to trouble shoot Come up with work around
Participant 9	Any experience carries forward to the actual job would be beneficial; anything learned from one job to the next job would be helpful; and the team effort and the problem solving can be carry forward to the future.	Benefit the student Team effort Problem solving
Participant 10	It will benefit; practice their technology skills, team work skills, communications skills, collaboration skills and leadership skills; all the skills are what the real industry is looking after.	Benefit the student Technology skill Team work skill Communication skill Collaboration skill Leadership skill
Participant 11	Will help student enter workforce; the problem-solving skills, the project development skills, and the project implementation skills are the helping factor; and actual doing of it can also benefit students.	Benefit the student Project development skill Project implementation skill
Participant 12	Will benefit students; the teamwork; the collaboration; the sense of responsibility; the increased communication; and the project usefulness.	Benefit the student Teamwork Collaboration Sense of responsibility Increased communication Project usefulness
Participant 13	It will benefit students and they have seen the impact of their work.	Benefit the student

Aggregated data from this interview question generated one theme and 24 keywords. The duplicated keywords have been removed. This theme was generated based on the various learning outcomes the participants pointed in the area of the benefits in real workforce. All 13 participants (100%) confirmed that they all believe the lessons learned through the senior capstone project will eventually benefit students when they enter the real workforce. The summarized keywords associated with theme 13 are in Figure 32:

Theme 13: Benefits in real workforce

- Benefit the students in workforce
- Good interview topic
- Differentiate candidate
- Soft skills
- Real understanding of the business
- Project execution
- Deal with business entity
- Highlight point in the portfolio
- Deal with the unexpected
- Ability to trouble shoot
- Come up with work around
- Team effort
- Problem solving
- Technology skill
- Teamwork skill
- Communication skill

- Collaboration skill
- Leadership skill
- Project development skill
- Project implementation skill
- Teamwork
- Sense of responsibility
- Project usefulness
- Increased communication.



In addition, the researcher asked each participant to deliver one most important message to students towards the end of the interview. All the messages are summarized in Table 31.

Table 31. *Messages delivered to students*

Participant No	Messages delivered to students
Participant 1	Senior capstone helps students learn all of these skills, but at the end of the day what you need to really understand is you're working with different people, coming from different backgrounds with different lives.
Participant 2	I think the most important thing is that students learn a sense of responsibility and commitment and seeing the project through. A lot of times with school work, students will just do it to get by in this one class, instead of necessarily learning the material long term. I think by doing a real-world capstone they realize the value of a continual learning and the sense of responsibility in executing something. They will enjoy being successful, and you can see how that's going to carry that away as they go on.
Participant 3	I think probably the most important thing is collaboration and communication.
Participant 4	You have to learn from experiences. Experience can be good or bad, but if you gave up, you don't learn anything. In life, if you want to be successful, you have to accomplish something. The biggest tip is no matter how difficult the project is, there is always a solution. There is never an unknowing scenario in technology, just identifying it, trying to solve it, and move forward with it.
Participant 5	Well, I think that for me they should learn that it can be messier to work in the real world than in theory because things change. There's a lot of people providing input and direction, and it can be very difficult to meet the needs of all of those directions and still get the project done. We haven't released the game yet, and unfortunately, that's the real world, and it is something that is frustrating. But, boy, you do live that in the real world, so I think that's probably a really big learning experience between theory and practice. Because students only think what it's like for a course assignment. Ok, this is a description, and I have two weeks to work on it. Right in the real world, things are different. There will be lots of modifications to the eternal plan. Hopefully this is a big lesson.
Participant 6	I think the most important things students learn from the real-world problem base senior capstone project is to work with, and communicate with, not only each other, to make sure that it's clear communication in the back internal wise, but also to make sure that they're presenting their work clearly as well to the client. And I think they learned how to communicate in a business-like setting. So with weekly meetings, they're able to see the client's needs and work to achieve the client needs while also staying true to their creative touch and offering new suggestions, as well, and solutions to issues that maybe we don't have at the time.

Participant No	Messages delivered to students
Participant 7	If I would deliver the message to students I would tell them first of all be a part of something that you enjoy doing, because that is half the battle. In my opinion, if I enjoy it, I'm going to be willing to put in the work in order to get the job done. And again, never underestimate the power of interpersonal skills because oftentimes that could be the deciding factor between you and your competitor for that particular position. I know, like even though I don't remember their names, and to some extent barely remember their faces, I do remember that there were several who stood out in both demos. There were a handful that clearly stood out from the rest. I remember that during the demo each one had to speak, there were some there just do it due to shyness. You know, speaking in front of people that they're not familiar with, we all understand that. But I would think, to a certain degree, even the ones who stood out were somewhat nervous of getting in front of individuals that they've never met before. And let me speak for myself at least, I could clearly see, for the ones who stood out in my opinion, they had a desire, and they will succeed. And again, it was evident in the words that they expressed, and their mannerisms while expressing them. So that's very key, in my opinion. The motivation has placed huge factors into the future success. Yes, I think.
Participant 8	Well, they're tackling a real-world problem in a specific limited time frame with specific limitation budgetary, etc., and they're solving the problems that develop in a less than ideal situation. And I think this is different from textbook learning where the projects and the software are generally kind of idealized, and at least this has been my experience when working with software textbook-based problem. So, they have to work with all the bugs and glitches. So, I think that the most important thing is kind of, you know, the imperfection of the real world and kind of working through that. Being able to kind of keep their sense of humor.
Participant 9	They came in and did a good job on the project, this is a good thing to carry forward. I want to tell them never give up. That's kind of a big one.
Participant 10	You have an amazing ability to get out of it and be honest about it. You know such experience can directly get you to a good paycheck, into that career that you're pursuing.
Participant 11	If you are not a contributing member of a team, your team will fall apart. I think it is a great opportunity for students to get a lot out of it.
Participant 12	This is real life. This is more than hypothetical. Whatever you are work on, it can make an important change for the organization they work for. If the visitors of our new organization website find it resourceful, find it user friendly, find it easy to access, you've done a good job. So, I suggest detailed follow-up and follow through.

Participant No	Messages delivered to students
Participant 13	Have a time for something, don't treat senior capstone as just check off the box.

Thirteen major themes emerged from the detailed data coding process by analyzing the 13 interview transcripts. Furthermore, keywords were extracted out by analyzing each theme. The data analysis and the aggregated keywords all indicated that participants believed that the real-world problem based senior capstone courses support Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning. They all expect to see enhanced learning outcomes in the area of various learning theories. In addition, the responses of all participants revealed that the real-world problem based senior capstone project could greatly enhance students' employability skills.

Summary of Chapter

This chapter reviewed the demographics of the participants, the general overview of data collection and data analysis process, emerging themes, and the presentation of findings. The purpose of the study was to examine the learning outcomes and employability skills computer science students gained through senior capstone courses when the courses are partnered with industry/community organizations through real world problems. To address the purpose of the study, the researcher used the well-designed, semi-structured interview questions that are closely aligned with all three research questions and interviewed 13 participants from various positions of different industry sectors. While eight of the interviews were done face-to-face either at the researcher's office or at the participant's office, the remaining five interviews were done through online video conferencing via WebEx. The interviews ranged from 30 minutes to one hour and 25 minutes and were audio recorded and transcribed. Thereafter, the collected data were coded and analyzed. The data coding analysis revealed 13 major themes which are: collaborative

learning outcomes, experiential learning outcomes, project-based learning outcomes, transfer of learning outcomes, service learning outcomes, soft skills, specific learning outcomes, student's performance, employability skills, need for enhanced employability skills, contribution to enhanced employability skills, student's behavior, and benefit in real workforce. All 13 themes were associated with interview questions that were closely aligned with research questions.

Chapter Five further elaborates on the findings of Chapter Four and summarizes the findings in relation to the central research questions. This final chapter presents not only an overview of Chapter One through Chapter Four but also the study limitations. Moreover, Chapter Five describes the research implication for both scholars and practitioners and presents the research contributions to the body of knowledge and literature.

CHAPTER FIVE

The purpose of this study was to examine the learning outcomes and employability skills computer science students gained through senior capstone courses when the courses are partnered with industry/community organizations through real-world problems. A set of 15 interview questions was developed, and 13 interviews were conducted with industry/community organizations professionals. The interview transcripts were coded and analyzed, and 13 themes emerged. The keywords were then extracted out from each theme. To address the research question and the problem statement, Chapter Five focuses on the prominent themes that emerged from data analysis, research finding, and conclusions. In addition, chapter five also presents the research implications and makes future study recommendations.

Findings and Conclusions

This exploratory qualitative study obtained the outcome by conducting 13 interviews with 15 interview questions that are closely aligned with the three research questions. The exploratory qualitative methodology was selected since it better supported the research questions and allowed the researcher to collect and interpret data effectively. Thirteen professionals from various industry and community organizations with extensive experience working with college computer science major students in real world problem based senior capstone projects participated. The interview participants came from an information technology (IT) industry, a consulting firm, a design firm, a state education regulatory agency, a healthcare organization, a telecommunication firm, and a nonprofit community-based organization. The participants included an IT director, a director of technology, a director of marketing, a faculty chair, a marketing assistant, a web developer, a database developer, a client relations specialist, an accounting manager, a program director, an executive director, a company president, and a consultant. The participants answered each interview question based on their actual experience

where their organization partnered with college computer science students to execute a real-world problem based senior capstone project. The participants' insights resulted in 13 themes and many keywords that can be further used to address the research questions.

This section first provides the relationships between the 13 themes and the three research questions. It provides the summarized list of keywords of each theme by forming categories. The findings that related to the research questions and hypotheses will be presented at the end.

The Relationship between the Themes and Research Questions

The 15 interview questions were designed around the three research questions, and there were 13 major themes that emerged from the data coding process of this exploratory qualitative study. Figure 33 provides a graphic representation of the relationships between the research questions and the major themes.

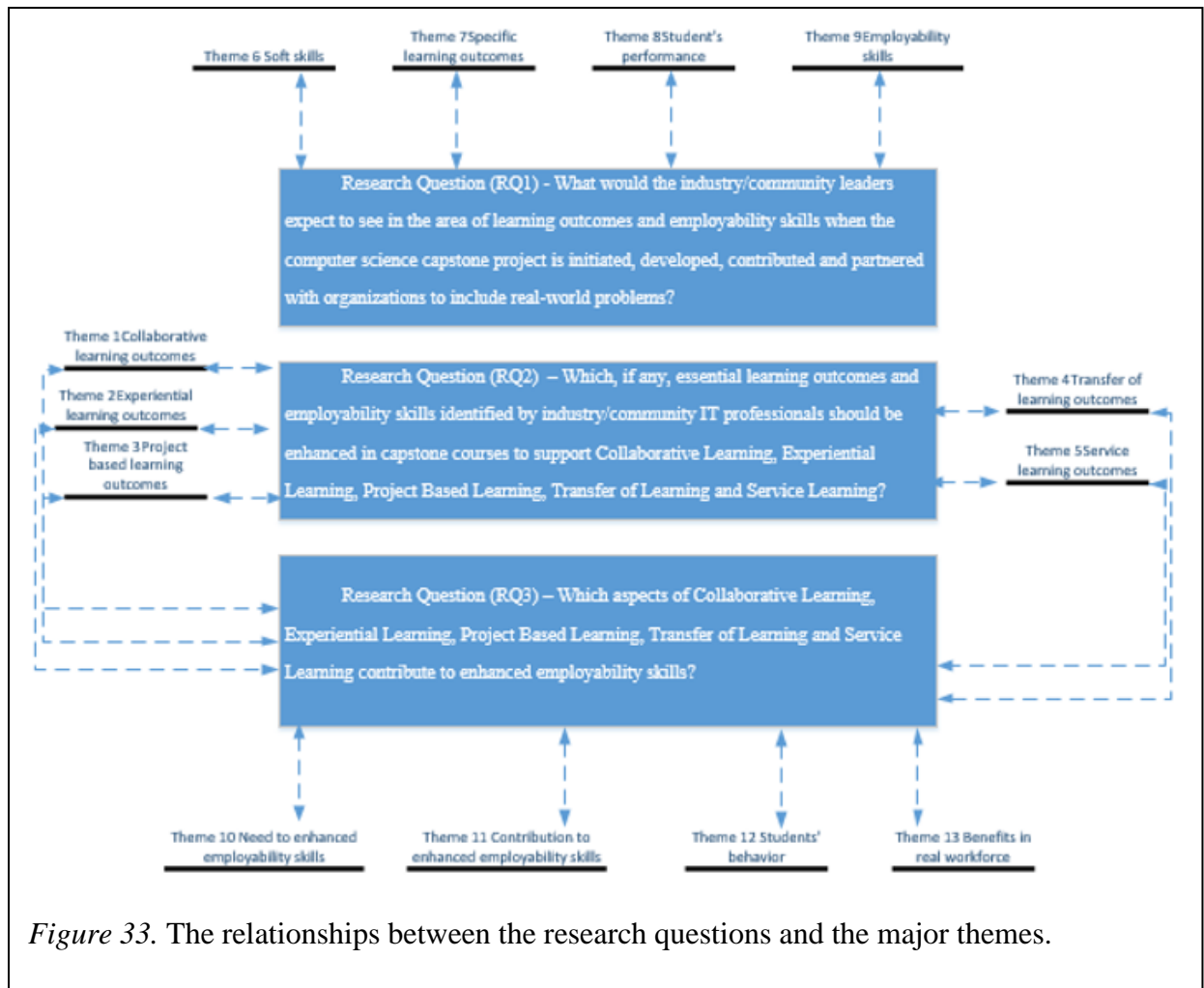


Figure 33. The relationships between the research questions and the major themes.

The Keywords Associated with Each Theme

Theme 1: Collaborative learning outcomes

Collaborative learning refers to the instructional method in which students are working together in a small group setting to achieve a common goal. The students are responsible for their own achievement as well as their team members' achievement. This shared learning method can greatly engage students in the whole process and also promote various learning outcomes.

Theme one is aligned with research questions two and three. The participants pointed out the

learning outcomes and enhanced employability skills in the area of collaborative learning. The keywords are summarized into the following five major categories:

- *Collaboration*: interaction in the business environment, work collaboratively, and the collaboration between students and teachers;
- *Personal skills*: drive the process, come up with ideas, troubleshooting ability, deal with unexpected, invest in learning, positive personality, motivation, implement research result, information sharing, do as promised, being here, be organized, have commitments, and time management;
- *Communication*: effective communication, active team communication, follow up with the client, and follow through;
- *Team management*: mix skill sets, know member strength, know member weakness, learn to maximize the minimum, team member involvement, fill-in-blank in the team, bring strength together, bring knowledge together, elevate experience, share the outcome, small group environment, work in harmony, balance skills, team playing skills, split workload, help each other, team leadership, gather information, and assign specific task;
- *Project management*: making achievable goals, putting deadlines to goals, achieve the goal, the goal for accomplishment, work on dynamic aspect, work on the identified project, put together deliverables, raise flag early for an issue, put the timeline together, and document the issues.

Theme 2: Experiential learning outcomes

Experiential learning is a great way to build up students' skills as practitioners. It can help to facilitate the transition from abstract academic theory to real practice. This immersive experience can help students achieve many learning outcomes, so they have a real understanding of the authentic situation and real-world problems. Theme two is aligned with research questions two and three. The participants pointed out the learning outcomes and enhanced employability skills in the area of experiential learning. The keywords are summarized into the following five major categories:

- *Work ethics*: fearless, proud of work, develop skills, build a better relationship, and be involved;

- *Knowledge gaining*: apply knowledge, reflect knowledge, test knowledge, draw conclusions, develop new skills, and gain experience;
- *Problem-solving*: scenario handling ability, learn about limitation, capable of implementation, study background information, and practice the right way;
- *Leadership*: grow experience and utilize team skill;
- *Feedback and debriefing*: gain feedback from different entities, effective use of feedback, make the recommendation, and offer the useful solution.

Theme 3: Project-based learning outcomes

This nontraditional education method can well prepare students to face the real-world problem challenge and trains students to learn knowledge in a more practical way. The project-based learning cannot only provide students with opportunities to drive their own learning, but also enhance many core skills. Theme three is aligned with research questions two and three. The participants pointed out the learning outcomes and enhanced employability skills in the area of project-based learning. The keywords are summarized into the following four major categories:

- *Project participation*: communicate effectively, communicate with the client, social interaction, timely feedback, met the goal, take over the project, deal with the changing environment, meet with client demands, consider audience needs, direct approach to the client, communicate the unexpected, explain the unexpected to the client, keep the client informed, and keep the leadership informed;
- *Project management*: bring milestones, show critical path, identify critical path, planning of project scope, propose scope, objective to hit goal, define project, learn about scope, identify not-defined components, diagnose issue, understand the process, going through project, plan project, offer alternative solutions, redefine project to meet goal, narrow down the goal, collect requirements, perform analysis, come up with proposal, go through checklist, plan implementation, offer work around, try to achieve goal, meet client expectation, and make agreement;
- *Twenty-first century skills*: note-taking, knowledge acquisition, learn different methodologies, adapt to the situation, use technique as tool, and troubleshooting;
- *Improved learning attitude*: follow through, follow-up, increase motivation, grow knowledge, learn from internal and external entities, grow practically, make

progressive growth, be accountable, focus on the objective, be acceptable, have a deeper understanding, and have solid experience.

Theme 4: Transfer of learning outcomes

Transfer of learning is the application in which students get to transfer their knowledge from the traditional classroom environment to a different working environment. Such application can help students developing a deeper understanding of tasks and improve their ability to learn new knowledge more proficiently. Theme four is aligned with research questions two and three. The participants pointed out the learning outcomes and enhanced employability skills in the area of transfer of learning. The keywords are summarized into the following three major categories:

- *Applying for the transfer*: differentiate environment, adapt to the business environment, able to work with the client, and meet client's needs;
- *Near transfer*: transfer classroom experience, applying programming technique, practice theory, attest knowledge, apply knowledge, transfer to practice, learn by doing, transfer theory to hands-on, the capability of applying knowledge, transfer theory, transfer plan, comprehend instructions, produce the product, test knowledge, and test fix;
- *Far transfer*: shift knowledge, deal with dynamics, think outside of the box, be aware of alternatives, learn from failure, deal with unfavorable scenarios, and seek guidance.

Theme 5: Service learning outcomes

Service learning is a special form of experiential learning to get students engaged in activities that can help address community/human needs. With the combination of learning and service contribution, it can have great learning outcomes in areas of academic goal achievement and democratic revitalization. Theme five is aligned with research questions two and three. The participants pointed out the learning outcomes and enhanced employability skills in the area of service learning. The keywords are summarized into the following three major categories:

- *Civic responsibility*: gain interest in social services, help with the upgrade, gain interest in community service, provide benefits to the community, engage with community service, make a contribution to the community, make stronger

communities, more community involvement, deeper community service understanding, and giving back to the community;

- *Career advancement*: bring cutting edge technology, deliver knowledge in a fun way, set up a good example, have the desire, deliver the product, work with limitation, and generate real usefulness;
- *Global understanding and citizenship*: learn personalities, learn backgrounds, address human needs, gain satisfaction, have a sense of the importance of public engagement, learn to put up reputation, bring positive influence, further influence individual, make future contribution, make impact, future post-graduation service involvement, make societal contribution, eager to make a contribution, make service agreement, greater satisfaction, and promoting good citizenship.

Theme 6: Soft skills

Compared to hard skills that are the knowledge of specific skill sets that employers are looking for soft skills are those personal attributes that can help enhance a student's interaction and performance. Soft skills can help students improve in the area of interpersonal skills, information skills, analytical skills, and behavioral skills. Theme six is aligned with research question one. The participants pointed out many keywords associated with soft skills and the summarized list of keywords is listed below:

- *Interpersonal Skills*: critical thinking skill, self-gathering skill, communication skill, collaboration skill, digitalized communication, digitalized collaboration, team skill, team leadership skill, leadership sharing skill, relationship skill, help skill, interaction skill, business skill, negotiation skill, communication with internal entity skill, communication with external entity skill, work in harmony, responsibility to accomplish task, take ownership, and hold team member accountable;
- *Information Skills*: problem analyzing skill, building upon skill, sense-making skill, data analysis skill, documentation skill, and troubleshooting skill;
- *Analytical Skills*: quantitative skill, qualitative skill, technology skill, research skill, and brainstorming skill;
- *Behavioral Skills*: handle new situation skill, friendship skill, presentation skill, face-to-face presentation skill, public speaking skill, networking skill, professional skill, social skill, self-control patience, due diligence, extremely dynamic, be on time, professionalism, time management, engagement and personal appearance, and friendliness.

Theme 7: Specific learning outcomes

The researcher focused on studying the learning outcomes in the area of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning. To cover learning outcomes from other areas, the researcher approached the participants to gain their perspectives of other specific learning outcomes outside the categories participants discussed. Theme seven is aligned with research question one. The participants pointed out many specific learning outcomes. The keywords are summarized in the following four categories:

- *Academic development*: technology skills, explore a new area of study, ability to collect information, technical skill, problem-solving skill, and find a way to solve the problem;
- *Client interaction*: keep leadership informed, follow up with client, engagement with the client, ability to work with the client, meet the client's need, follow through with the client, and meet the deadline;
- *Personality success*: interpersonal skills, more interactive, present new ideas, collaboration skills, able to take the challenge, effective communication, confident outreaching, growing level of confidence, team communication, leadership skill, communication skill, and take commitment;
- *Area for improvement*: not doing well in project planning, can do better for project status report, and need better team management.

Theme 8: Student's performance

Theme eight is aligned with research question one and emerged from interview question nine: Are students better, the same, or worse in the area of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning as a result of the real-world problem based senior capstone project? Describe specific examples that you have witnessed that support your reasoning. Out of 13 participants, 11 participants (77%) confirmed that students are better in all areas, two participants (15%) believed that the performance will be based on individual's motivation and that the more motivated ones will get better. One

participant (8%) pointed out that students will do better in other areas but stay the same in the area of project-based learning. (Figure 29).

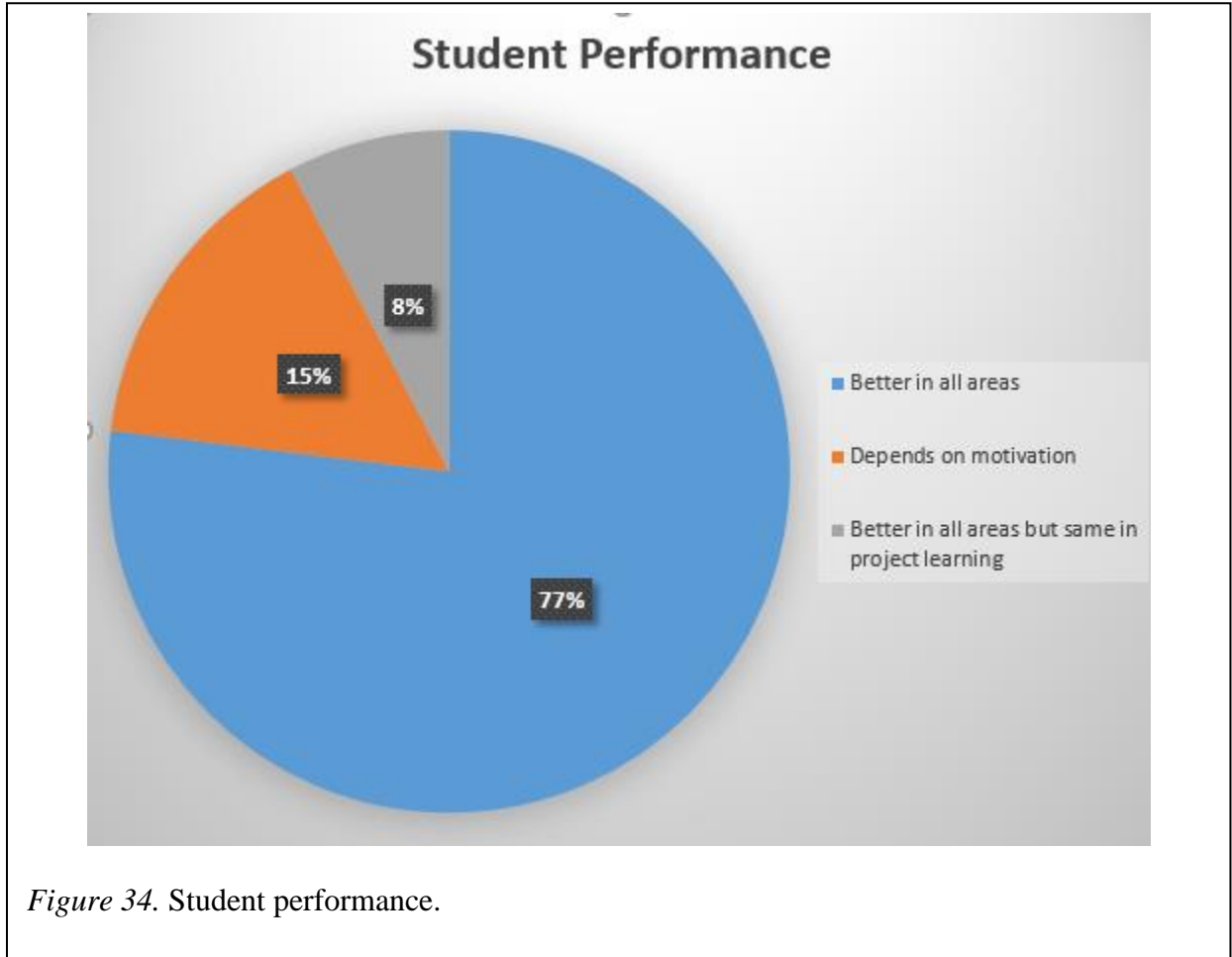


Figure 34. Student performance.

The supporting keywords that were identified include: gain stand out employability skills, increased ability to seek for help, true growing experience, better client interaction, actively seeking for advice, take various learning, increased level of confidence, increased level of public speaking, improved problem-solving skills, gain absolute knowledge use, and can transfer classroom learning.

Theme 9: Employability skills

For students to gain employment, employability skills are critical. Employability skills include both hard skills and soft skills that can make students more likely to secure employment, stay with that employment, and contribute effectively. Theme 9 is aligned with research question one. The participants pointed out what they would expect to see in the area of employability skills as a result of a real-world problem based senior capstone project. To better address the research question, the researcher developed a sub-question by asking the participants whether or not the whole experience will eventually assist students with a career choice. All participants (100%) agreed that such an experience can assist the student with employment. The keywords are summarized into the following three categories:

- *Communication and collaboration*: communication with the client, digitized communication, digitized collaboration, and communication skill with the stakeholders;
- *Teamwork*: team building efforts, managing priorities, managing expectations, managing member personalities, and communication with the team members;
- *Soft skills*: putting effort, leadership skill, research skill, analysis skill, meet deadlines, transfer experience, bring personal value, meet expectations, attitude towards improvement, timely follow up, gain experience, general societal skill, real world project skill, work with limitations, grow ability in handling limitations, and hands-on experience.

Theme 10: Need to enhanced employability skills

To address the research question three regarding the need for enhanced employability skills, the researcher asked the participants their perspectives on any essential needs for enhanced employability skills to better support the learning outcomes. Four participants posited that there is not much need for more enhanced employability skills besides the ones mentioned as expected employability skills. Nine participants mentioned some specific need for enhanced employability skills. The summarized keywords are listed below in three categories:

- *Soft skills*: polishing skills, be proactive, be willing to make a change, ability to understand the problem, ability to find the solution, social ability, public

speaking, interpersonal skill, accountability, leadership, team building, more student involvement with leadership, and follow sequencing;

- *Client communication*: direct communication with the client, collaboration effort, follow through with the client, follow-up with the client, and flexible communication;
- *Project management*: project planning, take ownership of project management, follow through with the whole project cycle, move the project forward, drive the project, project bidding, and business sale.

Theme 11: Contribution to enhanced employability skills

Theme eleven is aligned with research question three. The participants pointed out the aspects of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning that could contribute to enhanced employability skills. Out of 13 participants, eight participants (62%) believed all skills can contribute to enhanced employability skills, one participant believed the contributing factors are collaboration skill, accountability, and problem-solving skill. One participant believed the contributing factors are hands-on, take ownership, and experiential learning. One participant believed the contributing factors are experiential learning, technology skill, and research skill, one participant believed the contributing factors are teamwork skill, communication skill, and analytical skill. Lastly, one participant believed the contributing factors are collaborative learning and small group skill.

Figure 30 shows the enhanced employability skills details:

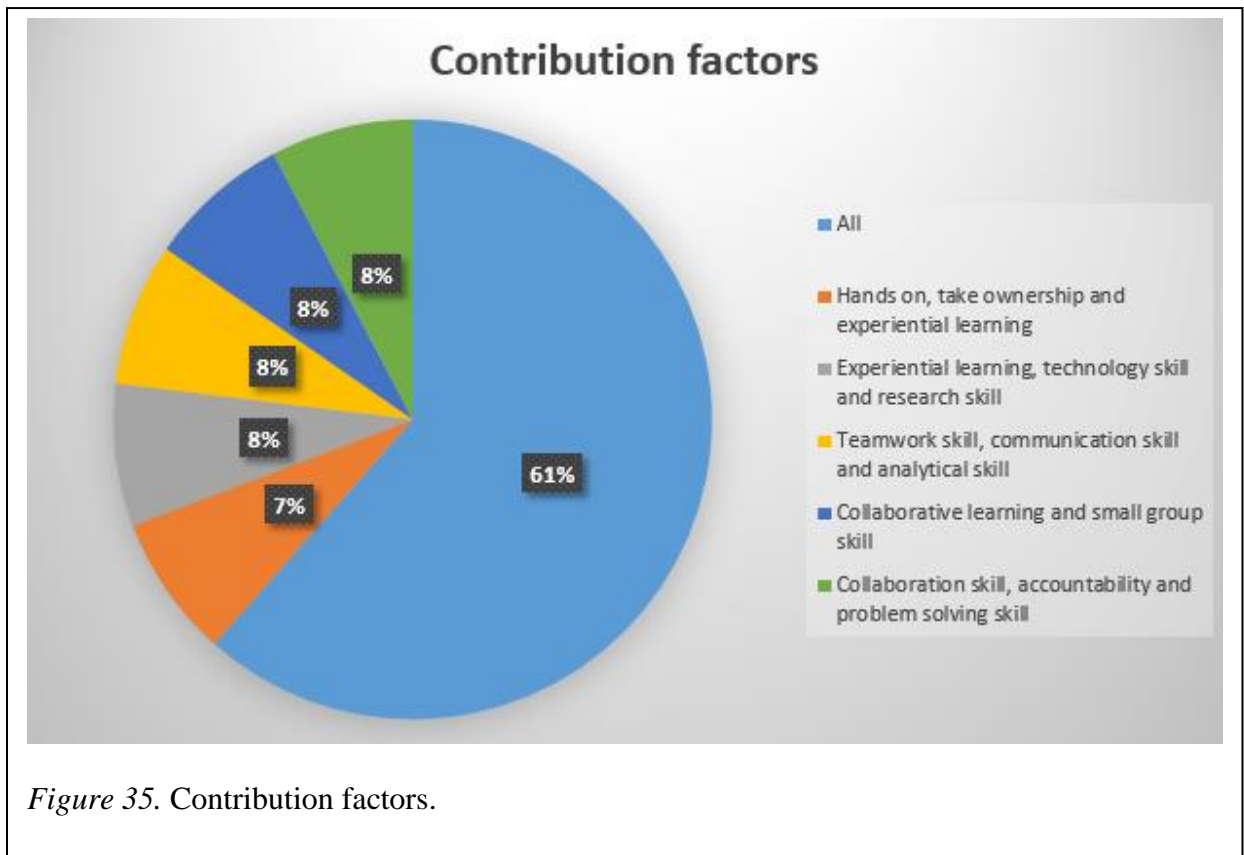


Figure 35. Contribution factors.

The pointed aspects are teamwork skill, communication skill, analytical skill, project development skill, technology skill, research skill, small group skill, hands-on skill, ownership of learning, accountability, and problem-solving skill.

Theme 12: Student's behavior

Theme 12 is aligned with research question three. The participants pointed out students' creative behavior, information processing ability, and responsibility as a result of completing the real-world problem based senior capstone project. The summarized list of keywords of each category is:

- *Creative behavior*: brainstorming ability, enhanced creativity, learn outside textbook, ability to offer the suggestion, increased desire to learn, motivation about learning, desire to win, desire to achieve, kindness, learn technology, transfer learning, and easier to make career choice;

- *Information processing ability*: conduct research, increased research ability, and problem-solving;
- *Responsibility*: more effective, enhanced responsibility, ready to dive in, ready to take the challenge, meet the project specification, collaborative effort, interactive communication, keep the deadline, better project management, project follow through, deal with the customer inquiries, meet the client's demand, and enhanced social skill.

Theme 13: Benefits in real workforce

Theme thirteen is aligned with research question three. The participants pointed out the benefit of the senior capstone project when students enter the real workforce. The summarized list of benefits is: good interview communication topic, differentiate from other candidates, soft skills, real understanding of the business, project execution, deal with the business entity, highlight in portfolio, ability to deal with the unexpected, ability to troubleshoot, come up with workaround, team effort, problem solving, technology skill, communication skill, collaboration skill, leadership skill, project development skill, project implementation skill, sense of responsibility, and project usefulness.

Findings that address the research questions

The study accomplished the purpose statement through the following research questions: Research Question (RQ1) What would the industry/community leaders expect to see in the area of learning outcomes and employability skills when the computer science capstone project is initiated, developed, contributed and partnered with organizations to include real world problems; Research Question (RQ2) Which, if any, essential learning outcomes and employability skills identified by industry/community IT professionals should be enhanced in capstone courses to support Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning; and Research Question (RQ3) Which

aspects of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning contribute to enhanced employability skills.

Themes one through five addressed research question two directly and research question three indirectly. The summarized keyword list provided the essential learning outcomes and employability skills that need to be enhanced in capstone courses to better support Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning directly. In addition, the collected keywords also summarized the aspects of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning that contribute to enhanced employability skills indirectly. Themes six, through nine directly addressed research question one. The keyword list from each theme summarized the expected learning outcomes and employability skills from the perspective of industry/community professionals. Themes ten through 13 directly addressed research question three regarding the contributions to the enhanced employability skills. The findings include the following:

The industry/community leaders expected learning outcomes of senior capstone include:

- *Interpersonal Skills*: critical thinking, self-gathering, communication, collaboration, digitalized communication, digitalized collaboration, team membership, team leadership, leadership sharing, relationship skill, help skill, interaction, business skill, negotiation skill, communication with internal entity, communication with external entity, work in harmony, responsivity to accomplish task, take ownership, and hold team members accountable;
- *Information Skills*: problem analyzing, building upon skill, sense-making skill, data analysis, documentation skill, and troubleshooting;
- *Analytical Skills*: quantitative, qualitative, technology, research, and brainstorming skills;
- *Behavioral Skills*: handle new situation, friendship, presentation, face-to-face presentation, public speaking, networking, professional skill, social skill, self-control patience, due diligence, extremely dynamic, be on time, professionalism, time management, engagement and personal appearance, and friendliness.

- *Academic development*: technology skills, explore new area of study, ability to collect information, technical skill, problem-solving, and find a way to solve the problem;
- *Client interaction*: keep leadership informed, follow-up with the client, client engagement, ability to work with the client, meet the client's need, follow through with the client, and meet the deadline;
- *Personality success*: interpersonal skills, more interactive, present new ideas, collaboration skills, able to take the challenge, effective communication, confident outreaching, growing level of confidence, team communication, leadership skill, communication skill, and take commitment;
- *Communication and collaboration*: communication with the client, digitized communication, digitized collaboration, and communication skill with the stakeholders;
- *Teamwork*: team building efforts, managing the priorities, managing the expectations, managing member personalities, and communication with the team members;
- *Soft skills*: putting forth effort, leadership, research, analysis, meet deadlines, transfer experience, bring personal value, meet expectations, attitude towards improvement, timely follow-up, gain experience, general societal skill, real world project skill, work with limitations, grow ability in handling limitations, and hands-on experience.

The aspects that contribute to enhanced employability skills include:

Collaborative Learning

- *Collaboration*: interaction in the business environment, work collaboratively, and the collaboration between the students and the teachers;
- *Personal skills*: drive the process, come up with ideas, trouble shooting ability, deal with unexpected, invest on learning, positive personality, motivation, implement research result, information sharing, do as promised, being here, be organized, have commitments, and time management;
- *Communication*: effective communication, active team communication, follow-up with the client, and follow through;
- *Team management*: mixed skill sets, know member strength, know member weakness, learn to maximize the minimum, team member involvement, fill-in-the-blank in the team, bring strength together, bring knowledge together, elevate experience, share the outcome, small group environment, work in harmony,

balance skills, team playing skill, split workload, help each other, team leadership, gather information, and assign specific task;

- *Project management*: making achievable goals, putting deadlines to the goals, achieve the goal, goal for accomplishment, work on dynamic aspect, work on the identified project, put together the deliverables, raise flag early for issues, put together timeline, and document the issues.

Experiential Learning

- *Work ethics*: fearless, proud of work, develop skills, build the better relationship, and be involved;
- *Knowledge gaining*: apply knowledge, reflect knowledge, test knowledge, draw conclusions, develop new skills, and gain experience;
- *Problem-solving*: scenario handling ability, learn about limitations, capable of implementation, study background information, and practice the right way;
- *Leadership*: grow experience and utilize team skill;
- *Feedback and debriefing*: gain feedback from different entities, effective use of feedback, make the recommendation, and offer the useful solution.

Project Based Learning

- *Project participation*: communicate effectively, communicate with the client, social interaction, timely feedback, met the goal, take over the project, deal with the changing environment, meet with the client demand, consider the audience needs, direct approach to the client, communicate the unexpected, explain the unexpected to the client, keep the client informed, and keep the leadership informed;
- *Project management*: bring the milestones, show the critical path, identify the critical path, planning of the project scope, propose the scope, objective to hit the goal, define the project, learn about the scope, identify the not-defined components, diagnose the issues, understand the process, going through the project, plan the project, offer alternative solutions, redefine the project to meet the goal, narrow down the goal, collect requirements, perform analysis, come up with the proposal, go through the checklist, plan implementation, offer work around, try to achieve goal, meet the client expectation, and make the agreement;
- *Twenty-first century skills*: note-taking, knowledge acquisition, learn different methodologies, adapt to the situation, use technique as tool, and troubleshooting;
- *Improved learning attitude*: follow through, follow-up, increase motivation, grow knowledge, learn from internal and external entities, grow practically, make

progressive growth, be accountable, focus on the objective, be acceptable, have a deeper understanding, and have a solid experience.

Transfer of Learning

- *Applying for the transfer*: differentiate the environment, adapt to business environment, able to work with the client, and meet the client's needs;
- *Near transfer*: transfer classroom experience, applying programming technique, practice the theory, attest knowledge, apply knowledge, transfer to practice, learn by doing, transfer the theory to hands-on, the capability of applying knowledge, transfer the theory, transfer the plan, comprehend the instructions, produce the product, test the knowledge, and test the fix;
- *Far transfer*: shift knowledge, deal with dynamics, think outside of the box, be aware of the alternatives, learn from failure, deal with unfavorable scenarios, and seek guidance.

Service Learning

- *Civic responsibility*: gain interest in social services, help with the upgrade, gain interest in community services, provide benefits to the community, engage with community service, make a contribution to the community, make stronger communities, more community involvement, deeper community service understanding, and giving back to the community;
- *Career advancement*: bring cutting edge technology, deliver knowledge in a fun way, set a good example, have a desire, deliver the product, work with limitations, and generate real usefulness;
- *Global understanding and citizenship*: learn personalities, learn backgrounds, address human needs, gain satisfaction, sense the importance of public engagement, learn to put up reputation, bring positive influence, further influence individual, make future contribution, make impact, future post-graduation service involvement, make societal contribution, eager to make contribution, make service agreement, greater satisfaction, and promote good citizenship.

Students' behavior

- *Creative behavior*: brainstorming ability, enhanced creativity, learn outside of textbook, ability to offer suggestions, increased desire to learn, motivation about learning, desire to win, desire to achieve, kindness, learn technology, transfer learning, and easier to make career choice;
- *Information processing ability*: conduct the research, increased research ability, and problem-solving;

- *Responsibility*: more effective, enhanced responsibility, ready to dive in, ready to take the challenge, meet the project specification, collaborative effort, interactive communication, keep the deadline, better project management, project follow through, deal with the customer inquiries, meet the client's demand, and enhanced social skill.

The need to be enhanced learning outcomes and employability skills include:

- *Soft skills*: polishing the skills, be proactive, be willing to make changes, ability to understand the problem, ability to find a solution, social ability, public speaking, interpersonal skill, accountability, leadership, team building, more student involvement with leadership, and follow sequencing;
- *Client communication*: direct communication with the client, collaboration effort, follow through with the client, follow-up with the client, and flexible communication;
- *Project management*: project planning, take ownership of project management, follow through with the whole project cycle, move the project forward, drive the project, project bidding, and business sale.

The benefits of senior capstone project in the area of employment include: good interview communication topic, differentiate from other candidate, soft skills, real understanding of the business, project execution, deal with the business entity, highlight point in portfolio, ability to deal with the unexpected, ability to troubleshoot, come up with workaround, team effort, problem-solving, technology skill, communication skill, collaboration skill, leadership skill, project development skill, project implementation skill, sense of responsibility, and project usefulness.

The finding is notably aligned with the purpose of the study. Out of 13 participants, 11 participants (84%) believed that students are better in the area of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning as a result of the real-world problem based senior capstone project. All participants (100%) agreed that such experience can assist students with future employment. Eight participants (62%) believe that Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of

Learning, and Service Learning skills all contribute to the enhanced employability skills. Also, all participants (100%) expected to see the enhanced learning outcome and employability skills.

In conclusion, the analysis of the research finding shed light onto the learning outcomes and employability skills the industry/community organization professionals expected to see when computer science major students are implementing a real-world problem based senior capstone project. The study presented the different learning outcomes in the area of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning. The study also revealed the need for enhanced employability skills.

Limitations of the Study

There were three major limitations of this study. First was the population and demographics of the interview participants. To keep the research scope to a manageable level, the researcher conducted 13 qualitative interviews with participants from industries and community organizations within the Chicago, IL area. The researcher selected participants from various industry and community organization sectors with various roles. The wide range of business types and working titles of the participants greatly improved the reliability of the study.

The second limitation related to the number of years the participants had working with college computer science major students on real world problem-based capstone courses. While two participants had over five years' experience and two other participants had over two years' experience, the remaining nine participants (69%) had between one to two years' experience working with students on the real-world problem based senior capstone projects. The candidates with limited exposure and experience have been eliminated from the study. This strategy can improve the data reliability of the research.

The final limitation of this study was the researcher's passion for and experience with real world problem based senior capstone courses as the best practice in education. It was

imperative the researcher stay objective in the data collection process as well as data interpretation process. It was important to eliminate all bias throughout this research.

Implications for Practice

The result of the study shows that real world problem based senior capstone can greatly enhance Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning. Additionally, results indicate that the real-world problem based senior capstone can help enhance employability skills and demonstrate critical soft skills. In light of the study results, the following three implications are offered.

Implication One

Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning have proven to be effective learning outcomes for a real-world problem based senior capstone project as a result of this study. Faculty members and administrators responsible for senior capstone course curriculum with institutional needs as well as industry/community organization professionals can be helped by this study's findings. College computer information science and information technology programs need to design the senior capstone curriculum that best meets the needs of today's active learners who can benefit from the unique experience. One of the findings of this study was that the structure of a real-world problem based senior capstone that supports Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning is key to student's learning. There is no one concrete way to structure a real-world problem based senior capstone course that includes Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning experience, but this study revealed findings that can help faculty members to structure their capstone course. For example, if the capstone project will be small team based, faculty members need to give guidance to students on how to work in a small team

environment, how to do effective communication, how to collaborate, and how to drive the whole team moving forward. Many participants expressed the importance of teamwork and how much they value teamwork skills in the real workforce. Teamwork skill training should be built into the curriculum as a goal to minimize member conflict while maximizing team productivity. On the other hand, industry/community organization professionals can see the great benefits of forming a partnership with educational institutions to accomplish projects. This could promote more interactions between the two entities in the future.

Implication Two

Previous research pointed that real-world problem based senior capstone experiences are to provide an opportunity for students to develop critical soft skills while demonstrating technical skills in real workforce (Brown & Benson, 2005). Students demonstrate acquisition of some critical soft skills as a result of engagement with real world problem based senior capstone project experience. There is significant evidence demonstrating the gain in soft skills as a result of such engagement. College computer information science or information technology programs should continue to emphasize implementing critical soft skills as part of their core curricula and continue to enhance the soft skills as part of the real-world problem based senior capstone course. More emphasis should be placed on promoting direct client and student interaction, so students are practicing teamwork skills, interpersonal communication, ethical behavior, information skills, and analytical skills.

Implication Three

The study findings revealed that the real-world problem based senior capstone can enhance student's employability skills. Besides promoting direct interaction with clients, the faculty member's mentoring role should be enhanced as well so student's employability skills

can be further developed. Eby, Rhodes, and Allen (2008) pointed that mentoring is a relationship between individuals. Mentoring is a learning partnership. The mentoring relationship is reciprocal with both the mentor and protégé benefitting from the experience. Mentoring relationships change over time. First, faculty should increase the interaction with students by forming a stronger relationship. Such interactions include but are not limited to coaching students on the technical aspects, knowing students' personality, knowing students' strengths and weaknesses, and providing counsel. The frequent interactions should occur not only inside the scheduled classroom but also exist outside of the classroom in the form of substantial electronic communication and informal conversation. Second, faculty should form a learning relationship with students. Such learning interaction includes but is not limited to passing knowledge to students, so they can meet course learning outcomes, exposing students to the real workplace, supporting students in completing the project, and serving as a role model. Third, faculty should provide direct support in developing students' employability skills and preparing them for the real workforce. Guidance can be offered that allows the team to work through different interpersonal issues. Employability skills can be enhanced by developing students' attitude, behavior, and personal value. Fourth, the relationship between the student and the faculty should be reciprocal so both benefit from the experience. It is not uncommon that students are practicing in a subject area that is outside the faculty member's expertise scope. Faculty members will need to acquire new knowledge to facilitate their coaching in order to better assist the students. Finally, such mentoring relationships will change over time. Once students are more mature in handling research, teamwork skills, and interpersonal skills, the faculty member's dedication can be changed to a more supporting role so students can develop their own project management skills and be responsible for their own learning. By expanding the traditional meaning of senior

project mentoring to a broader operational sense, students' employability skills can be further enhanced.

Implications of Study and Recommendations for Future Research

This qualitative study investigated learning outcomes and employability skills in the area of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning when the computer science capstone project is initiated, developed, contributed, and partnered with organizations to include real world problems. Participants of the research provided original input that described the expected employability skills and learning outcomes, proposed suggestions on developing soft skills, and discussed their concerns on achieving various learning outcomes. Furthermore, participants provide a most important message to students, so they can be successful in the future. The findings of this study would be beneficial for researchers who would like to conduct future research in this area.

The following are three recommendations for future research:

Recommendation 1: Soft skills

This study has provided insights into the expected learning outcomes and employability skills. It also revealed some additional soft skills that are crucial for enhancing the senior capstone learning outcomes. Many of the soft skills are expected as a result of engagement of a real-world problem based senior capstone; however, some are emphasized more than others. The results have exposed gaps in senior capstone course curriculum targeted towards teaching soft skills. Future research can be done to determine which soft skills are more critical and can benefit students the most when they enter the real workforce.

Recommendation 2: More entities involvement

This study focused on gaining perspectives from the industry/community professionals only. Future research can include more entities such as faculty member, students, and parents.

Yin (2009) suggested that by replicating the study the researcher has a better chance to tie up loose ends for future research. By including more entities, future researchers can gain additional insight into the employability skills and learning outcomes from a real-world problem based senior capstone projects.

Recommendation 3: Effectiveness

This study only evaluated the expected employability skills and whether or not the real-world problem based senior capstone project can enhance students' employability skills. However, the study did not address how effective such real-world based capstone is in promoting and enhancing employability skills. Future research can be done to evaluate the effectiveness of such partnership in regard to the promotion of employability skills.

Conclusion

This study identified expected employability skills and learning outcomes from the point of view of industry/community professionals. The study employed an exploratory qualitative approach by conducting interviews. The interview contained 15 semi-structured interview questions that are closely aligned with the research questions. Data were collected from 13 selected participants. Thirteen themes were identified as a result of the data analysis. The keywords associated with each theme were explored, and each theme was fully discussed. The finding reveals that the industry/community professionals expected to see interpersonal skills, information skills, analytical skills, behavioral skills, academic development, client interaction, personality success, communication, collaboration, and teamwork in the area of learning outcomes and employability skills. They expected to see collaboration, personal skills, communication, and project management as a learning outcomes in the area of Collaborative Learning; work ethics, knowledge gaining, feedback and debriefing, problem-solving, and leadership in the area of Experiential Learning; project participation, project management,

twenty-first century skills, and improved learning attitude in the area of Project Based Learning; applying the transfer, near transfer and far transfer in the area of Transfer of Learning; and civic responsibility, career advancement, and global understanding and citizenship in the area of Service Learning. In addition, the study revealed the aspects of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning that contributed to the enhanced employability skills as well as the benefits of the senior capstone project in the area of employment.

The purpose of the study was to determine if the real-world problem based senior capstone project could promote students' employability skills and enhance the learning outcomes in the areas of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning, and Service Learning by examining industry/community organization professionals' insights. In conclusion, the findings of this study provided insight on how a real world based senior capstone project can greatly benefit the student in many learning areas and, therefore, enhance their employability skills. By conducting this research, the researcher hoped to offer suggestions to faculty mentors on learning outcomes and employability skills with added experience in the area of Collaborative Learning, Experiential Learning, Project Based Learning, and Transfer of Learning through real world problem based senior capstone projects.

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APPENDIX A

Interview Questions

1. Describe some of the experiences you have had while college computer science major students implementing their real-world problem based senior capstone project.
2. What kind of learning outcomes in the area of Collaborative Learning would you expect to see?
3. What kind of learning outcomes in the area of Experiential Learning would you expect to see?
4. What kind of learning outcomes in the area of Project Based Learning would you expect to see?
5. What kind of learning outcomes in the area Transfer of Learning would you expect to see?
6. What kind of learning outcomes in the area of Service Learning would you expect to see?
7. Besides Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning and Service Learning, are there any other soft skills (such as interpersonal skills, information skills, analytical skills and behavioral skills) that are expected to achieve? Any additional comments on the learning outcomes besides all the categories mentioned above?
8. Have you or have you not witnessed any specific learning outcomes that students have acquired that indicate this was the result of real world problem based capstone project? Please describe that instance.
9. Are students better, the same, or worse in the area of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning and Service Learning as a result of the real world problem based senior capstone project? Describe specific examples that you have witnessed that support your reasoning.

10. What would you expect to see in the area of employability skills as a result of a real world problem based senior capstone project? Will the whole experience eventually assist students on career choice?
11. Are there any essential employability skills should be enhanced in order to better support the learning outcomes?
12. Which aspects of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning and Service Learning contribute to enhanced employability skills? How has the senior capstone project influenced students' ability to take ownership of their learning?
13. How, if at all, did completion of the real world problem based senior capstone project influence the way student process information and their creative or imaginative behavior because of the senior project? Are students became more or less responsible for their learning after the whole industry/community project partnered capstone experience?
14. Do you feel that the lessons learned through the senior capstone project will eventually benefit students when they enter the real workforce? Why or why not? What observations have you made to justify your answer?
15. What do you think is the most important thing students should learn from the real world problem based senior capstone project? What specifically have you seen to support your answer?

APPENDIX B

Interview Questions in Alignment with Research Questions

1. Describe some of the experiences you have had while college computer science major students implementing their real-world problem based senior capstone project. (In alignment with RQ1)
2. What kind of learning outcomes in the area of Collaborative Learning would you expect to see? (In alignment with RQ2 and RQ3)
3. What kind of learning outcomes in the area of Experiential Learning would you expect to see? (In alignment with RQ2 and RQ3)
4. What kind of learning outcomes in the area of Project Based Learning would you expect to see? (In alignment with RQ2 and RQ3)
5. What kind of learning outcomes in the area Transfer of Learning would you expect to see? (In alignment with RQ2 and RQ3)
6. What kind of learning outcomes in the area of Service Learning would you expect to see? (In alignment with RQ2 and RQ3)
7. Besides Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning and Service Learning, are there any other soft skills (such as interpersonal skills, information skills, analytical skills and behavioral skills) that are expected to achieve? Any additional comments on the learning outcomes besides all the categories mentioned above? (In alignment with RQ1)
8. Have you or have you not witnessed any specific learning outcomes that students have acquired that indicate this was the result of real world problem-based capstone project? Please describe that instance. (In alignment with RQ1)
9. Are students better, the same, or worse in the area of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning and Service Learning as a result of the

real-world problem based senior capstone project? Describe specific examples that you have witnessed that support your reasoning. (In alignment with RQ1)

10. What would you expect to see in the area of employability skills as a result of a real-world problem based senior capstone project? Will the whole experience eventually assist students on career choice? (In alignment with RQ1)

11. Are there any essential employability skills should be enhanced in order to better support the learning outcomes? (In alignment with RQ3)

12. Which aspects of Collaborative Learning, Experiential Learning, Project Based Learning, Transfer of Learning and Service Learning contribute to enhanced employability skills? How has the senior capstone project influenced students' ability to take ownership of their learning? (In alignment with RQ3)

13. How, if at all, did completion of the real-world problem based senior capstone project influence the way student process information and their creative or imaginative behavior because of the senior project? Are students becoming more or less responsible for their learning after the whole industry/community project partnered capstone experience? (In alignment with RQ3)

14. Do you feel that the lessons learned through the senior capstone project will eventually benefit students when they enter the real workforce? Why or why not? What observations have you made to justify your answer? (In alignment with RQ3)

15. What do you think is the most important thing students should learn from the real-world problem based senior capstone project? What specifically have you seen to support your answer? (In alignment with RQ1, RQ2 and RQ3)