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ABSTRACT

INCREASING ADOLESCENT INTEREST IN COMPUTING THROUGH THE USE OF SOCIAL COGNITIVE CAREER THEORY

by
Osama Eljabiri

While empirical research efforts are sufficient to provide evidence of the role of most constructs in the Social Cognitive Career Theory (SCCT), this dissertation shifts the research focus and finds serious shortcomings in defining the construct of computer technology learning experiences design.

The purpose of this dissertation is to investigate whether, and to what extent, the proposed SCCT-enhanced framework can increase self-efficacy and interest of pre-college and college students in computer-based technology through the newly proposed "Learning Experiences" construct; in particular, whether it can reduce the gender gaps.

As a result of a comprehensive literature review, the dissertation connects learning, instructional design and career development theories in a holistic fashion identifying and synthesizing gaps with corresponding interventions concerning learning experiences. Subsequently, the study carries out an evolutionary re-design of SCCT in multiple iterations with the incorporation of theoretical findings until a revised SCCT framework is proposed utilizing interventions used in best practices. Accordingly, eight hypotheses are formulated to answer all research questions.

A multi-phase experiment of four rounds is designed to study the impact of the revised "learning experiences" on self-efficacy, outcome expectations and technology interest. The data collection process is cumulative in nature with numerous refinements

that leads to a scale which is confidently replicated for future research and theory evolution with few refinements.

Next, an extensive statistical analysis is conducted to test all hypotheses. All hypothesized relationships between SCCT constructs and technology interest are substantiated, proving the effectiveness of the refined learning model. It is concluded that the redefined “learning experiences” construct has three key dimensions with social integration as the most powerful predictor. It is also inferred that, while the new combined interventions appear to be more powerful predictors of pre-college and college student interest in computer technology than variables derived from SCCT traditional sources, using the new model has a limited impact on reducing the gender gap; it can be attributed to a time-factor in experimental design.

INCREASING ADOLESCENT INTEREST IN COMPUTING THROUGH THE USE OF SOCIAL COGNITIVE CAREER THEORY

by
Osama Eljabiri

A Dissertation
Submitted to the Faculty of
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APPROVAL PAGE

INCREASING ADOLESCENT INTEREST IN COMPUTING THROUGH THE USE OF SOCIAL COGNITIVE CAREER THEORY

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Dedicated to my mother

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Who believed in me from day one until I completed this dissertation

through her endless inspiration and encouragement

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CHAPTER 1

INTRODUCTION

More than three decades of research positioned the Social Cognitive Career Theory (SCCT) in the heart of career development literature as one of the most influential theories to explain how students make their career choices (Ali, McWhirter and Chronister, 2005). The most dominant factor in this theory is self-efficacy (Stajkovia and Luthans, 1998), which in turn depends on how effectively we design our students learning experiences (Lopez et al, 1997). While empirical research efforts were sufficient to provide evidence of the role of most constructs in the SCCT theory (Diegelman and Subich, 2001), they suffered from shortcomings in regard of effective design of students learning experiences since such design was limited to Albert Bandura's identification of four source of self-efficacy that remained almost untouched for four decades Bandura (1977, 1994).

First, not only there is an obvious disconnect between the Social Cognitive Career Theory and learning theories, instructional design theories and career development theories as it relate to learning experiences design, there is also a perception that such theories are rather contradictory.

Second, the SCCT theory was frequently viewed as one-size- fits-all despite the need to have more emphasis on variations that could be attributed to age (Amato-Henderson et al, 2007), gender (Lopez et al. 1997), and area of study especially computer technology- related subjects (Venkatesh, et al., 2003; Smith, 2004). Third, there is little incorporation of the results of studies about best practices or assessment of

existing practices of actual real world interventions used to enhance the design of students learning experiences. In fact, real world statistics reveal deepened problems in students learning environments usually characterized by knowledge fragmentation and lack of relevance, personalization, and social integration.

An assessment of the literature demonstrated that there are serious gaps in designing motivational learning experiences for upper middle school, high school, and early college students especially as they relate to computer technology education in STEM areas. Such gaps become more severe with female adolescents as boosting female students' interest to computer technology requires significant efforts and is not easily attainable.

Social cognitive career theory (SCCT) researchers frequently associated four external sources of self-efficacy to boosting students' interest (i.e., accumulative accomplishments, vicarious learning, social persuasion and emotional arousal) (Bandura, 1977 & 1994) without consideration for social integration or personal relevance. An extensive literature review on teaching strategies and self-efficacy showed that the issue was studied primarily by examining experiential learning and teacher-owned factors that contribute to student enrollment rates. In this study, the focus was on learning experiences dimensions that had more to do with students-owned constructs than external factors or demographics. Moreover, this study shifted the research focus in the Social Cognitive Career Theory (SCCT) to examine the design of "learning experiences characteristics" to increase self-efficacy and interest in computer technology among adolescents as opposed to studying the impact of self-efficacy on other constructs assuming that the four traditional sources of self-efficacy are sufficient.

This study was carried out in the context of an assessment for an existing learning model (i.e., Real World Connections Program at NJIT (RWC)) that has created a unique combination of intervention mechanisms to boost adolescent's self-efficacy and interest in STEM-related computer technology education. While the study aimed at assessing the effectiveness of the RWC model in the light of the SCCT theory, the model, on the other hand, offered an enhanced approach to improve SCCT self-efficacy sources. Subsequently, the hypotheses were formulated to test the exchangeable impact of SCCT and RWC on one another.

1.1 Background of the Problem

STEM education for adolescents in the United States today, especially among women and minorities, faces major challenges due to an unprecedented degree of student dropout rates from coast to coast, lack of interest in STEM fields (Science, Technology, Engineering and Math), and the little impact that K-12 education has had on preparing students for post-high school careers. Retention rates of early college students, especially female students, pursuing degrees in science and engineering primarily during the freshman and sophomore years are considerably challenging. As a result, the United States does not enjoy a STEM-related leading position in the world today, and it faces significant economic challenges associated with poor workforce preparation. Over the last few years, it has become apparent that intensive research efforts must be exerted to identify the root causes of our ailing K-12 and early college education system.

The Four Traditional Sources of Self-Efficacy: Bandura (1977, 1994) explained four major sources of information for expectations of self-efficacy. One source is performance accomplishments (mastery experiences) which build efficacy through personal successes especially after facing obstacles. A second source is vicarious experience provided by social models. The similarity of the social model to a particular situation and context is positively correlated with the degree of persuasiveness of such a model. Another source is verbal or social persuasion that results from social support and encouragement. However, it is more effective when efficacy builders structure situations carefully in such ways that bring positive results and avoid placing people in situations prematurely where they are likely to have negative results frequently. The last source is emotional arousal such as mood, tension, stress reactions, fatigue, aches and pains, which affect people's judgments of their personal efficacy. Reducing stress reaction and negative emotions helps in modifying self-beliefs of efficacy.

Bandura (1982) also introduced another important type of efficacy related to groups, communities and organizations called "collective efficacy." Bandura's findings confirmed that collective or group efficacy is grounded in personal perceived self-efficacy and that it is a critical factor for social change. According to Bandura (1982), collective efficacy is not only essential in encountering group problems and challenges, but also in influencing group choices, determination of group collective efforts and maintaining group overall sustainability. As a result, collective efficacy can also be crucial to group learning motivation and broadening peer influences in terms of social learning and career interests. A low sense of social efficacy can create internal challenges to preferred peer relationships (Bandura, 1994). Bandura and Locke (2003)

indicated that collective efficacy mediates positive and negative feedback on group goals and partially mediates the benefits of instructive modeling on group effectiveness.

Adolescents have Unique Learning Characteristics: Gottfredson (1981) emphasized in the theory of Circumscription and Compromise the way young people deal with the broad array of career choices they encounter today. The theory is based on the observation that many adolescents frequently delay their career choice decisions as a way to deal with the anxiety resulting from such an overwhelming number of career choices. The theory suggests four non-sequential processes of development: cognitive growth, self-creation, circumscription and compromise. According to the theory, there are four sequential stages for circumscription: orientation to size and power (ages 3-5), orientation to sex-roles (ages 6-8), orientation to social valuation (ages 9-13) and orientation to internal and unique self (ages 14 and up). During the four stages, children apply the process of elimination excluding occupations that do not fit their size, power, gender and some social perceptions. The last two stages are of particular interest in this research as they deal with middle and high school students more intensively.

Ali, McWhirter, and Chronister (2005); Lent, Hackett, et al. (2000); and Bright et al. (2005) indicated, parent, family, sibling, peer and teacher support have been found to predict adolescents' career behavior indicators such as educational plans, career aspirations, perceptions of structure of opportunity, school retention, self-efficacy, and outcome expectations (through school outcomes).

Despite the fact that a large amount of research has been carried out examining the role of occupational self- efficacy in adults or young adults, there has been little research examining the development and importance of self-efficacy beliefs in middle school and

high school students' career decisions (Amato-Henderson et al. 2007). It was also found that vicarious learning, including connections to role models in the field, and mastery experiences have more effect on high school students' self-efficacy than social persuasion (Amato-Henderson et al. 2007). These findings were further confirmed for college students concerning IT education by Smith (2004). Self-efficacy in high school students has an extended impact even beyond regular school activities as evidenced in physical health studies involving variables of the social cognitive theory (Winters et al. 2002).

Ji et al. (2004) found that eighth grade students' occupational sex-type perceptions for particular jobs were correlated with their levels of self-efficacy and interest based on Holland's types, which supports the hypothesized relationship between distal background contextual affordances factors and person inputs in SCCT. This also implies that the perceptions of the sex-type of an occupation are a barrier for career decisions as early as the eighth grade (Gottfredson, 1981). One intervention mechanism that may help overcome this barrier would be providing young adolescents with role models who were able to overcome difficult situations with a sense of resilience and coping efficacy (Ji et al. 2004).

Ali, McWhirter and Chronister (2005) emphasized that personal, contextual (environmental), and social cognitive factors are all integrated in the SCCT framework to try to explain adolescents' and young adults' career interests, goals and behaviors. In the Lopez et al. (1997) study, outcome expectations for high school students in math were empirically found to be explanatory for an increase in interest to the extent that it depends on self-efficacy.

The Gender Gap: The low percentage of women in the information technology field is viewed as a reflection of career barriers for this group (Smith, 2004). According to the Census Bureau (2008), women represent 46.3 percent of the total civilian workforce but only 26.7 percent of the IT field in computing and mathematical occupations (more than a 3% decrease from 2000). Bandura (1994) defines self-efficacy as "people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives." Lent, Brown, and Hackett's (1994) social cognitive career theory emphasized that women and ethnic minorities perceive more self-efficacy barriers to their career goals than do other groups. Despite the fact that many studies investigated the role of occupational self- efficacy in adults or youth, there has been limited research examining the development of self-efficacy beliefs in middle school, high school and early college students' career decisions (Amato-Henderson et al. 2007).

While empirical evidence supported self-efficacy predictability power for science and math related interests (Lopez et al. 1997), much more research is needed to examine its influence on adolescents', especially women's, interest in computer technology related fields. Lindley's research found that there is a stronger relationship between coping efficacy (belief in one's ability in adapting to challenges) and self-efficacy in men than women. Surprisingly, findings of Lindley's (2005) empirical research (that incorporated Holland's six career options in the social cognitive career theory (SCCT) analysis) included the information that women's perception of career barriers as impacting their career development was positively related to their outcome expectations, and that women who chose investigative or conventional careers had a much higher perception of career

barriers as opposed to women who chose social careers.

An interesting conclusion in Lindley's (2005) work is that women who made career choices in investigative or conventional occupations as opposed to social occupations had strong persistence in those fields despite their perceptions of considerable barriers to overcome. Smith (2004) indicated that structural changes in the economy have created another contextual influence in terms of the employment environment in IT fields especially for women and minorities and found that women perceived significantly greater barriers for their career choices than did men.

Byars and Hackett (1998) studied the differences among women of color (African American, Latina, Asian American and American Indian) in terms of the four sources of self-efficacy in SCCT (i.e.: performance accomplishments, vicarious learning, social persuasion and emotional arousal) and found significant differences. He concluded that special attention should be paid in research to their socio-cultural factors including historical and ongoing references as well as their unique and shared experiences, and how these factors impact their self-efficacy sources (especially performance accomplishments and vicarious learning), which in turn influence their career self-efficacy.

The Computer Technology Dimension: In the behaviorism era, technology-based instructional design was task-based and developed stimulus-response chains of behavior. It was most useful for simple and straightforward content where the branching is conditioned and student responses are either correct or incorrect. Cognitivism's impact on instructional design technology was far more reflective of task complexity and individual differences. Deek and McHugh (2003) illustrated how systemic, cognitively-based dialogs can provide an effective learning environment for problem solving tasks

and how the overall architecture of the system provides an iterative strategy to master software engineering processes. As Cooper (1993) noted, this resulted in more hardware sophistication, enforcement of an intuitive graphical user interface, content-structured design mechanisms, and the development of cognitively-driven computer-based learning approaches such as intelligent tutoring, hypertext, hypermedia and expert systems. Sian and Rao (2003) indicated that while behavioral learning theory played an important role in building educational games, especially when using operant conditioning to learn by trial and error, cognitivism played a more crucial rule due to the incorporation of memory processing models in game design. Yet, constructivism produced the most dramatic paradigm shift in computer-based instructional design as the desires and goals of the learner and her ability to learn by discovery and doing became more influential in designing software than the views of the instructor (Cooper, 1993) (Sian and Rao, 2003).

Instructional design strategies and models were grounded in the three major leaning theories: behaviorism, cognitivism and constructivism. As Cooper (1993) pointed out, this was strongly connected to paradigm shifts in dependent educational technologies. Ironically, it is also true that the software development paradigm mirrors the evolution of the learning theories as well (Cooper, 1993). This has become even more obvious with the shift toward object-oriented design of learning environments based on context-independent learning objects as described by Baruque and Melo (2003). This is in spite of the serious concerns that technology used to support instructional design has little or no impact on students' learning outcomes without incorporating other instructional factors such as pedagogy, course design and the quality of instructional design (Johnson and Aragon, 2002).

This implies that the higher the perceived self-efficacy in a certain discipline or a subject of knowledge, the higher the likelihood this discipline or subject will become a career choice. This conclusion was confirmed by empirical findings of many researchers during the last two decades, which was also the foundation of the SCCT (Lent, Brown and Hackett, 1994).

Based on empirical evidence and extensive research and analysis, the final unified model included four constructs that Venkatesh, et al. (2003) found to be the most significant factors in predicting behavioral intention and use behavior of IT. These constructs are performance expectancy, effort expectancy, social influence, and facilitating conditions. It is quite surprising that at least three of these four factors are strongly correlated one way or another with the self-efficacy theory and SCCT.

While empirical evidence was in support of self-efficacy predictability power for science- and math- related interests (Lopez et al, 1997), much more research is needed to examine its influence on women's interest in IT related fields.

Real World Connections Program (RWC): The RWC program started at New Jersey Institute of Technology in 2005 with a small group of students interested in learning by doing and in educational experiences that offer real world challenges. The idea was to take a project-based learning experience at the senior college level and make it available to high school students after numerous refinements and configurations. The program evolved over the years to include additional instructional design elements, which created an entirely new model for teaching and learning with a high degree of sustainability in terms of student recruitment and retention for more than nine consecutive years.

There are several elements in the design of the learning environment in the Real World Connections Program (RWC) for middle school/high school students. The first element is using project-based learning in real-world contexts. This element is based on providing a real world problem-based learning (PBL) environment which enables students to experience a high degree of authenticity, usability, relevance and learning by doing. This element mirrors key intervention mechanisms such as cognitive restructuring, vocational exploration, attention to decreasing career barriers, attention to building support, world of work information, and values clarification mechanisms.

A second RWC design element is peer-to-peer learning in conjunction with expert mentorship. The program facilitates learning support from equivalent high school peers, advanced high school peers, college students as advisors, college students as a joint team and industry stakeholders, university faculty, parents as subject matter experts (SME's), and mentors. As a result, this element mirrors key intervention mechanisms such as vicarious achievements, counselor support, individualized interpretations and feedback, attention to building support, collaborative learning and social persuasion intervention mechanisms.

The third RWC design element is social intelligence via activities that aim at creating a community of learners and facilitating social bonding using activities that strongly encourage social interactions, positive peer pressure and collaborative learning. This element serves as a source for anxiety reduction, vicarious achievements, and counselor support intervention mechanisms.

The fourth design element is self-regulated learning within teams and between teams which includes self-organization (i.e.: running the class as a company of consulting

teams), real world simulations and shadowing, realistic role playing, and evolutionary prototyping with continuous feedback control loops (project time-boxed sprints). This mirrors well-known intervention mechanisms such as personal performance accomplishment and self-reporting. Frequent feedback control loops from judges in particular also mirror decision making modeling and strategy, individualized interpretations, goal negotiation, and personal performance accomplishment intervention mechanisms.

The fifth RWC design element is adaptive multidisciplinary training that is based on generic and specific project needs driven by demands of real world projects and the industry job market. This element mirrors known intervention mechanisms such as outside reading, modeling, and workbook and written exercises.

The sixth element is integrating joy and fun with learning experiences all the time as part of the teaching pedagogy, using carefully designed and implemented activities, games, ice breakers, simulations, tours, hands-on experiences and movies. This element reflects mechanisms such as anxiety reduction and motivation-based interventions.

The seventh element is post-program support and re-engagement of human resources such as alumni and advanced students. This long-term support goes beyond the class, beyond the class timeframe and beyond graduation, which helps again as a decision making model intervention mechanism.

Moreover, one of the very key elements in RWC is accommodating students' personal interests, respecting their preferences and choices, and customizing the entire program to meet their passions and ambitions.

Other intervention mechanisms used in RWC include computer-aided intervention mechanisms using web-based social networking, communication and collaboration tools, and online technologies as key enablers. Furthermore, the RWC design incorporates a complex recognition system that serves as personal performance accomplishment and motivation-based interventions.

This study suggests a revised socio-constructivist model for instructional design that aims at integrating various claimed sources of self-efficacy and providing support elements of self-efficacy in women related to IT-based STEM fields within the social cognitive career theory framework. It is statistically proven that improving self-efficacy in students increases their interest in the subject and impacted their career goal choices. This revised model will be inspired by an existing model in real-world instructional design offered by the Real World Connections Program (RWC) for middle school and high schools students.

1.2 Statement of the Problem

Why cannot current classrooms meet students' real needs? Why are our middle schools and high schools struggling in motivating youth in STEM areas – especially areas related to technology and particularly with women?

For many decades, the focus of learning and teaching theories was on the extent within which instructional interventions can actually cause an impact on human behavior. The question was always whether an educational approach (instructional design or design of a learning environment) can predict the actions, the future behavior, or the choices of the learner. There have been several paradigm shifts from an external environmental view

of learning (behavioral learning theory) to an internal view (cognitive theory) to a multi-level personal developmental learning theory (mild constructivism, strong constructivism, moderate constructivism, socio-constructivism and process-oriented constructivism).

There were four major challenges that arise from traditional instructional design that rely solely on behavioral and cognitive learning theories. Lai-Chong and Ka-Ming (1995) referred to two of these challenges. One problem is the issue of "learning out of context," when learners fail to access relevant knowledge naturally while trying to solve a unique problem. This can be attributed to their habitual learning strategy of memorizing information without understanding its relevance to a specific context.

The second challenge is the problem of knowledge fragmentation, which refers to the lack of connections among different pieces of knowledge that may come from various disciplines. This is usually caused by the lack of linkages between the newly-taught concepts with learners' preconceptions and relevant knowledge in the topic concerned.

The third challenge is the problem of not relating learning to personal needs, interests, passions, emotions and backgrounds. When it comes to women, the problem becomes more intense since most educational programs related to technology have paid very little attention to women's needs in terms of social integration and emotions.

Finally, there is the problem of not relating learning to the social environment surrounding the learner, including peers, family and community. This is a more serious problem in regards to women since social relationships are critical in influencing women's choices.

Those problems and others caused frequent failures in the traditional design of instruction, yet encouraged more student-centered learning pedagogies where knowledge

is built by students via experience and exposure.

As a result, “constructivism” emerged, marking a new era of learning theories and instructional design. Eight characteristics unique to constructivist learning environments are providing multiple dimensions of reality, mirroring the complexity of the real world, emphasizing the construction of knowledge rather than its reproduction, emphasizing authentic tasks in a relevant context, providing learning environments such as real-world configurations or case-based settings instead of predetermined steps of instruction, encouraging feedback on learning experiences, enabling context- content-dependent knowledge building, and supporting collaborative construction of knowledge “collective intelligence” via social negotiation, not competition among students for the sole sake of recognition.

There are two mainstream approaches of the constructivist school: One approach is the cognitive constructivism from a personal perspective. According to Jean Piaget (Piaget, 1972), the construction of human intellectual skills matures through an adaptation to environment and an organization of information in a meaningful fashion. He looked at mental development as the driver to integrate knowledge and action and considered such an organized and complex integration as the basis of the adult mind. The other approach is the social-cultural constructivism from a socio-constructivist perspective. According to Lev Vygotsky (1978), constructivism is a social phenomenon that can be attributed to language and thought, and the role of society in mediating them. Vygotsky saw the impact of people, community, and culture as the influential factors in constructing knowledge rather than personal perceptions of facts and real situations. He also attributed collaborative action to the use of social speech as it develops in early

childhood.

However, the socio-constructivist learning theories were also criticized by well-known education researchers. Researchers explored the differences between the impact of adaptive or situated views (social approach) and cognitive views (individual approach) on learning and found that the diversity in individual styles might impact the effectiveness of the constructivist instructional design strategies. Moreover, the breakdown of complex skills and the abstraction of a learning situation are important cognitive capabilities of the human mind that are often overlooked by constructivist approaches.

Furthermore, there is a major issue with the links among the learning objectives from an adaptive perspective. In other words, we need to know which configurations of learning will prepare students the most for the various types of participation in social activities and accelerate the development of students' characters as learners. Another critique was the limited scope of learning in the constructivist theory as an active process that must take place only in the presence of the external environment. The reality is that there are many changes that happen to the learner which are not necessarily connected to the outside environment.

Obviously, high school students' - especially women and minorities - lack of interest in technology related fields is an alarming indicator for students' lack of motivation in STEM fields. Numerous studies have shown that motivation plays a crucial role in teaching effectiveness and learning; thus it is one of the biggest contributing factors to student behavior during school and after graduation. Self-efficacy and outcomes expectations have been used for decades to indicate learning motivation. One

of the most important theories that link self-efficacy to career development is the social cognitive career theory (SCCT). One of the SCCT's main claims is that students' self-efficacy impacts their interests which in turn influence their goals, and then their goals are expected to predict their behavior including their career decisions.

The SCCT theory also places special emphasis on the importance of contextual supports and barriers where the design of an effective and attractive learning environment becomes an essential factor for the success of the educational process. It is crucial to understand what prompts women to believe they cannot or do not want to continue in STEM courses, majors, or careers. It is also significant to identify ingredients, barriers and supports of learning experiences that may differ at various age groups and educational levels within the Social Cognitive Career Theory framework. Identifying and understanding effective instructional design components, environmental barriers and supports may assist to predict the increase of interest of women in technology-driven STEM career development and also help in the design of interventions that can facilitate the increase of women's self-efficacy in STEM fields.

The main problem with SCCT is that it focuses more on the impact of self-efficacy on students' interests and goals while paying less attention to the design of learning experiences as the main foundation claiming to influence self-efficacy. While learning experience sources such as vicarious learning, accumulative experiences, emotional arousal, and social persuasion received heavy attention from researchers, very few studies reviewed these sources in the context of designing total learning experiences, nor was much attention paid to women' interest in technology-related fields in middle and high schools.

This research aims at examining an existing STEM-driven informal high school educational program called MS/HS Real World Connections (RWC) within the SCCT framework with focus on women's interest in STEM fields. The program, which started in 2005, provides a career-oriented learning environment for middle school and high school students in New Jersey, based on a real world project-based learning methodology.

The program emphasis is usually on technology-related projects from software development to biotechnology. The research will examine how the design of a personalized and socially-empowered learning environment in this program may help to provide effective learning experience characteristics including supports and overcoming the contextual barriers in SCCT.

1.3 Purpose Statement

In this study, the focus was on learning experiences dimensions that had more to do with students-owned constructs than external factors or demographics. Moreover, this study shifted the research focus in the Social cognitive career theory (SCCT) to examine the design of "learning experiences characteristics" to boost self-efficacy and interest in computer technology among adolescents as opposed to studying the impact of self-efficacy on other constructs assuming that the four traditional sources of self-efficacy are sufficient. The study was carried out in the context of an assessment for an existing learning model (i.e., Real World Connections Program at NJIT or RWC) that has created a unique recipe to boost adolescent's self-efficacy and interest in STEM-related computer technology education. While the study aimed at assessing the effectiveness of the RWC

model in the light of the SCCT theory, the model, on the other hand, offered an enhanced approach to improve SCCT self-efficacy sources. Subsequently, the hypotheses were formulated to test the exchangeable impact of SCCT and RWC on one another.

1.4 Research Questions

1. Does using the refined learning model have a positive impact on students' self-efficacy and interest in computer-based subjects?
2. Does re-designing the "learning experiences" construct in SCCT using the refined learning model ingredients make a significant difference in its impact on students' computer technology self-efficacy?
3. Does the refined learning model fit the SCCT framework?
4. Does using the refined learning model reduce the gender gap between boys and girls in their computer-based self-efficacy?
5. Which ingredient of the refined "learning experiences" construct is the most influential?
6. How does the impact of RWC model compare to traditional SCCT sources of self-efficacy?

1.5 Definition of Terms

Social Cognitive Career Theory (SCCT). This complex theory has become one of the most influential theories in career development and counseling. The social cognitive career theory (SCCT) is an evolution of the social cognitive theory (SCT) and the social learning theory. Ali, McWhirter and Chronister (2005) emphasized that personal, contextual (environmental), and social cognitive factors are all integrated in the SCCT framework to try to explain adolescents' and young adults' career interests, goals and behaviors. In this theory, both self-efficacy and outcome expectations are considered predictors for

significant incremental variance in interests and intentions (Diegelman and Subich, 2001).

Self-efficacy This is the central variable of focus in the SCCT theory as well as in this research effort. As one can conclude from literature (Lent, Brown and Hackett, 1994), the key ingredients in defining self-efficacy are judgment of people about themselves (belief-centered), people's belief in their capabilities (capabilities-related), making change by organizing and utilizing resources to make a difference in a certain situation (transformation-based); a course of action required in a certain task and a particular context (task-context-specific) and people's judgments that take place when they compare what they believe they can do with the standard criteria used to evaluate performance levels (criteria-driven).

Outcome expectations these expectations are defined as personal beliefs about probable response outcomes. If self-efficacy implies "Can I do this"? outcome expectations imply "If I do this, what will happen"? (Lent, Brown and Hackett, 1994).

1.6 Delimitations

The data collection process was evolutionary in nature. It was conducted in two phases of quantitative internal pilot studies, one phase of qualitative study (Q-sort) and one final dissertation study.

The first pilot study included 41 subjects, the second pilot had 60 subjects, the Q-sort had five peer judges and the last round included 57 valid responses (out of 95 initially surveyed). The total number of valid responses in all studies was 158 subjects. The first pilot study had some weak validity results which triggered a full review of the

questionnaire design using quantitative and qualitative methods in addition to an extended scale-based literature review of all related instruments. As a result, the survey was redesigned iteratively and the new survey was given to new groups of subjects in three rounds. The validity results of the new survey were excellent. Therefore, the resulting survey was adopted for to test the hypotheses of final dissertation model.

In the second round, a sample of 60 middle and high school students participating in the Real World Connections program was used, 25 female and 35 male students. Of these students, 32 (46.3%) were between the ages of 15 and 18, 20 (28.9%) were between the ages of 11 and 14, and 7 students were between the ages of 19 and 20. 65.7% of these students indicated very strong support from their families, and 48.6% indicated very strong support from their friends if they decided to pursue a technology-related career. 88.6% of the sample indicated that they speak only English at home while 11.4% indicated that they speak multiple languages at home. These 60 students were participants in the Real world Connections experience at New Jersey Institute of Technology during summer and fall of 2010.

A comprehensive sampling method was used in the final study where all available groups that met the criteria were chosen to participate. The participants for this study were recruited from multiple precollege and college students groups across several high schools and universities. Thirty students completed the first experiment, twenty seven completed the second set, and fourteen completed the third experiment. Only 57 students completed all two sets of data. This final participant pool (N = 57) consisted of 24 men and 33 women. There were 10.5% students between the age of 13 and 14, 15.8% between the age of 15 and 15, 21.1% between the age of 17 and 18 and 52.7% above the

age of 18. Of the participants, 35.7% were Caucasian, 17.9% were Asian, 8.9% were African American, 8.9% were Hispanic, 10.7% were from other ethnicities and 17.9% from multiple ethnicities. 79% of these students indicated very strong support from their families and 66.6% indicated very strong support from their friends if they decided to pursue a technology-related career. Of the sample, 46.4% indicated that they speak only English at home, 3.6% speak only Spanish at home, 1.8% speak only Hindi at home, 5.4% speak other languages at home, while 42.8% indicated that they speak multiple languages at home.

1.7 Limitations

There were several limitations within this study. It was difficult to run the experiment online since parents' approval is required for IRB approval which made the sample size option logistically infeasible and limited participation volume. The students' age was also a challenge in survey design and instrument wording since students may not be familiar with some terminologies or concepts used in the survey. However, only four responses were rejected in the first pilot due to including a large number of missing or redundant values.

The students were asked to report their strength of interest before and after their RWC experience, which was actually a threat to the validity of responses since this was asking them to use their long-term memory and recall their feelings prior to the RWC experience after completing it. Clearly, a vast majority of people have limited ability to recall their previous feelings long after they have been exposed to a new treatment. A solution to this problem is to ask the subjects before and after they participated in the

Real World Connections experience.

The final study was able to overcome most of the threats to internal and external validity alike. Since one of the key challenges in our pilot studies was subjects' poor ability in recalling their initial attitude after they have been exposed to a treatment due to history and maturation effects, the design of the final experiment provided a time boxed treatment that concludes the entire experience within a maximum of two hours versus several months. This design did not only overcome memory effects but also increased the size of participation as it has ensured participants availability within a short duration and excluded any external factors that could have impacted the effectiveness of the experiment in less-controlled environment settings.

However, the side effect of such a highly controlled experiment is that short durations do not allow strong social bonding to form, or senses of ownership and self-importance to mature which limits the anticipated impact of RWC interventions to levels below what is usually seen in regular program settings. The influence of this side effect was obvious in our test results in terms of low statistical significance of some RWC interventions.

One problem with one-group pretest-posttest design was that while a pretest may have familiarized the subjects with the topic increasing attention, it may have been also a factor in diminishing their sensitivity to the topic resulting in reducing the effectiveness of the treatment. This fact can explain why few subjects did not score similar to their peers in terms of self-efficacy after the treatment was introduced.

Another problem is associated with the relatively high pre-test scores for a good percentage of the participants due to the fact that we were drawing this sample from

either a group with high appreciation to RWC program or a group that is studying in a STEM-based school with high emphasis on computer technology. As a result, statistical regression could become a threat to the internal validity of our experiment as the mean-pretest scores are unusually high because it operates to increase the scores of the subjects on the posttest if the mean-pretest score is unusually low and vice versa.

Finally, since one-group posttest-only design is at its best in controlled settings where the time interval between the pretest and posttest is relatively short, the internal validity of our experimental design can be upgraded by incorporating other pretest levels such as a level with traditional sources of self-efficacy alone. This proposed approach for future work is the one-group double pretest-posttest design.

1.8 Study Design

The experiment has been redesigned to simulate the RWC program interventions in a shorter duration to enhance its feasibility and measurability alike. Participants were asked to take part in two activities. One activity would simulate traditional learning where participants receive no interventions (to serve as a control group with no treatment) while the other activity simulates RWC intervention mechanisms in Real World Connections' revised learning model (to serve as the group after receiving treatment). The role of the instructor in the traditional activity represents a cognitivist while the instructor ion the second activity represents an RWC-style constructivist. Activities were related to computer skills such as database using MS Access, advanced spreadsheets using MS Excel or advanced presentation techniques using MS PowerPoint. Accordingly the two activities included the interventions illustrated in Table 5.7 followed by providing the

same questionnaire to the same group after completing each activity. Full description of these activities is included in Appendix B.

1.9 Theoretical Framework

This study is an attempt to connect learning theories, instructional design strategies, and career development theories in a holistic yet pragmatic fashion. Based on a multifaceted literature review, instructional design was revisited to identify major current gaps in middle schools, high school and early college education concerning learning motivation and self-efficacy with emphasis on SCCT, STEM, gender and adolescents. SCCT gaps were reviewed in the light of the literature survey analysis. Theories of learning, instructional design and career development, and the existing Real World Connections model provided the ingredients of the theoretical framework for this study of young women in the technology-related STEM fields.

The SCCT theory was the major source of all key variables in this study and a large taxonomy of many non-traditional factors provided sources for learning experience characteristics in the context of the Real World Connections models.

1.10 Overview of the Chapters

Following this introductory chapter, the specific elements of the study are presented in Chapters 2, 3, 4, and 5. Chapter 2 provides a literature review that is synthesized, analyzed, critiqued in Chapter 3. Chapter 4 provides an overview of the Real World Connections Program (RWC). Chapter 5 includes the methodology used in the research work. Chapter 6 presents an analysis of the statistical SPSS results, and Chapter

7 includes dissertation conclusions, discussion and future work implications. References and materials relevant to the data collection and analysis are included in the Appendices.

CHAPTER 2

LITERATURE REVIEW

The purpose of this study was to create a theory of career interests and development in the context of the information technology field as part of the STEM, specifically targeted to female students in middle schools, high schools and early college in the US. An essential first step in the construction process of this theory was to carry out a literature review central to the study theme. Within this review, theories of learning, instructional design pedagogies, models incorporating multiple theories (Andrews and Goodson, 1980), and theories of career development are discussed in breadth and depth. Variables related to learning motivation and career interests of women in information technology and STEM are also investigated within the context of real world project-based learning.

2.1 General Learning Theories

While they can always be subject to criticism and modification, theories in general aim at explaining observations and predicting behavior. One of the main questions in educational psychology research history has been "How do students learn"? On the one hand, traditional theories advocate that effective learning is mainly a result of transmitting material from instructor to student. On the other hand, student-centered theories claim that learning can best take place when it is constructed by the students themselves. Since learning theories help explain, predict and impact human behavior and learning capabilities, it is obvious that they also help us design better learning environments with more effective intervention mechanisms.

2.1.1 Behaviorism Theory

Pioneered by Pavlov, Watson, Thorndike and Skimmer, "Behaviorism" is the first known learning theory in modern educational psychology. Behaviorism views human behavior as a result of the impact of the external environment in terms of conditions and actions or stimuli and responses. Mergel (1998) noted that behaviorism considers the mind as a black box as if there were no thought processes when a stimulus triggers a response.

In behaviorism, there are two types of conditioning: classical and operant. In classical conditioning, learning takes place by differentiating between one stimulus that causes a response and one that causes no response. In operant conditioning, reinforcement (positive or negative) encourages repetition of desired behavior while punishment discourages the repetition of unacceptable behavior.

Defining the three key stages of behaviorism as analysis, design and testing, Cooper (1993) pointed out three assumptions on which behaviorism relies. One assumption is that understanding human behavior depends on how well we observe external events (objectivism). A second assumption is that human behavior is mostly determined by the surrounding environment (environmentalism). Cooper concluded that subsequent human behavior is a result of intrinsic and extrinsic realization of reinforces as consequences of action and feedback control loops that either correct or motivate behavior (reinforcement).

Behaviorism's strength is in its focus on environmental influences shaping human behavior while trying to explain "how students learn." Baruque and Melo (2003) indicated that behaviorism sees instructional objectives as the desired behaviors expected

from students as well as the metrics used to measure learning effectiveness. Yet once behaviorism intervention mechanisms focus on the "required performance" as opposed to peripheral knowledge acquisition (Cooper, 1993), such mechanisms fall short as they fail to integrate cognitive, social and self—motivational components in learning processes. One major criticism of behaviorism was that technological developments were not well integrated by behaviorists especially taking advantage of computers and interactive media.

2.1.2 Cognitive Learning Theory

Despite differences, cognitive learning theory shares with behaviorism learning theory the assumption that "knowledge" is mutually exclusive from the "knower" as Lai-Chong and Ka-Ming (1995) emphasized. However, as Deek and McHugh (2003) and Baruque and Melo (2003) have pointed out, in the cognitive approach the behavioral perspective has an internal focus, which means that the challenge of instructional designers is actually to organize and link information and use various techniques to assist the mental processes of the student.

These mental processes develop within a learner via an existing knowledge structure that must be present to compare and process new information for learning (McLeod, 2003). While this might be considered the major strength for cognitive theories, it also presents a major weakness since instructional designers will encounter a new challenge every time they present a new level of knowledge that requires a previous background, especially when dealing with new learners. Another point of strength in "cognitivism" is its recognition of individual differences, including learning styles, described as the learner's preferred way of processing information, problem solving or

thinking (Mödritscher, 2006).

Siang and Rao (2003) described the complex problem-solving process and insightful thinking involved in learning as stressed by cognitive learning theorists. They also indicated that viewing learning in terms of encoding, retaining and retrieving memories involves theories such as memory processing and remembering and forgetting models. This is aligned with Wildman and Burton's (1981) and Deek et al. (1999) views that advocated the significance of the cognitive learning theory in instructional design and saw learning as an information processing system in humans (Wildman and Burton, 1981).

As a result of viewing the human being as an information processer, it was concluded that one of the key challenges to the learning process is information overload, which can be overcome through limiting the amount of content and activities, organizing instruction around learning cycles, and providing graphic organizers or visual road maps for courses (Johnson and Aragon, 2002).

As the cognitive learning theory has evolved over the years into more refined and enhanced versions, Fox (1997) compared the traditional cognitive theory (TCT) and the situated learning theory (SLT) in several aspects. First, TCT sees learning as a process that takes place in one's mind, while SLT attempts to encompass mind and lived-in-world at both the personal and social levels. TCT sees learning as the responsibility of learners while SLT holds the formal education system accountable. TCT limits learning to regular schools while SLT extends learning beyond the classroom and traditional environments. Additionally, SLT is not necessarily concerned in improving formal educational systems or teachers since it extends well beyond formal facilities and learning resources, TCT

views the learner as a knowledge container, as opposed to SLT which does not see the mind as a container but rather as a mind-in-action in the everyday world. Another aspect is that SLT sees the learning process as a process of knowledge creation from the situated, contextual, social engagement with the material lived-in-world.

According to Winn (1990), “cognitivist’s” impact on instructional design is different from “behaviorism” in terms of extensive task analysis that requires mental and unobservable tasks to be analyzed. Objectives are used as schematic representations of the knowledge that the student should acquire as opposed to using objectives as statements of what the student is to accomplish. This is similar to the way cognitive theory pays special attention to the mental models that students bring to class versus the entry behaviors that they demonstrate, and instructional design strategies or “cognitive apprenticeships” depend on student’s development of suitable knowledge structures, cognitive procedures and mental models.

Other extensions of the traditional cognitive learning theory include the theory of cognitive development, Fodor's modularity of mind, and the theory of ecological systems.

2.1.3 Constructivist Learning Theory

Lai-Chong and Ka-Ming (1995) referred to two major problems that arise from traditional instructional design that relies on behavior and cognitive learning theories: One is the problem of inert knowledge or “learning out of context,” when learners fail to access relevant knowledge naturally while trying to solve a unique problem. This can be attributed to their habitual learning strategy of memorizing information without understanding its relevance to a specific context. The other problem is knowledge compartmentalization or “knowledge fragmentation,” which refers to the lack of

connections among scattered pieces of knowledge. This is usually caused by the lack of linkages between the newly taught concepts and learners' preconception of relevant knowledge in the topic concerned.

Constructivism Characteristics: Those problems and others caused frequent failures in the traditional design of instruction and encouraged more student-centered learning pedagogies where knowledge is built by students via experience and exposure.

As a result, "constructivism" was the foundation of the new era of learning theories and instructional design. According to Jonassen (1994), eight characteristics are unique to constructivist learning environments. The first characteristic is providing multiple representations of reality. Constructivist learning also offers multiple representations to avoid oversimplification and represent the complexity of the real world. It emphasizes knowledge construction instead of knowledge reproduction, and authentic tasks in a meaningful context rather than abstract instruction out of context. Constructivist learning provides learning environments such as real-world settings or case-based learning instead of predetermined sequences of instruction. Moreover, it encourages thoughtful reflection and feedback on experience and enables context- and content-dependent knowledge construction. One last characteristic in constructivist learning is supporting collaborative construction of knowledge through social negotiation, not competition, among learners for the sole sake of recognition.

As Lai-Chong and Ka-Ming (1995) stated, despite the broad spectrum of constructivist theoretical positions, they all can be characterized by their relative stands in four philosophical directions: existence of an objective reality, predominance of internal processes, effects of instructional interventions, and legitimization of translating

descriptive theory into prescriptive practice.

Cognitive Constructivism and Social-Cultural Constructivism: There are two main approaches of the constructivist school. The first stream is cognitive constructivism from an individualistic perspective. In this approach, the development of human intellectual capabilities evolves through adaptation and organization. Piaget (1972) identifies knowledge with action; he considers that mental development puts these schemes together in more organized, complex and integrated ways to create the adult mind. According to Piaget, the young learner not only takes knowledge in passively as an information processer, but actively constructs it and integrates it with his/her prior knowledge and experiences. From an instructional design perspective, the student's learning activities should be crafted to activate his own prior perceptions and associate them to new streams of knowledge (Järvelä and Niemivirta, 1999). The second stream is social-cultural constructivism from a socio-constructivist perspective. According to Vygotsky (1978), constructivism is based on language and thought theories and their mediation by society. Vygotsky took an anti-realist approach that the process of knowing depends on the impact of other people and the influence of community and culture. This view sees collaborative action as shaped in childhood when speech and practical activities merge and essential use of social speech starts.

Generally speaking, in the socio-cultural approach, human activities are seen as dependent on social factors and elements. Accordingly, learning is integrated with a social process of knowledge construction as opposed to individual efforts, as individual knowledge is viewed as a product of internalization processes of information from the surrounding culture. This implies that when one student participates in a social system,

his/her cognition is shaped by culture and communication tools, especially language, as knowledge reflects the network of interactions (Po¨ ysa and Lowyck, 2001).

2.1.4 Social Learning Theory

Bandura's social learning theory is grounded in the concept of vicarious learning within which people learn from each other by observing, imitating, and modeling. The theory bridges the gap between behaviorist learning and cognitive learning theories since it includes attention (behaviorism), memory (cognitivism), and motivation. Bandura's theory explains behavior as a result of ongoing reciprocal interaction among three variables: personal (cognitive), behavioral, and environmental impacts. This implies that environment and human behavior, influenced by one's ability to process images and language, impact each other; people can influence their own environments and behaviors by reciprocal determinism (Bandura, 1978). Social learning was also the focus of Vygotsky's Social Development Theory and Lave's Situated Learning Theory.

2.1.5 Social Cognitive Learning Theory (SCT)

As indicated by Stajkovia and Luthans (1998), the social cognitive learning theory takes the social learning theory to another level by basing knowledge acquisition on two dimensions; what individuals learn from being part of a society (the social dimension) and what individuals learn through their own thought processes, human motivation, attitudes, action and other unique personal characteristics (the cognitive dimension).

According to Bandura (1989) and Stajkovia and Luthans (1998), there are five basic human capabilities in SCT. One capability is symbolizing, in which symbols are cognitive representations of human experiences, and they serve as vehicles of capturing

and communicating thought. Another capability is forethought, where learners plan their actions, anticipate the outcomes, and determine the level of desired performance. A third capability is observational (vicarious) learning, observing peers and supervisors and the consequences of their actions. A fourth capability is self-regulatory learning, where learners control their actions by setting internal standards and comparing them to their own performance so they can improve them. A fifth capability is self-reflection, where learners evaluate their actions and determine their future success expectations within a certain context.

SCT is the foundation of SCCT (social cognitive career theory), one of the most popular career development and counseling theories in the history of educational psychology. This fact also indicates the strong connections among learning theories and career development and counseling theories.

By contrast, Deci and Ryan (1990) argued that empirically based theories' view of self as a set of knowledge structures and cognitive mechanisms and/or their view of cognitive structures as reflections of social evaluations are not reflective of the true motivational processes rooted in intrinsic motivation, organismic integration or self-determination. Deci and Ryan (1990) stated that the "self is not merely conditioned by the social context" and that regulations and value become part of the self and a reflection of its autonomy only if they are integrated through the activity of the agentic self. According to Deci and Ryan (1990), this integration can take place if the content of social learning is reflective of one's basic needs and the social context provides the environment needed for integration.

2.2 Instructional Design (ID) Strategies and Pedagogies

While it is too common to see teachers holding the students responsible for their own motivation as something that is difficult to predict or control, it is also obvious that our methods and sincerity in impacting students' learning is also responsible for students' level of enthusiasm and the effectiveness of their learning.

Keller (1987) saw the challenges in instructional design in answering two questions. One question is whether we can we unify human motivation theories into one simple, meaningful and practical model. The second question is about the possibility of developing a systematic approach to design motivating instruction.

Andrews and Goodson (1980) distinguished between individual success and systematic success and emphasized the importance of instructional design modeling as the basis for sustainable instructional design. As a result, Keller developed the ARCS model of motivation that views instructional design as an iterative process that includes four phases: defining motivational objectives, designing strategies, developing and integrating motivational elements, and evaluating motivational outcomes. The ARCS model defines four major conditions for people to become and remain motivated: attention, relevance, confidence and satisfaction. ARCS phases are aligned with the generic life cycle activities list described by Reiser (Reiser, 2001).

In the last two decades, ideas such as "bridging the gap between theoretical formal learning and real-life application of knowledge in the work environment" captured the imagination of many thinkers and researchers. As Herington and Oliver (1995) indicated, such ideas were translated into models with six critical factors in common: apprenticeship, collaboration, reflection, coaching, multiple practice, and articulation.

However, the challenge with such learning theories remained in implementing these ideas in instructional settings. Herington and Oliver (1995) defined nine critical characteristics of situated learning for instructional design: authentic context that reflects how knowledge will be used in real life, authentic activities, access to expert performances and the modeling of the processes, multiple roles and perspectives, collaborative construction of knowledge, coaching and scaffolding at critical times, promotion of reflections to enable abstractions to be formed, promotion of articulation to enable tacit knowledge to be made explicit, and integrated assessment of learning within the tasks.

Despite its importance as a critical ingredient in instructional design, metacognition was often overlooked or less frequently integrated into design models as Osman and Hannafin (1992) emphasized. Metacognition refers to awareness of one's ability to understand, control and manipulate individual cognitive processes. Components of metacognition include meta-memory, meta-comprehension, self-regulation, schema training, and transfer. There are serious implications of integrating metacognitive components into instructional design, such as ensuring that metacognitive strategies do not become counterproductive if too much effort is expended to employ strategies learners cannot effectively apply, using more explicit strategies when dealing with younger versus older and novice versus expert, using metacognitive training in an adaptable way to the situation, and using strategies portable across content, emphasis on connections within and beyond a given lesson, integration of new and existing knowledge, construction of relationships, the importance of instructing learners on why as well as when and how to use metacognitive strategies. Additionally, one important

implication is the importance of specifying criteria and standards and providing external prompts to assist students in tracking the depth at which they are processing instruction and methods used to process lessons.

Reiser (2001) described the life cycle of instructional design in terms of six phases that do not necessarily take place in a sequential fashion. Figure 2.1 shows these phases and their relationships such as analysis, design, development, implementation, evaluation, and management.

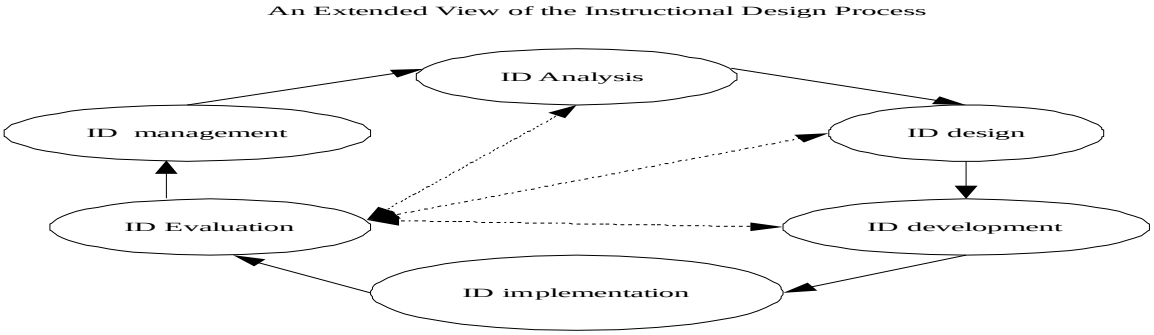


Figure 2.1 An extended view of the instructional design (ID) process.

According to Reiser, instructional design theories originated after the Second World War, and at that time they were related to providing training materials for the military services. There have been a number of movements and trends in instructional design since then, including but not limited to the programmed instruction movement, the criterion-referenced testing movement, Gagne's domains of learning, events of instruction and hierarchal analysis, indirect launching of formative analysis, and emergence of instructional design models. Such models include 70's models that were influenced by the system approach, 80's models that were influenced by cognitive psychology and use of microcomputers, and 90's models that were influenced by new technology advancements (Deek et al., 1999), rapid prototyping, electronic performance

support systems, distance learning, knowledge management and "constructivism." The last includes using real world problems, using team-based problem solving, integrating multidisciplinary problem solving skills, facilitating students' learning process ownership, and increasing role awareness in constructing knowledge by students.

Andrews and Goodson (1980) defined models of instructional design in terms of having descriptive, prescriptive, predictive and/or explanatory components at various levels. They identified fourteen common tasks in instructional design model development: goals and sub-goal formulation, pre-test and post- test development for goals and sub- goals, goal and sub goal analysis in regard to skills expected, goal and sub goal sequencing, defining learners' characteristics, instructional strategy formulation to match requirements with curriculum, courseware development as an implementation of instructional strategy, evaluating courseware empirically using a feedback control loop, constructing materials and procedures for continuous maintenance of the instructional system, assessment of needs, problems, occupational analysis and training requirements, examining alternative solutions to instruction, formulation of an instructional system including environmental variables and constraints, cost estimation and budgeting.

As so many ID models were introduced in the last three decades, Edmonds, Branch, et al. (1994) advocated the importance of building a suitable meta-theory when comparing among instruction design models rather than favoring one model over another. They also identified five additional factors influencing instructional design theory and practice: model purpose, model context, designer experience, type of learning tasks, and the adoption of the systems-theory. As a result , these factors helped Edmonds, Branch, et al. (1994) to produce new instructional design practitioners' framework based on type of

model orientation (prescriptive or descriptive), type of knowledge the model is supporting (procedural or declarative), required designer's expertise (novice, intermediate or expert) and theoretical origins (hard systems, Sportsystems or intuition).

As stated earlier, instructional design strategies and models were grounded in the three major leaning theories: behaviorism, cognitivism and constructivism. As Cooper (1993) pointed out, this was strongly connected to paradigm shifts in dependent educational technologies. Ironically, it is also true that the software development paradigm mirrors the evolution of the learning theories as well (Cooper, 1993). This has become even more obvious with the shift toward object-oriented design of learning environments based on context-independent learning objects as described by Baruque and Melo (2003). This is in spite of the serious concerns that technology used to support instructional design has little or no impact on students' learning outcomes without incorporating other instructional factors such as pedagogy, course design and the quality of ID (Johnson and Aragon, 2002).

In the behaviorism era, technology-based instructional design was task-based and developed stimulus-response chains of behavior. It was most useful for simple and straightforward content where the branching is conditioned and student responses are either correct or incorrect. Cognitivism's impact on instructional design technology was far more reflective of task complexity and individual differences. As Cooper (1993) noted, this resulted in more hardware sophistication, enforcement of an intuitive graphical user interface, content-structured design mechanisms, and the development of cognitively-driven computer-based learning approaches such as intelligent tutoring, hypertext, hypermedia and expert systems. Sian and Rao (2003) indicated that while

behavioral learning theory played an important role in building educational games, especially when using operant conditioning to learn by trial and error, cognitivism played a more crucial rule due to the incorporation of memory processing models in game design. Yet, constructivism produced the most dramatic paradigm shift in computer-based instructional design as the desires and goals of the learner and her ability to learn by discovery and doing became more influential in designing software than the views of the instructor (Cooper, 1993) (Sian and Rao, 2003).

Gla¨ ser-Zikuda et al. (2005) used an ECOLE approach (emotional and cognitive aspects of learning) that utilized a composite of intervention mechanisms in ID in an attempt to enhance well-being, enjoyment, satisfaction, interest and achievement while reducing anxiety and boredom. These intervention mechanisms included student-centered instruction, activation of students, differentiation and transparency of demands, individual feedback, cooperative activities, play-like activities, clearly structured instruction, authentic tasks, and transfer to everyday life. The educational guidelines for this approach were self-regulation, competence, social interaction, structure, and value. While the empirical findings of the ECOLE confirmed its effectiveness in improving students' performances, its general impact on interest, intrinsic motivation, and emotions was weak. Some of these unexpected results were attributed to limited development of a variety of strategies, level of teachers' acceptance and students' unfamiliarity.

2.3 Career Development Theories

A career is an individual choice made by a person based on exposure, interest, expectations, appreciation and other cultural, social, emotional and personal factors, and thus it can be significantly impacted by the way we design our instruction. Moreover, due to the fact that a career also reflects the bidirectional impact between one and his or her environmental circumstances, it can be concluded that "people are the products and the producers of their environment" (Bandura, 1989).

2.3.1 Self-Efficacy Theory

The SCCT mentioned in the career theories table above is the product of the self-efficacy theory which is in turn the product of both the social learning theory and the social cognitive theory mentioned earlier. So what is self-efficacy and how is it linked to career development?

Bandura (1994) defines self-efficacy as "people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives." Bandura described the impact of self-efficacy on one's behavior as the driving force to overcome difficulties, face challenges and create inside us a fighter who approaches threatening situations with confidence that we can exercise control over them.

This implies that the higher the perceived self-efficacy in a certain discipline or a subject of knowledge, the higher the likelihood this discipline or subject will become a career choice. This conclusion was confirmed by empirical findings of many researchers during the last two decades, which was also the foundation of the SCCT (Lent, Brown and Hackett, 1994).

Bandura (1977, 1994) explained four major sources of information for expectations of self-efficacy. One source is performance accomplishments (mastery experiences) which build efficacy through personal successes especially after facing obstacles. A second source is vicarious experience provided by social models. The similarity of the social model to a particular situation and context is positively correlated with the degree of persuasiveness of such a model. Another source is verbal or social persuasion that results from social support and encouragement. However, it is more effective when efficacy builders structure situations carefully in such ways that bring positive results and avoid placing people in situations prematurely where they are likely to have negative results frequently. The last source is emotional arousal such as mood, tension, stress reactions, fatigue, aches and pains, which affect people's judgments of their personal efficacy. Reducing stress reaction and negative emotions helps in modifying self-beliefs of efficacy.

Bandura (1982) also introduced another important type of efficacy related to groups, communities and organizations called "collective efficacy." Bandura's findings confirmed that collective or group efficacy is grounded in personal perceived self-efficacy and that it is a critical factor for social change. According to Bandura (1982), collective efficacy is not only essential in encountering group problems and challenges, but also in influencing group choices, determination of group collective efforts and maintaining group overall sustainability. As a result, collective efficacy can also be crucial to group learning motivation and broadening peer influences in terms of social learning and career interests. A low sense of social efficacy can create internal challenges to preferred peer relationships (Bandura, 1994). Bandura and Locke (2003)

indicated that collective efficacy mediates positive and negative feedback on group goals and partially mediates the benefits of instructive modeling on group effectiveness.

The impact of the self-efficacy theory went beyond providing a new framework for learning motivation and career development to become a new criterion in evaluating some existing models that tend to have large acceptance across the board. For example, the popular information system's Technology Acceptance Model (TAM) explained that perceived ease of use, perceived usefulness and users' belief in positive outcomes are the key determinants of technology usage by users. However, Igbaris and Iivari (1995) found that TAM failed to provide sufficient explanation without acknowledging that outcome expectations alone are insufficient unless combined with users' belief in their own capabilities to use technology, which is their perceived self- efficacy. Even after the refinement of TAM into TAM2 by including the subjective norm factor (Venkatesh, et al. 2003), self-efficacy was still not part of the theory. These findings are substantial not only in refining TAM with SCCT components but also in re-introducing an extended version of the TAM model as a career development model in IT-related fields. This is especially important for this research with its emphasis on learning motivation in IT-related STEM fields.

2.3.2 Unified Theory of Acceptance and Use of Technology (UTAUT)

Since choosing an IT-related STEM field as a career is not a separate issue from user's interest in using technology, the UTAUT represents an important recent IS model after the TAM. As Venkatesh, et al. (2003) concluded, the significance of the UTAUT is in its unique integration of the key elements in eight of the most influential IT usage, social learning, motivation and career-oriented theories. The models they studied are theory of

reasoned action (TRA), technology acceptance models (TAM) and (TAM2), motivational model (MM), theory of planned behavior (TPB), combined TAM and TPB (C-TAM-TPB), model of PC utilization (MPCU), innovation diffusion theory (IDT), and social cognitive theory (SCT).

Based on empirical evidence and extensive research and analysis, the final unified model included four constructs that Venkatesh, et al. (2003) found to be the most significant factors in predicting behavioral intention and use behavior of IT. These constructs are performance expectancy, effort expectancy, social influence, and facilitating conditions. It is quite surprising that at least three of these four factors are strongly correlated one way or another with the self-efficacy theory and SCCT.

2.3.3 Developmental Theory of Circumscription and Compromise

Gottfredson (1981) emphasized in the theory of Circumscription and Compromise the way young people deal with the broad array of career choices they encounter today. The theory is based on the observation that many adolescents frequently delay their career choice decisions as a way to deal with the anxiety resulting from such an overwhelming number of career choices. The theory suggests four non-sequential processes of development: cognitive growth, self-creation, circumscription and compromise. According to the theory, there are four sequential stages for circumscription: orientation to size and power (ages 3-5), orientation to sex-roles (ages 6-8), orientation to social valuation (ages 9-13) and orientation to internal and unique self (ages 14 and up).

During the four stages, children apply the process of elimination excluding occupations that do not fit their size, power, gender and some social perceptions. The last two stages are of particular interest in this research as they deal with middle and high

school students more intensively.

2.3.4 Social Cognitive Career Theory (SCCT)

This complex theory, SCCT, has become one of the most influential theories in career development and counseling. This theory is an evolution of the social cognitive theory (SCT) and the social learning theory. Ali, McWhirter and Chronister (2005) emphasized that personal, contextual (environmental), and social cognitive factors are all integrated in the SCCT framework to try to explain adolescents' and young adults' career interests, goals and behaviors. In this theory, both self-efficacy and outcome expectations are considered predictors for significant incremental variance in interests and intentions (Diegelman and Subich, 2001).

According to Lent, Brown and Hackett (1994), SCCT is rooted in key foundations in SCT. The first foundation is the interactive/dynamic triadic reciprocally between personal attributes, external environmental factors and overt behavior, which also provides a view of human self-regulation (Zimerman, 1989). The second foundation is the crucial role of self-efficacy beliefs, outcome expectations and goal representations as social cognitive mechanisms relevant to career development. The third foundation is the effect of learning experiences and environmental factors that are largely mediated cognitively, but they also do not "reflect a largely mechanistic, operant conditioning view of human functioning." according to Zimerman. The fourth foundation takes a cognitive constructivist approach to career development with emphasis on cognitive feed forward mechanisms, active/interactive construction of meaning with environmental influences, and viewing people as "proactive shapers of the environment" and not as reactive or

"responders to external forces."

Lent, Brown and Hackett (1994) also pointed out that SCCT has compatibility with other non-social learning models of career development such as the ones proposed by Dawis & Lofquist, Holland and Super. According to Lent, Brown and Hackett (1994), the social cognitive career theory is in fact a modularization of interest, choice and performance into three loosely coupled yet tightly cohesive models. One of these models is the model of interest development which links self-efficacy, outcome expectations and interest. Another model is the model of career choice that links interest, choice and action. A third is the model of performance that links outcome expectations and performance in a bidirectional fashion.

The SCCT theory also addresses additional person, contextual and experiential factors. Person factors include gender, race and culture. Contextual (environmental) influences include supports, opportunities, opportunity structure (background influences and proximal influences) and barriers. Experiential factors include performance accomplishments, vicarious learning, social persuasion and emotional arousal (Lent, Brown and Hackett, 1994).

2.4 Review of SCCT, Experiential, Contextual and Person Factors

Since the main interest of this research is exploring the way instructional design of learning experiences shapes self-efficacy of female adolescents in IT-related STEM fields, it is important to elaborate on four types of factors or variables in terms of their definitions, dimensions, sources and relationships: social cognitive career theory main constructs, experiential factors, contextual factors and personal factors. It is also

important to note that these factors represent the area where new instructional design strategies and interventions can be incorporated.

2.4.1 SCCT Individual or Psychological Variables

Self-Efficacy: Self-efficacy is the central variable of focus in the SCCT theory as well as of this research effort. As one can conclude from literature (Lent, Brown and Hackett, 1994), there are several key ingredients in defining self-efficacy. Among these ingredients is that self-efficacy is belief-centered since it is a judgment of people about themselves. Self-efficacy is also capabilities-related since it is about people's belief in their capabilities. Self-efficacy is also transformation-based as it is about making change by organizing and utilizing resources to make a difference in a certain situation. Furthermore, it is task-context-specific as it based on a course of action required in a certain task and a particular context and criteria-driven since people's judgments take place when they compare what they believe they can do with the standard criteria used to evaluate performance levels.

Self-efficacy is unique. It is quite different from self-esteem as self-esteem represents self- evaluation across a wide variety of different situations while self-efficacy is task and context-specific. Self-efficacy also can rapidly change with new inputs and experiences while self-esteem is relatively stable. Self-efficacy is also different from locus of control and (E1, E2) dimensions in the expectancy motivation theory (Stajkovia and Luthans, 1998).

Self-efficacy is of particular interest also to researchers and practitioners examining learning motivation and job performance due to its high predictive power (Stajkovia and Luthans, 1998). When self-efficacy is examined to study its impact on

performance, it is viewed in terms of three dimensions: level of task difficulty a person believes he or she is capable of performing, strength of efficacy expectations, and degree of generality across similar activity domains.

Self-efficacy is generally measured in terms of magnitude (what is the maximum level of difficulty of a certain task one believes he or she is capable of executing?) and strength (what is the level of certainty one has toward his or her ability to execute a certain task?) (Bandura, 1977; Stajkovia and Luthans, 1998).

While empirical evidence was in support of self-efficacy predictability power for science- and math- related interests (Lopez et al. 1997), much more research is needed to examine its influence on women's interest in IT related fields. Lopez et al. (1997) also found additional supportive evidence in that among Bandura's four sources of self-efficacy, perception of prior performance and accomplishments contributed the most.

Outcome Expectations: "Outcome expectations" is the second most important mediating variable in the SCT and SCCT theories after self-efficacy. Both outcome expectations and self-efficacy exchange influence on each other and are expected to predict, explain or influence career interest, choice and performance. Outcome expectations are defined as personal beliefs about probable response outcomes. If self-efficacy implies "Can I do this"? "Outcome expectations" implies "If I do this, what will happen"? (Lent, Brown and Hackett, 1994).

Bandura classified outcome expectations into three categories: physical expectations (such as increase in salary), social expectations (such as approval by the community), and self – evaluation (such as self-satisfaction).

While Bandura confirmed the importance of outcome expectations in SCT, which is also a crucial element in several past career development and counseling theories, he argued that self-efficacy is more dominant since people may avoid a promising action if they doubt their capabilities and this causal effect is not vice versa (Lent, Brown and Hackett, 1994). It should be noted though that in some occasions, high self-efficacy with considerably low outcome expectations might result in avoidance as well.

Diegelman and Subich (2001) expected that the combined effect of both self-efficacy and outcome expectations will have a positive correlation with interest and vocational behavior. They also predicted that self-efficacy will have a unidirectional impact on outcome expectations. However, much less research has been done to examine the causal relationship between outcome expectations and vocational behavior in SCCT. Diegelman and Subich's (2001) empirical findings were in support of the positive impact of outcome expectations on vocational intent, but they found little empirical support for its impact on interest. Interestingly, they found that self-efficacy failed to account for significant variance in pursuit intentions if outcome expectations were intervening between both.

In the Lopez et al (1997) study, outcome expectations for high school students in math were empirically found to be explanatory for an increase in interest to the extent that it depends on self-efficacy.

Interest and Goals: Increasing career interest and thus influencing career goals, choices and performance is the ultimate goal of the career development theories and the foundation of SCCT. Many studies have been particularly focused on the triadic directional and unidirectional relationship among self-efficacy, outcome expectations,

and interest (Diegelman and Subich, 2001; Lopez et al, 1997).

This research considers "career interest" as the main dependent variable of interest in the social cognitive career theory. Interest is the cornerstone of the dependent variables chain in SCCT; it is difficult to imagine that a career choice will be made without increasing interest. According to Deci and Ryan (1990), interest is the foundation of motivational processes as through interest people connect to emotions, needs and external inputs to action, regulate intentional actions in a joyful fashion and create unity, coherence, autonomy and self-determination. Entwistle et al. (1979) noted that there are three forms of motivation: extrinsic, intrinsic streaming from interest, and intrinsic streaming from maintaining self-esteem. The second form is of particular interest in this research effort. Entwistle et al. (1979) found in their study three categories that distinguish students' interests, approaches and styles to learning. The first category is intrinsic motivation that is autonomous and syllabus-free. Students who have this orientation have one of two styles: deep approach and comprehension learning. The second is extrinsic motivation related to fear of failure, and it is characterized by anxiety and syllabus-bound. Students who have this orientation have one of two styles: operation learning and surface approach. The third is students' interests in achieving high grades, which is related to hope for success and characterized by stability, self-confidence and ruthlessness. Students who have this orientation are organized and achievement-oriented.

Yet, what really increases interest and whether interest can be sometimes bypassed is also an issue raised in several studies (Diegelman and Subich, 2001; Lopez et al, 1997). While measuring interest is usually simple and straightforward, it is important to note the important connections among personal factors, self-efficacy and interest in terms of

Holland's theory, Big Six areas of interest (Nauta's, 2004). Holland's big six types of career interests are realistic, investigative, artistic, social, enterprising and conventional. These connections will be discussed later in the personal factors section. As indicated by Gla¨ ser-Zikuda et al. (2005), interest is a type of emotion that has both a value-related and a feeling-related valence. Interest-value results from an experience relevant to an object of interest whereas interest-feeling results from positive emotions (such as enjoyment) while participating in an interest-based activity.

In SCCT, goals also play a crucial role in behavior self-regulation. Goals are important for outcomes sustainability because they help people move forward in the absence of external reinforcement. A goal is defined as the determination to engage in particular task or to influence a certain future outcome. Goal mechanisms include career plans, decisions and aspirations (Lent, Brown and Hackett, 1994).

2.4.1 Experiential Factors

According to Bandura (1977), the four sources of efficacy information have common mechanisms of operation as in Table 2.1.

Table 2.1 Mechanisms of Operation for the Four Sources of Efficacy

Source of self-efficacy	Mechanisms of operation
Performance accomplishments	Participant modeling Performance desensitization Performance exposure Self- instructed performance
Vicarious experience	Live modeling Symbolic modeling
Verbal persuasion	Suggestion Exhortation Self-instruction Interpretive treatments
Emotional arousal	Attribution Relaxation and biofeedback Symbolic desensitization Symbolic exposure

2.4.2 Contextual Factors

As indicated earlier, contextual or environmental determinants include supports and barriers. These determinants help shape the learning experiences and feed personal career interests and choices and the opportunity structure that acts as a platform for career planning (Lent, Brown and Hackett, 1994). They are also crucial to the success of instructional design, yet they are largely ignored in many models (Tessmer and Richey, 1997).

An essential part of the supports is defining an “opportunity structure,” which can be divided into two categories as shown in Table 2.2, despite the fact that these categories include overlapping elements such as family and social inputs.

Table 2.2 Opportunity Structure Categories and Examples derived from Lent, Brown, and Hacket (1994, 2000).

Opportunity Category	Impact	Examples
Background influences (distal)	Help shape interests and self-cognitions.	- Differential opportunities for task and role model exposure. - Emotional and financial support for being part of certain activities. - Cultural and gender role Socialization processes.
Proximal influences	Their role is more significant at critical milestones and events.	- Personal career network contacts. - Structural barriers such as hiring that discriminates based on gender or race.

Lindley's (2005) research concluded that even though contextual career barriers may be similar to proximal process outcome expectations, they are different from distal outcome expectations. Distal or background contextual affordances affect learning experiences which are the source of career-based self-efficacy and outcome expectations while proximal contextual influences are more important during active phases of educational or career decision making. Person inputs such as gender, race and predispositions were also predicted to have a bidirectional influence with background contextual affordances, and SCCT prefers to look at them separately despite their overlap, coupling and role interchangeability of impact on career decisions (Lent, Hackett, et al., 2000).

As Lent, Brown and Hackett (1994, 2000) pointed out, the influence of environmental factors on vocational behavior is guided by either objective features or perceived aspects of the environment. The perceived aspects do not reduce the importance of objective features but rather reflect on the social cognitive theory as it emphasizes person's active role as the translator of environmental factors via cognitive

appraisal processes.

According to Lent, Brown and Hackett (1994), it is anticipated that people who have higher perception of beneficial contextual influences (presence of ample support and few barriers) tend to have stronger interest-goal and goal-action relations in SCCT as opposed to people who perceive less favorable conditions.

While this may imply that contextual influences play only a moderating role, they sometimes play a determinant role, but this does not happen too often. However, and as Ali, McWhirter and Chronister (2005), Lent, Hackett, et al. (2000) and Bright et al. (2005) indicated, parent, family, sibling, peer and teacher support have been found to predict adolescents' career behavior indicators such as educational plans, career aspirations, perceptions of structure of opportunity, school retention, self-efficacy, and outcome expectations (through school outcomes).

In non-SCCT- based research, career barriers are usually defined as events or conditions that make career progress difficult (Lent, Hackett, et al. 2000). Lindley (2005) pointed out two aspects of contextual barriers that are particularly important for SCCT studies – especially for women and minorities: perception of barriers and coping efficacy. Coping efficacy mirrors individual's perceptions of his or her ability to negotiate particular situational elements that present environmental barriers or obstructions for performance (Lent, Hackett, et al. 2000).

According to Lindley (2005), coping efficacy is a predictor of the likelihood that individuals will attempt to and successfully overcome perceived barriers to career development, a predictability power that points to the possible complementary role of coping efficacy to task-related self-efficacy in enabling performance and persistence

(Lent, Hackett, et al. 2000). It should be noted though that coping efficacy can be significantly impacted by gender differences, especially if we take domestic violence against women into consideration (Chronister & McWhirter, 2004).

Lent, Hackett, et al. (2000) developed an extended framework for SCCT where they have posited that coping efficacy, past barrier experiences and vicarious barrier information will influence proximal barriers (or process expectations), and where proximal barriers are expected to play a moderating role in the interest-goal and goal-action relations but have a direct negative impact on career goals. Albert Bandura also argued that there is both a direct and indirect influence of supports and barriers on career choices (Lent et al. 2003)

Lindley's research found that there is a stronger relationship between coping efficacy and Holland's theme self-efficacy in men than women. Surprisingly, findings of Lindley's (2005) empirical research – that incorporated Holland's six career options in SCCT analysis – including women's perception of career barriers as impacting their career development, was positively related to their outcome expectations. Women who chose investigative or conventional careers had much higher perceptions of career barriers as opposed to women who chose social careers.

An interesting conclusion in Lindley's (2005) work is that women who made career choices in investigative or conventional occupations as opposed to social occupations had strong persistence in those fields despite the perceptions of considerable barriers they have to overcome. Smith (2004) indicated that structural changes in the economy have created another contextual influence in terms of employment environment in IT fields especially for women and minorities and found that women perceived

significantly greater barriers for their career choices than men did.

In spite of its importance, Albert and Luzzo (1999) noted that Weiner's attribution theory – of external and internal factors - was never applied to SCCT in the context of understanding the roles that perceived career barriers play in career decision making. Albert and Luzzo (1999) indicated that attributing barriers to internal and controllable causes has a positive impact on coping efficacy and vice versa when barriers are attributed to external and uncontrollable environmental forces.

2.4.4 Person Factors

Person factors in SCCT mainly include gender, ethnicity and socio-economic status (SES) (Ali, McWhirter and Chronister, 2005). However, factors such as individual differences, cognitive and learning styles, prior knowledge, prior experience predispositions, disabilities, parental and family influence, and contextual affordances could play a crucial role. It is obvious, however, that some of these factors might be at the borderline between contextual and personal classifications, which is an ongoing argument between SCCT researchers and other career development theorists (Lent, Hackett, et al. 2000). However, the emphasis of this review will be focused on gender with different ethnicities since this is the main theme of this research work.

Bussey and Bandura (1999) pointed to several dimensions concerning gender development. A key dimension is psychological (intra-psychic processes), biological and socio-structural determinants. Another important dimension is the nature of transmission models in which Bussey and Bandura (1999) indicated that the SCT of gender-role development and functioning integrates psychological and socio-structural determinants within a unified framework. This framework views gender conceptions and role behavior

as the results of a large network of social impacts that goes beyond a familial transmission model to a multifaceted social transmission model. A third dimension is the temporal scope of theoretical analysis where the SCT is distinguished by taking a life-course perspective in contrast to other theories that were either childhood or adulthood focused.

In their extensive review of gender development literature, Bussey and Bandura (1999) concluded that there is a significant impact of stereotypic gender occupational orientations in educational practices on the structure of self-efficacy of boys and girls, which usually results in girls' perceived occupational efficacy centered on careers in service, clerical, caretaking and teaching avenues whereas boys' perceived occupational efficacy is centered on careers in science, technology, computer systems and active pursuits. Busch and Trondelag (1996) confirmed in their study the low efficacy of female students in computer studies and accompanied this finding with the impact of previous computer experience, previous encouragement and access to one's own computer on gender-based self-efficacy. Miura (1987) indicated the relationship of math to computer science; the impact of video games on male students has given boys some advantage over girls in strengthening their performance accomplishments as a major source for their computer science self-efficacy. Media has also contributed to boys' vicarious experiences more than girls' since boys are usually featured as the champions in computer-related fields. Miura's (1987) empirical study found that current and past enrollment in past and current computer-based classes was positively correlated to self-efficacy. According to Miura (1987), three factors were found to be the most influential in predicting computer self-efficacy in women: completion of a high school programming course, college major,

and past enrollment in a computer science class.

Additionally, Bussey and Bandura (1999) considered among the most influential factors in gender development and self-efficacy: parental impact, media representations of gender roles and peer influence and affiliation. They also suggested that collective efficacy has had its impact on gender development over the years.

Patton, Bartrum, et al. (2004) studied the impact of optimism and self –esteem on career decision-making and career goals in the light of SCCT and CMR (cognitive-motivational-relational) theories. They indicated that the literature supports the adaptational nature of the career development process and the functional role that optimism and pessimism play in the development of high school students' career maturity. They found that female students who have a positive outlook are more likely to set career goals and explore their career options whereas optimism was not found to be of significant impact on their career expectations. Interestingly, their study also found that females with high self-esteem were less likely to attribute the outcomes that take place in situations to their own hard work and efforts.

Byars and Hackett (1998) studied the differences among women of color (African American, Latinas, Asian American and American Indian) in terms of the four sources of self-efficacy in SCCT (i.e.: performance accomplishments, vicarious learning, social persuasion, and emotional arousal) and found significant differences. They concluded that special attention should be paid in research to their socio-cultural factors including historical and ongoing references as well as their unique and shared experiences, and how this impacts their self-efficacy sources (especially performance accomplishments and vicarious learning), which in turn influence their career self-efficacy.

Brown et al. (2002) studied the impact of gender on self-efficacy in problem-based learning (PBL) environments due to PBL importance in simulating real world contexts and engaging students in collaborative knowledge building. The study found no significant difference between genders in reporting gains in self-efficacy items, which was also confirmed by Chung (2002). Both studies (Chung, 2002; Brown et al. 2002), however, found that that those with higher career-related self-efficacy tended to be more committed to career decision-making activities, which is consistent with SCCT premises.

Personality Factors: As concluded by Nauta (2004), Holland's big six types of career interests (realistic, investigative, artistic, social, enterprising and conventional or RIASEC) are strongly related to the five big dimensions of personality (openness, conscientiousness, extraversion, agreeableness and neuroticism). Nauta (2004) also indicated that researchers found direct relationships among personality, self-efficacy and interests as well as some overlap. Nauta's (2004) empirical work revealed important connections between certain personality variables and some of Holland's six self-efficacy and interest areas.

Gla¨ ser-Zikuda et al. (2005) studied the importance of emotions in learning achievement in terms of self-regulation, cognitive information processing, task mastery, attributions, and self-concepts and pointed to three areas where research is relevant in studying positive influences of instruction on emotions: well-being, anxiety and quality of instruction. While the "emotions" topic might also belong to the instructional design section or SCCT learning experience variables (i.e., emotional arousal), it is important not to overlook it while discussing personal factors. It is also valuable to note that emotions are of significant importance when it comes to designing career-driven

instruction for women.

It is also worthwhile to incorporate individual differences in personal factors between people in regard of their cognitive styles. Ausburn and Ausburn (1978) defined cognitive styles as the "psychological dimensions that represent consistencies in an individual's manner of acquiring and processing information." They also emphasized the significance of cognitive styles in instructional design in order to bridge the gap between the learner and the task by helping with essential processing.

2.5 Women and Minority Adolescents and IT-Related STEM Fields

"Adolescents" in this study include students aged 13-20 in upper middle school, high school and early college. Under-representation of women and ethnic minorities in the IT field may involve career barriers for such groups (Smith, 2004). According to the Census Bureau (2008), women represent 46.3 percent of the total civilian workforce but only 26.7 percent of the IT, computing and mathematical occupations (more than a 3% decrease from 2000). African Americans occupy only 7.3 percent of IT professions, while representing 10.9 percent of the U.S. population. Also, while 13.6 percent of the American population is Hispanic American, they make up only 5 percent of the IT workforce (Census Bureau, 2008). Lent, Brown, and Hackett's (1994) social cognitive career theory emphasized that women and ethnic minorities perceive more self-efficacy barriers to their career goals than do other groups.

Despite the fact that a large amount of research has been carried out examining the role of occupational self- efficacy in adults or young adults, there has been little research examining the development and importance of self-efficacy beliefs in middle school and

high school students' career decisions (Amato-Henderson et al, 2007). It was also found that vicarious learning, including connections to role models in the field, and mastery experiences have more effect on high school students' self-efficacy than social persuasion (Amato-Henderson et al, 2007). These findings were further confirmed for college students concerning IT education by Smith (2004). Self-efficacy in high school students has an extended impact even beyond regular school activities as evidenced in physical health studies involving variables of the social cognitive theory (Winters et al. 2002).

It was noticeable in the Lent et al. (2003) study that while supports and barriers had a negative correlation with each other, supports provided a much stronger path to self-efficacy. This was attributed to one of three reasons: the mediation role of supports between barriers and self-efficacy, the possible impact of barriers on supports, and the possible impact of excluding barrier-coping efficacy as opposed to occupational task self-efficacy. Lent et al. (2003) also noted that the results may have been different if another age group had participated.

Ji et al. (2004) found that eighth grade students' occupational sex-type perceptions for particular jobs were correlated with their levels of self-efficacy and interest based on Holland's types, which supports the hypothesized relationship between distal background contextual affordances factors and person inputs in SCCT. This also implies that the perceptions of the sex-type of an occupation are a barrier for career decisions as early as the eighth grade (Gottfredson, 1981). One intervention mechanism to help overcome this barrier would be providing young adolescents with role models who were able to overcome difficult situations with a sense of resilience and coping efficacy.

CHAPTER THREE

ANALYSIS, CRITIQUE OF EXISITING APPROACHES AND INTERVENTIONS

3.1 Literature Review Analysis and Synthesis

This study is an attempt to connect learning theories, instructional design strategies, and career development theories in a holistic yet pragmatic fashion. Based on this multifaceted literature review, instructional design will be revisited to identify major current gaps in middle schools, high school and early college education concerning learning motivation and self-efficacy with emphasis on SCCT, STEM, gender and adolescents. SCCT gaps are reviewed in the light of the literature survey analysis.

3.1.1 Linking Learning Theories

While behaviorists emphasize learning by consequences, cognitive theorists emphasize learning by effective processing of information, and constructivists emphasize learning by doing, social learning emphasizes learning via observing others' behavior, attitudes, and outcomes of those behaviors, or in other words "modeling." An extended view of reciprocal determinism in the light of the four major learning theories is provided in Fig 3.1 partially based on Bandura (1987).

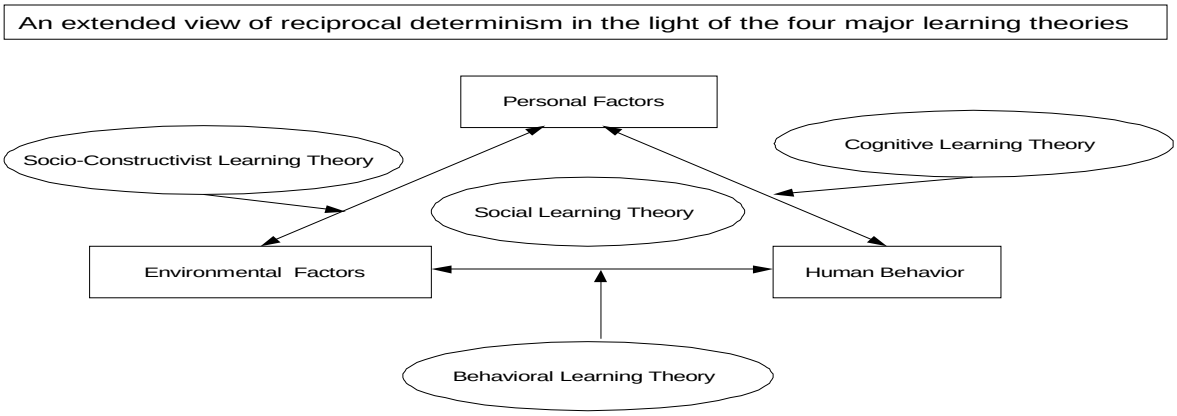


Figure 3.1 An extended view of reciprocal determinism in the light of the four major learning theories.

Criticism of Socio-Constructivism: As the 60's cognitive revolution in educational psychology started to face two contrasting movements in the 90's, situated learning and constructivism, the debate never stopped about whether it is better to transfer knowledge from teachers to students in a structured way or to facilitate authentic socially-active environments where knowledge is constructed by the students themselves.

Anderson et al. (1996) distinguished between "constructivism" and "situated learning," as the former is actually a philosophical position while the latter has strong empirical consequences within which the basic idea is that much of what is learned is specific to the situation in which it is learned. To a certain degree, situated learning, just like constructivism, emphasizes participation in social practice as opposed to the cognitive perspective that emphasizes individual development in the acquisition of intellectual skills (Anderson et al. 1999).

The socio-constructivist (as well as situated learning) theories were critiqued by well-known education researchers in five key areas. Anderson et al. (1999) explored the differences between situative perspectives (social approach) and cognitive perspectives

(individual approach) on learning and found that both approaches can actually complement rather than contradict each other.

Since there is often a great value in instruction that focuses on parts of a competence or individual learning as opposed to limiting instruction to complex social situations, it is not always effective to turn the classroom into a workplace (Anderson et al. 1997).

Abstract instruction can be very effective, and vocational settings are not always the best way of teaching. The breakdown of complex skills and the decontextualization of the learning situation as an important cognitive characteristic of the human mind are often overlooked by constructivist approaches. Additionally, instruction can often generalize from the classroom to "real world" situations (Anderson et al, 1997).

In the constructivist theory, learning must be an active process. This always assumes that activities are limited by interaction with an external environment. Since learning requires a change in the learner in terms of what the learners do and what they attend to, the nature of activities they engage in should include a broader spectrum of options.

Cognitive psychology has demonstrated, in numerous applications, how a careful understanding of the mental processes of learning and applying knowledge and skills can generate enriched pedagogies and techniques of teaching and learning alike.

A Survey of Constructivism-Driven Pedagogies

The constructivist learning theories discussed earlier have had a significant impact on instructional design and technique since the early 90's. These pedagogies evolved into a broad array such as participant-centered learning, situated learning, active learning, case

studies, role play exercises, team-group exercises, management games, simulations, and problem-based learning (PBL) approaches such as project-based learning, inquiry-based learning, case-based learning, collaboration-based learning and research-based learning.

3.1.2 Linking Learning Theories to Instructional Design Strategies

Instructional design strategies and pedagogies are a reflection of the three key learning theories and their extensions, expansions and integrations. Each one of these theories has implicit and explicit assumptions, elements and mechanisms that contribute to learning environment architectures. Indeed, learning theories are meaningless if not translated into working methods and techniques that would help teachers design effective learning environments capable of boosting learning motivation and increasing learning effectiveness. Despite the high importance of linking learning theories to instructional design and vice versa, it took a very long time before scientists and researchers started to construct comprehensive frameworks that explain how learning theories and ID practices are interconnected (Wildman and Burton, 1981).

Table 3.1 Impact of Learning Theories

Learning Theory	Behaviorism	Cognitivism	Constructivism
ID Implications	Development of instructional objectives.	- Designers thoroughly analyze appropriate tasks needed for the learner to effectively process information received. - Goals should reflect learner characteristics, needs and interests.	- Similar to Cognitivism in accounting for learner's prior knowledge and interest. - Open-ended expectations as opposed to an objective approach. - Heavy attention to context of the learning situation.
ID Strengths	Learner is focuses on clear and specific objectives.	Learning is relevant because it is based on person's cognitive structure.	- Content can be presented from multiple perspectives using projects and cases. - Learners can create their own individual versions of information and articulate it. - Active knowledge construction as opposed to passive transmission of information.
ID Weaknesses	Dependency on the appropriate stimuli to continue the intended behavior.	Since pre-requisite knowledge must exist first, instructors must design for appropriateness for all levels of experience. This could be costly and time-consuming.	- Individual learner interpretations are difficult to evaluate. - Teachers cannot respond to a broad array of students interests due to lack of resources and complexity.

3.1.3 Linking Career Theories

Similar to what we have seen in the strong connections among learning theories and instructional design strategies and models, career development theories also mirror the evolving learning experience of children all the way toward adulthood and formal occupations. Career theories can be categorized as either trait-factor, developmental, or social cognitive. Career theories go back to 1909 when Parsons made his categorization of people regarding their career decisiveness as either certain or uncertain (Churach and Rickards, 2007). Table 3.2 tracks the evolution of career development theories since then.

Table 3.2 Evolution of Career Development Theories

Year	Founder(s)	Contributions	Weakness(es)
1909	Parsons (Trait and Factor)	Classifying people into decided and undecided.	Very limited theory that views career choice as a non-dynamic behavior.
1937	Williamson and Darley (Trait and Factor)	Classifying people into very certain, certain and uncertain.	-Simplistic either-or approach. -Produced mixed and inconsistent results.
1951	Ginzberg, Ginsburg, Axelrad and Herma	People tend to experience a development process of three phases: fantasy, tentative and realistic which includes: (exploration, crystallization and specification).	No recognition of race, gender or social class.
1953	Super	- Impact of "self-concept" on career choices, where "self-concept" is shaped by personal experiences. - Developmental theory of five stages: growth (childhood), exploration (adolescence), establishment (early adulthood), maintenance (middle adulthood) and decline (later adulthood).	Omitted women, people of color and the poor.
1956	Roe	Occupational choice is multifaceted and can be viewed in diverse ways.	
1959 & 1995	Holland	Introduced a hexagonal model that matches six types of personalities with six types of modal environments including realistic, investigative, artistic, social, enterprising and conventional.	Gender bias since women score better in three personality types: artistic, social and conventional.
1964	Vroom	Differentiated between preferred occupation and attained occupation. "People not only select occupations, they are selected for occupations"	
1981	Hackett and Betz	Translation of self-efficacy theory to career development	
1976, 1990	Krumboltz and Mitchell	Social learning theory of career decision making	Primarily concerned with choice behavior as opposed to correlations between interest, choice and performance.
1987	Lent, Brown and Hackett	Social cognitive career theory (SCCT) based on Bandura's SCT. This dynamic theory addresses issues of culture, gender, genetic endowment, social context and unexpected life events. SCCT is based on the correlations of self-efficacy, outcome expectations, interests and personal goals as predictors to individual's career choice.	Limited implementation and evaluation in some fields.

3.1.4 Linking Learning Theories to SCCT

After reviewing various learning theories, instructional design strategies and career development theories, the key ingredients of the SCCT theory were then comprehensively investigated and several refinements and connections were applied to the original SCCT model. Figure 3.2 provides an extended view of SCCT process through contextual influences in the light of three main learning theories and embedded SCT based on (Lent, Hackett, et al. , 2000; Lent et al. (2003); Byars & Hackett, 1998).

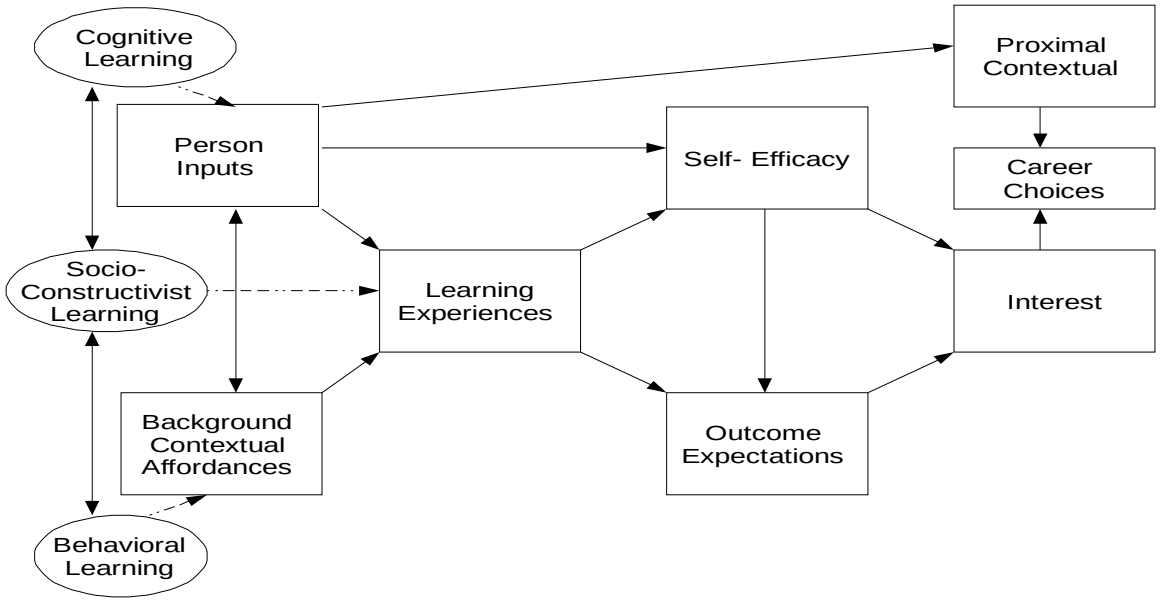


Figure 3.2 An extended view of SCCT process through contextual influences in the light of three main learning theories and embedded SCT partially based on (Lent, Hackett, et al. 2000; Lent et al. (2003); Byars & Hackett, 1998).

Lent et al. (2003) found empirically that the combination of self-efficacy and outcome expectations was able to provide a powerful explanation for the change in interest in high school students using Holland types. In this empirical study, while social barriers and supports related strongly to career choices through self-efficacy mediation, they had almost no direct influence on career choice. It was concluded that the real role of proximal social contexts and barriers is probably to inform self-efficacy rather than to impact career decisions. Accordingly,

a refined view of the earlier SCCT diagram (Figure 3.2) is provided in Figure 3.3. This diagram moves the arrow from proximal contextual barriers and supports to career choices to connect directly to self-efficacy.

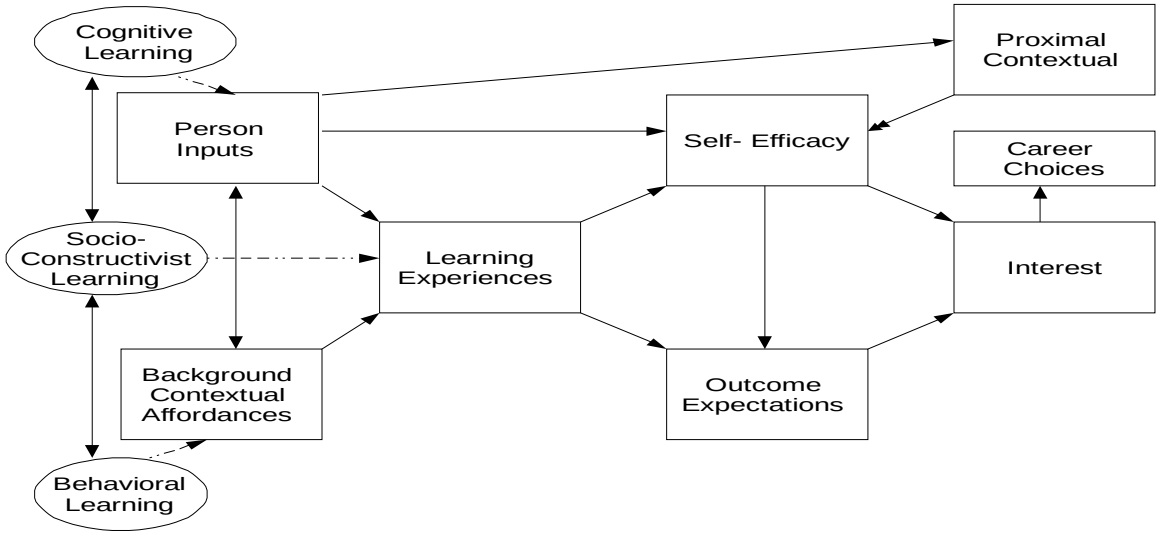


Figure 3.3 A refined view of SCCT process through contextual influences in the light of three main learning theories and embedded SCT partially based on High School Students' Data (Lent, Hackett, et al. 2000; Lent et al. (2003); Byars & Hackett, 1998).

3.2 Critique of Existing Approaches

Comparing the outcomes of the surveyed literature and current instructional design of typical or common learning environments in middle schools, high schools and early college today and in the light of the SCCT theory, one can pinpoint several serious general and specific problems concerning instructional design (ID) impact on adolescent's, especially women's, self-efficacy in IT-related STEM fields, including but not limited to:

- Lack of subject connectivity to other subjects.
- Lack of relevance.

- Lack of utilization of positive peer influence.
- Lack of mature mentorship.
- Lack of self-regulated learning.
- Poor learning motivation.
- Lack of role modeling.
- Lack of excitement and joy.
- Poor chemistry in classroom environment.
- Poor sense of ownership.
- Poor adaptability to students' individual differences.

3.2.1 Lack of Subject Connectivity

The first gap in current instructional design is lack of subject connectivity to other subjects and poor multi-disciplinary or cross-disciplinary design.

SCCT impact: Girls who are trained to see disconnection among the six Holland's types of interests are less likely to pursue careers in the three non-women areas (investigative, realistic and enterprising). Obviously, this is a barrier unless otherwise adequate support is provided.

3.2.2 Lack of Relevance

The second gap in current instructional design is lack of relevance in connecting theory to practice and real world applications.

SCCT impact: Real world applications help form true and solid performance accomplishments that can become part of the past positive experiences when women are in a position of making a career choice. Since these experiences are of an educational

nature, they can build self-efficacy in Holland's non-women areas gradually and adaptively with the minimum level of anxiety, fear or emotional arousal accompanied by the maximum level of excitement and fun. This is also in line with the incorporation of the attribution theory Albert and Luzzo (1999).

3.2.3 Lack of Utilization of Positive Peer Influence

The third problem in current instructional design is lack of utilization of positive peer influence.

SCCT impact: Peers are the most influential element in adolescent lives, and they can provide role models for success (vicarious learning) as well as a source of collective efficacy that is also predicted to have positive influence on increasing self-efficacy (Bandura, 1982, 1994; Bandura and Locke, 2003). Peers can also provide social support to overcome barriers.

3.2.4 Lack of Mature Mentorship

The forth problem in current instructional design is lack of mature mentorship for individuals and groups alike.

SCCT impact: Mature mentorship can provide role models of long-term successes and life stories. It can also provide social support and help shape learning experiences in one-on-one or team-based formats. Additionally, mentorship can be substantial for enhancing social persuasion.

3.2.5 Lack of Self-Regulated Learning

The fifth issue with current instructional design is lack of self-regulated learning and disconnection of instruction to self, interest, choice, self-actualization and passion.

SCCT impact: Connecting to self and passion is part of the personal inputs that are expected to have high impact on learning experiences and directly or indirectly on self-efficacy. Strengthening person inputs especially when it comes to gender-based strategies is crucial due to the psychological, biological and socio-cultural determinants (Bussey and Bandura, 1999). It should be noted also that this gap was one of the critiques of the SCT from motivational-centric researchers (Deci and Ryan, 1990).

3.2.6 Poor Learning Motivation

The sixth challenge with current instructional design is poor learning motivation (beyond fear of failing or interest in achieving good grades) including lack of challenging situations that establishes resilience overtime to overcome barriers.

SCCT Impact: "Learning for grades" creates an obstacle for self-regulation and self-reflection (Stajkovia & Luthans, 1998), which is substantial in creating the proactive personality that impacts the environment as opposed to passive reaction. This also impacts coping efficacy negatively as it decreases intrinsic motivation to overcome barriers (Entwistle et al, 1979).

3.2.7 Lack of Role Modeling

The seventh problem with current instructional design is lack of modeling, role modeling, dramatization, media partnership and other sources of vicarious learning.

SCCT Impact: Modeling is central to Bandura's value-chain of findings, analysis and theories, and it is a strategic self-efficacy source that was evidenced to have the second largest explanation power after performance accomplishments (Amato-Henderson et al, 2007).

3.2.8 Lack of Excitement and Joy

Another serious problem with current instructional design is lack of excitement and joy.

SCCT Impact: Excitement and joy are part of emotional stability (as opposed to anxiety and panic) and are also essential to learning motivation. Reducing anxiety is central as a source of self-efficacy in SCCT as well as using positive "emotions" as an influential personal input on learning experiences and self-efficacy (Gla¨ ser-Zikuda et al., 2005). The latter is particularly important when dealing with women's learning motivation.

3.2.9 Poor Chemistry in Classroom Environment

Another challenge in current instructional design is poor chemistry in classroom environment as a result of weak social bonding, poor emotional intelligence, emotional supports and emotional arousal coping mechanisms as well as limited or non-existing collective efficacy.

SCCT Impact: This is a clear connection to contextual social supports as well as emotional arousal. It also has an impact on social persuasion which is another source of self-efficacy. While personal self-efficacy is expected to predict collective efficacy, we are also examining the impact vice versa.

3.2.10 Students' Poor Sense of Ownership

Another challenge in current instructional design is students' poor sense of ownership of what they learn, what they join and what they produce.

SCCT Impact: Despite the fact that SCCT has an implicit integration of the socio-constructivist learning approach (Brown and Hackett, 1994), the organismic integration of learners in the social contexts and its impact on their intrinsic motivation might be

questionable (Deci and Ryan, 1990). Not enough attention in SCCT has been paid to students' sense of ownership or to their sense of self-actualization.

3.2.11 Poor Adaptability to Students' Individual Differences

Another challenge in current instructional design is poor adaptability to students' learning curves, cognitive styles and individual differences.

SCCT Impact: Individual differences are also part of person-inputs (Ausburn and Ausburn, 1978), which is one of the explanatory variables for learning experiences and self-efficacy (see Figure 2.4). "Adaptive learning" does not ask the learner only to adapt to ID but also enables ID and the curriculum to adapt to the student in a dynamic fashion. While this is in complete synchronicity with Bandura's and SCCT's foundations, it is not too clear in SCCT literature.

Other significant gaps include a lack of connection to higher levels of learning, disconnection to socio-cultural contexts, and disconnection to other existing resources (such as parents, community, etc.) as partners in the design for instruction.

These ID gaps are strongly aligned with career development challenges for two reasons: First, they play a crucial role in shaping and forming the "Learning experiences" variable (and other variables) posited by SCCT as the key predictor for self-efficacy and outcome expectations, and thus they indirectly influence career interest. Providing effective ID strategies or mechanisms is predicted to enrich "learning experiences" as main sources of self-efficacy. Second, they are expected to have significant impact on the contextual variables in terms of career interest and choice barriers. Clearly, bridging these gaps or providing intervention mechanisms is equivalent to providing contextual supports

to help increase the coping efficacy, resilience and ability to overcome these barriers.

3.2.12 Synthesis of Gaps of the Social Cognitive Career Theory

While the SCCT theory in its latest versions sits at the top of career development theories as the most comprehensive, reflective and integrative theory around, the theory still has some gaps that need to be addressed and bridged.

One gap is the lack of organismic integration of learners in the social contexts; its impact on their intrinsic motivation might be questionable (Deci and Ryan, 1990). Another gap is that SCCT is strongly aligned with the socio-constructivist philosophy especially when it comes to learners' proactive roles toward their environments. However, as SCCT is heavily grounded in the impact of learning experiences on self-efficacy and outcome expectations, its framework reflects only a few of the relevant instructional intervention mechanisms proposed by constructivist ID strategies.

Moreover little research has been done yet on the significance of outcome expectations in influencing interests and career choices in comparison to self-efficacy. Also, there is not too much evidence on the direct connection between learning experiences and outcome expectations without the mediating role of self-efficacy. Furthermore, more work needs to be done to examine the mutual exclusiveness of person inputs from contextual supports and barriers and also to further test the direct impact of person inputs on self-efficacy.

Additionally, a few more interesting relationships need to be investigated. One of these relationships is the impact of coping efficacy, social efficacy and collective efficacy on personal self-efficacy. Another relationship is the correlation direction between some contextual barriers and self-efficacy based on gender and sex-type Holland interest areas.

One major gap is that there are some motivational factors strongly related to women that are overlooked, including emotions. While emotional arousal is strongly considered by SCCT, it is often looked at as a barrier rather than a positive source of self-efficacy.

Finally, there is still much more that needs to be explored regarding the extent within which SCCT is really a full reflection of all essential variables, elements and ingredients that may have potential impact on self-efficacy, outcome expectation, interest and career choices. There is a wealth of self-efficacy sources that are either overlooked or considered.

These gaps identified the need for intervention mechanisms that need to be explored. A new model will be proposed to build on some of the findings of this review within the main focus regarding adolescent women's self-efficacy in IT-driven STEM fields

3.3 Intervention Mechanisms

In the next few pages, a few of the key intervention mechanisms that are largely thought and proven to be helpful and effective in bridging the ID gaps above will be surveyed in an effort to increase self-efficacy in adolescent women in IT-related STEM fields and thus potentially to increase their interests in Holland's areas perceived as gender-specific. This will be aligned with the SCCT refined framework as shown in Fig 3.3.

While many of these mechanisms are drawn from a socio-constructivist perspective, the author of this research work believes that the relationship among the three main learning theories, in addition to the social learning theory and SCT, despite their differences, is likely to be a complementary one and not necessarily contradictory. This can also be inferred from the three refined conceptual framework provided in figures

3.1, 3.2 and 3.3.

3.3.1 Common Intervention Mechanisms

According to Brown et al. (2003), some of the frequently used intervention mechanisms include cognitive restructuring (Deek et al., 1999, 2000), vocational exploration, attention to decreasing career barriers, attention to building support, world of work information, values clarification, vicarious achievements, counselor support, individualized interpretations and feedback, collaborative learning, social persuasion, anxiety reduction, self-regulated learning within teams and between teams, personal performance accomplishments, self-report inventories, outside reading, modeling, workbook and written exercises, decision making model and strategy, individualized interpretations and feedback and computer-aided interventions.

3.3.2 Authentic Contexts and Real World Project-Based Learning

Project-based learning is an important type of problem-based learning (PBL) that also includes case studies, inquiry based learning, collaboration-based learning and research-based learning. While problem -based learning is considered by educators as one of the most influential types of learning, its use is fairly limited (Jonnasen, 1997). One of the key benefits of PBL is combining learning and thinking skills alike in an experiential environment facilitated by instruction designers (Hmelo-Silver, 2004).

Real world project-based leaning is part of ill-structured problem solving ID that relies on an emerging theory of ill-structured problem solving as well as constructivist and situated cognition approaches to learning. Designing ill-structured problem solving instruction requires designers to engage with SME's (subject matter experts) and

experienced practitioners and follow the following six steps: articulating the problem context; introducing problem constraints; locating, selecting, and developing cases for learners; supporting knowledgebase construction; supporting argument construction; and assessing problem solutions.

Learners' activities in ill-structured problem solving learning environments include articulating goals (relate problem goals to problem domain, clarify alternative perspectives and generate problem solutions) and determining validity, as well as constructing arguments (implement, monitor and adapt solution) (Jonnasen, 1997).

Real world project based learning is an intervention mechanism in instructional design that provides an ill-structured problem solving environment within authentic contexts. As indicated by Law (2007), this method can improve learning motivation among high school students. Liu and Hsiao (2004) provided another evidence of the role of real world IT- PBL in enhancing middle school students' motivation when working as designers of multimedia applications.

Real world PBL encompasses the six key SCCT elements. One element is significantly enhancing performance accomplishments because these are real world projects and their accomplishments are very authentic; they allow self-efficacy to build over time via "learning by doing" (Carlson, 1998); they spread from one task to another and there is less anxiety in doing such projects through educational settings.

Another element is that ill-structured situations facilitate evolutionary and adaptive construction of knowledge by the learners themselves which helps the learners influence their environments proactively rather than being passively impacted especially when dealing with IT education (Waks and Sabag, 2004). This approach is strongly aligned

with SCT perception of the learner's role in the reciprocal determinism model and also helpful to building coping efficacy and resilience in regard to career barriers. A third element is that SME's project clients and other industry connections provide role models of success stories which contribute to vicarious learning effectiveness and are thus posited to influence self-efficacy positively. A fourth element is that many real projects are cross-disciplinary in nature which allows connecting STEM and non-STEM subjects and builds familiarity across Holland's types beyond sex-type areas. A fifth element is supporting self-directed or self-regulated skills as teachers act as facilitators and not as exclusive sources of knowledge (Hmelo-Silver, 2004). An additional element is enhancing the sense of students' ownership of what they learn and produce as they are able to construct extensive and flexible knowledge (Hmelo-Silver, 2004; Waks & Sabag, 2004).

Simpson et al. (2003) defined studio-based learning as a special type of real world project-based learning where knowledge and skills are acquired in context rather than as separate segments to be learned, which is an application of social-constructivist theories. In their version of studio-based learning in the IT domain, Simpson et al. (2003) characterized their approach as client-focused (where the clients are the students), requirements –sensitive, mentorship-driven with students' exposure to the process taking place in an evolutionary fashion as their individual responsibilities increase over time.

Cameron et al. (2005) introduced a special format of real world PBL using an IT consulting model. Liu and Hsiao (2004) designed an authentic IT learning environment for middle school students as multimedia designers. They found that such experiences facilitate the development of students' cognitive skills and engage them actively in

constructing their knowledge in requirements analysis, project management and multimedia applications creation needs. However, less engaging activities such as planning and testing for extensive time created boredom which required model refinement.

3.3.3 Social Bonding and Peer Support

Gupta (2008) indicated that under certain conditions, peer collaboration can increase learning effectiveness even with elementary students studying math in a constructivist learning environment. These conditions are related to the teacher, the student, the nature of the subject matter and the epistemological stance. Martinez et al. (2003) studied the impact of classroom social interactions on students' achievements from a social networking perspective and found that certain collaboration patterns form and tend to be effective.

Anderson and Betz (2001) defined social self-efficacy as "confidence in one's ability to engage in the social interactional tasks necessary to initiate and maintain interpersonal relationships in social life and career activities." According to Anderson and Betz (2001), it was found that adolescents who had higher social bonding to peers and capacity to experience close relationships had greater levels of environmental exploration and progress when it came to committing to career choices.

In studying the impact of social bonding in a learning environment on collective, personal, coping and social self-efficacy, it might be helpful to explore the interaction between emotion and cognition from a social cognitive neuroscience perspective, especially when it concerns women's interests and motivational factors (Ochsner & Lieberman, 2001).

3.3.4 Community of Inquiry and Blended Learning

In part, community of inquiry is a view of instructional design as a communication challenge within which such challenge can be overcome by creating an all-in-one collaborative learning community of teachers, students and other relevant resources and using e-learning efficiently to facilitate an effective higher-order learning environment. Creating such an educational experience is the product of integrating three components: social presence, cognitive presence, and teaching presence as the foundation of the community of inquiry (COI) communication system (McKerlich and Anderson, 2007). Blended learning is an extension of a COI that integrates e-learning with other means of communication to empower the educational process.

3.3.5 Adaptive Learning

Adaptive learning is a proposed ID strategy (whether manual or intelligent) that can be used to help design learning environments that interact dynamically with students in two ways: providing students with learning experiences that match their needs, interests, learning curves, level of experience, and prior knowledge after such backgrounds are carefully identified, and continually changing to reflect changes in learners' needs as new cohorts enroll, learning experiences evolve, and new environmental influences emerge.

Adaptive learning can be integrated with real world PBL through an evolutionary prototyping approach where project-based learning is carried out as evolving time-boxed sprints that adapt to students' capabilities and stakeholders' requirements alike. You (1993) introduced a new concept to ID, inspired by the chaos theory principles that reject the traditional assumptions of linear relationships and functional decomposition. The new approach advocates the dynamic and adaptive nature of the instructing and learning processes

as well as the interconnectedness among various components. According to You (1993), instructional objectives and interventions cannot safely predict human behavior in a pre-determined way and thus perfect design is not necessary. His findings were consistent with the constructivist theory principles.

Tessmer and Richey (1997) compared the instructional design process to the software development process and suggested an alternative way to instructional design through rapid prototyping. This is an adaptive way to reflect users' (students') needs in an evolutionary fashion that learns as it grows and is a productive way that mirrors time limitation. The latest uses of rapid prototyping suggest an even stronger connection to the chaos theory implications as concluded by You (1993).

3.3.6 Integral Multidisciplinary Instructional Design

As introduced to the world since the 50's by Sri Aurobindo and his co-worker "The Mother," integral education is the philosophy and practice of instruction that views the child comprehensively as a whole: body, emotions, mind, soul, and spirit. Integral education is a unique attempt to discover the complementary nature of partial truths of educational philosophies and methods and encompasses approaches to instructional design from biological, neurological, societal, cultural, psychological, and spiritual perspectives. While integral education takes into account individual and collective aspects of teachers and students, it considers the many developmental lines in a human being: cognitive, emotional, interpersonal, artistic, moral, spiritual, and others.

3.3.7 Other Intervention Mechanisms

Other intervention mechanisms include a multi-tier mentorship system, self-regulated learning within teams and between teams, simulated learning, evolutionary prototyping and CPI, joy-driven learning environments, participatory learning pedagogies such as *case studies*, *role-play exercises and simulations*, team-based activities, negotiation exercises, management games, online simulations, IT-supported environments, complex recognition systems, and personal-oriental pedagogies.

CHAPTER 4

REAL WORLD CONNECTIONS PROGRAM (RWC)

4.1 Program Background

The RWC program started at New Jersey Institute of Technology in 2005 with a small group of students interested in learning by doing and in educational experiences that offer real world challenges. The idea was to take a project-based learning experience at the senior college level and make it available to high school students after refinements and various configurations. The program evolved over the years to include more instructional design elements, which created an entirely new model for teaching and learning with a high degree of sustainability in terms of student recruitment, retention and resources for more than nine consecutive years.

4.1.1 Program History and Impact

Founded by Osama Eljabiri in 2005 as an extension to the CCS Capstone Program at New Jersey Institute of Technology, the award- winning Real World Real World Connections (RWC) program built a unique cross-disciplinary, cross- departmental and cross-organizational partnership between the CCS capstone program, university, industry, high schools, parents, students and community. The program aims at offering the next generation of authentic project-based learning environments for college and high school students alike. The program is offered year round including a flagship summer program free of charge for all students due to ongoing sponsorship by industry and community supporters. Program website at www.myrealworldconnections.com gives examples of what and how students learn in the RWC program.

For more than nine years, the program has been engaging thousands of high school students across the state of New Jersey and the Tri-state area through hundreds of real world projects sponsored by industry partners or initiated by college or high school students entrepreneurs in addition to satellite locations in few New Jersey towns such as Orange, Newark, Freehold and Mount Olive. Due to its well-known impact on students' lives and careers and the word of mouth, the program receives many invitations from high schools across New Jersey around the year to build new collaboration opportunities and satellite locations. The program attracts numerous applications from students in top notch schools in New Jersey which frequently exceeds program capacity.

The program has a very high retention rate and many students who were part of the program come back as college mentors or NJIT students. Students who graduate from the program come back as mentors, advisors, coaches and mentors. The program adopts NJIT's policies in child protection, permissions, authorizations and liability issues with a strict code of conduct for staff members.

4.1.2 Program Recognition

The program was featured several times in NJIT's president annual report, NJIT alumni magazine, NJIT's newsroom, NJIT's flyers to high schools for recruitment purposes, College of Computing Sciences media, NJIT's students main newspaper "Vector", the Star Ledger of New Jersey, Daily record, Asbury park press, News 12 New Jersey TV, NJN TV in addition to numerous press releases. RWC exclusive and joint events were kicked-off and attended by NJIT Presidents, NJIT Provosts, and NJIT Deans – including the Dean of students, departments Chairs and many NJIT faculties. In 2007, one RWC high school team presented their project to the education executives in NASA

headquarters in Washington DC and received a recognition letter from NASA's national director of education. The program was a main factor for a national award (New Jersey Professor of the year in 2007) by Carnegie Foundation – including a congressional reception and permanent inclusion in the congress records as well as NJIT's board of overseers' excellence in service award.

4.1.3 Program Partnerships

The program developed unique partnerships with the City of Newark, Newark Public School system, Newark city social services, Newark's non-profit organizations, foundations and government agencies. RWC joint college - high school teams contributed to re-engineering a learning environment in a Newark high school for at-risk students, helped the research efforts of a Robotic Surgeon in Newark Beth Medical Center and founded a pipeline of value-added programs for Newark students in multiple schools. The program applied exclusively and jointly to several federal grants including NSF, NCIIA and National health foundation and created value that earned the program great reputation and significant funding from industry and community alike.

Among the program's key industry and community partners were the CCS Capstone Program at NJIT, Nicholson Foundation in the city of Newark, Saint Barnabas Health Care System, Johnson and Johnson, Enterprise Development Center at NJIT, IMS Health, CBS News, Newark Beth Israel Medical Center, the Star Ledger, Essex county family justice center, Newark public Schools, Newark Now, Communities in schools in NJ, BanDeMar Networks (NJ entrepreneur of the year), CPT partners (including CBS anchor) and BCT Partners (winner of Donald Trump's Apprentice).

The program advisory board includes dedicated parents, industry partners, community leaders, alumni, college and high school students in addition to NJIT faculty and staff. The program is popular for its extraordinary ability to recruit an army of passionate volunteers including parents, alumni, students, teachers, industry experts and community supporters.

4.2 Program Design

The design of the Real World Connections Program incorporates many ingredients that act as intervention mechanisms in a transformational process that aim at boosting confidence, motivation and interest and allow the students to unleash their potentials.

4.2.1 RWC Project-Based Learning

Real World Connections is an authentic Project-Based Learning program that provides middle and high school students with opportunities to learn in small teams, by doing a series of short multidisciplinary real-world technology-driven projects over a multi-semester period. Each project team is led by a student project manager (a middle or high school student who received appropriate training). During each project, each student team receives ongoing coaching in project tasks (by a university graduate student, advanced undergraduate senior and/or industry mentor), as well as the inputs of an SME (provided by the project sponsor) on the technical and/or business aspects of the project.

4.2.2 RWC Instruction

Prior to and in parallel with each project, students receive an introduction to project-related IT concepts, methods, and tools. The curriculum includes hands-on training in

project management, software economics, requirements analysis, object-oriented design, structured design, computer aided software engineering (CASE) tools, plug and play programming, web design and development, PC build up, Network build, open source programming, database fundamentals, Apps programming, plus training in team-building. The learning process is interactive, based on games, team challenges, videos, and multimedia simulations (e.g., a pizza making project that teaches students how to construct Gantt charts or a scavenger hunt game that teach project management principles).

4.2.3 RWC Projects

Real World Connections is a flexible program, designed to meet the needs of students with a wide range of interests, capabilities and goals. It offers each student a broad range of projects to choose from – to discover her/his interests in IT and STEM (Science, Technology, Engineering, and Mathematics) fields, to develop a solid overall foundation in IT, and/or to pursue a specific interest through doing a sequence of projects in a selected theme. In the advanced courses, projects are grouped into thematic IT tracks, such as, E- commerce, multimedia, game development, criminal justice, Android Apps Development, Film making, Business Analysis, Art and Technology, Marketing and STEM research. The projects come from businesses, entrepreneurial start-ups, community organizations, and university research – as well as from student initiatives. Projects are actual projects for advanced students and simulation-based on real-world situations for beginners. The vast majority of the projects involves the broad use of technology in STEM fields, and provides opportunities to learn STEM concepts.

4.2.4 Other Educational Components in RWC

Real World Connections also provides students with: visits to businesses and research facilities, summer camp, which provides concentrated large group project experiences, summer internships, which provide actual IT work experience, (Industry partners sponsor six-week summer mentored-internships for Real World Connections high school students. Faculty from the NJIT IT Program, College of Science and Liberal Arts, Electrical and Computer Engineering Department, and Bio-Mechanical Engineering Department, sponsor summer research internships for Real World Connections middle and high school students) workshops that provide information about IT and STEM education and career tracks, and assist students with transitions from middle to high school and from high school to college.

4.2.5 Other RWC Program Features that Support Learning

Other important RWC program features that support Learning include:

- ***Cyber infrastructure:*** Involving technologies that allow learning to extend beyond the classroom. Members of student teams communicate using a variety of electronic modes, including a Google Hangouts, Wiggio Groups and private Facebook groups.
- ***Face-to-Face environments.***
- ***Expert advisor/mentor:*** *Real World Connections* provides each student with an advisor/mentor who works with him/her and his/her parents for the duration of the program to guide in selecting a sequence of projects and to help resolve learning, personal, resource and logistical issues that may arise.
- ***Virtual company (simulation):*** Real World Connections organizes students in each semester as a separate virtual company – in the sense that students elect a "CEO" (for each semester) who keeps track of and facilitates the entire set of

projects undertaken by the RWC community in that semester. This way of working introduces students to typical roles and ways of working in an IT company or in an IT department in a larger firm in a simulated fashion.

- ***Parents as partners:*** Building on the successful RWC model, Real World Connections involves parents as collaborators at every phase of the program: as presentation judges, advisors, mentors, recruiters, and (where appropriate) as SME's and project sponsors. A Parents Advisory Board participates in both formative and summative program assessment as needed. In addition, each student's parents meet with his/her advisor/mentor periodically.
- ***Social bonding:*** The learning environment creates a strongly bonded community of learners, and boost peer-to-peer motivation and self-motivation – through doing projects in teams, critiquing each other's project presentations, and participating in a social club that offers social, sports and numerous non-IT fun-filled activities.

4.2.6 Underlying Design Principles

Learning by doing complements traditional classroom learning. For many students, including those who do not learn effectively in typical classes, learning by doing is effective and enjoyable. *Real World Connections* is built upon four layers of design principles for project based learning:

- **Provide projects that students can carry out to successful completion.** People learn simply by doing, especially when they carry out an all aspects of an activity from planning to put a product into service to successful completion.

- **Provide projects that have realistic social contexts.**

Doing IT development in a realistic social context implies that students solve real-world problem with social dimensions and use technology as part of the solution. For example, a new food pantry needs to "position" itself. The solution might include architectural and interior design and website development. Effective learning by doing requires a student to develop some understanding of all the component activities, and to do technical IT development in this larger context.

Projects include all participants (the project team, client and end users), as well as the organizations to which the participants belong. (A Real World Connections "virtual company" simulates an IT company or multiple departments.)

Real-world problem solving increases the interest of students in technology, especially female students and others who prefer problems with social dimensions. Learning in a context that includes IT professionals and managers, and sometimes STEM professionals, helps students develop a professional network and get recommendations from professionals and executives.

- **Provide supportive scaffolding for student projects.**

Scaffolding includes instruction, coaching and other inputs that facilitate learning and doing in projects, as well as a learning setting that is supportive and information-rich for students.

Real World Connections provides project-related scaffolding workshops covering project-related concepts, methods and tools, a project manager for each project (a Real World Connections student), a coach and a SME for each project. Real World Connections also provides each student with a supportive and information-rich setting.

- **Provide an extended sequence of projects.**

An extended sequence of projects – which a student selects with inputs from his/her advisor– gives him/her opportunities to: do projects in several IT areas, as a way to explore his/her interests, experience several project roles, e.g., project manager, interface designer, database designer, and developer/implementer, as well as the "CEO" role in a "virtual company," pursue a specific interest and develop specialized IT skills through doing a sequence of progressively more challenging projects in a selected theme.

4.3 What and How Students Will Learn in the Real World Connections Program

4.3.1 Real World Connections Roles

The program staff is carefully selected from top graduates, college students, college alumni and dedicated parents. The ratio of staff to students usually ranges from 1:4 to 1:6. The students work in teams mentored and advised by advanced peers, parents as subject matter experts, sponsoring companies' executives and employees and joint CCS capstone teams. Real world connections roles that directly influence student learning are illustrated in Table 4.1.

Table 4.1 Real World Connections Roles That Directly Influence Student Learning

Role	Activities of the role	Who plays the role
Course instructor	Conducts hands-on workshops on project-related IT concepts, methods and tools	Program Staff
Project coach	Coaches each project team separately on project management and IT tasks	Coaches (graduate students, and industry experts)
Project SME	Coaches the project team doing his/her project on the technologies and organizational setting of the project	Project sponsors
Advisor/mentor	Works with each student and his/her parents on selecting the most useful projects, and on resolving learning, personal, logistical, resource issues, etc.	IT and STEM professionals from university faculty, alumni and sponsors, etc.

4.3.2 How Course Instructors and Others Are Selected, Taught and Supervised?

The Real World Connections Program has a staffing team with experience in middle and high school teaching. The Associate Director will work with developers of instruction on the overall instructional design, the design of specific workshops and the design of instructional materials, in terms of their suitability for each of Grades 7-8, 9-10, and 11-12, select, train, and supervise course instructors (NJIT faculty and graduate students), observe, and possibly teach, some workshops – and feedback observations into the ongoing instructional design process and formal evaluation process.

In addition, the staff influence all other direct interactions with students: select, train and supervise project coaches (NJIT graduate students and seniors), advise SME's on their interactions *Real World Connections* students, and meet with them periodically, recruit advisors/mentors, advise them on their role, and meet with them periodically.

4.3.3 How Real World Connections Will Develop Skills, Knowledge, and Understanding Project-Related Skills

By doing real-world IT and STEM projects in teams, students will develop skills including: multi-disciplinary problem solving and design, leadership, project management, negotiation, team-work and close collaboration, critical thought, communication and presentation/writing.

4.3.4 Roles and Ways of Working in Real-World IT and STEM Contexts

By doing IT and STEM projects in working relationships with project sponsors, students are immersed in, and understand roles and ways of working in, IT and STEM settings in business and in universities, develop relationships with IT and STEM professionals and communities of practice, develop an understanding of IT and STEM career paths and

education. This learning is augmented by visits to IT and STEM settings; as well as by workshops on career paths and education, and by workshops on transitions to jobs and to higher education.

By doing projects with entrepreneurial start-up companies, students develop: an understanding roles and ways of working in, start-up companies, relationships with entrepreneurs, and with IT and STEM professionals who work in entrepreneurial settings, an understanding of career paths and education that relate to entrepreneurial settings. Students also have opportunities to develop their own entrepreneurial projects. Coaches and SME's are drawn from RWC entrepreneurial partners.

4.3.5 IT Concepts, Methods and Tools

From participating in *Real World Connections* workshops and doing IT projects that are coached and have the inputs of SME's, students learn IT concepts, methods and tools. This learning continues in summer camp and in summer internships. By doing an extended series of progressively more sophisticated projects in a single IT thematic track, students further develop their understanding of IT (as well as project-related skills). This learning articulates with existing middle and high school IT curricula and standards.

4.3.6 STEM Concepts, Methods and Tools

By doing IT projects in STEM fields, students will learn some of the concepts, methods and tools of the specific STEM fields involved. This learning will take place primarily in the process of doing projects, and will be facilitated by extensive inputs from SME's. These projects, along with the SME's, will be provided by NJIT faculty and by businesses.

4.4 Program Interventions

There are several elements in the design of the learning environment in the Real World Connections Program (RWC) for middle school/high school students. The first element is using project-based learning in real-world contexts. This element is based on providing a real world problem-based learning (PBL) environment which enables students to experience a high degree of authenticity, usability, relevance and learning by doing. This element mirrors key intervention mechanisms such as cognitive restructuring, vocational exploration, attention to decreasing career barriers, attention to building support, world of work information, and values clarification mechanisms.

A second RWC design element is peer-to-peer learning in conjunction with expert mentorship. The program facilitates learning support from equivalent high school peers, advanced high school peers, college students as advisors, college students as a joint team and industry stakeholders, university faculty, parents as subject matter experts (SME's), and mentors. As a result, this element mirrors key intervention mechanisms such as vicarious achievements, counselor support, individualized interpretations and feedback, attention to building support, collaborative learning and social persuasion intervention mechanisms.

The third RWC design element is social intelligence via activities that aim at creating a community of learners and facilitating social bonding using activities that strongly encourage social interactions, positive peer pressure and collaborative learning. This element serves as a source for anxiety reduction, vicarious achievements, and counselor support intervention mechanisms.

The fourth design element is self-regulated learning within teams and between teams which includes self-organization (i.e.: running the class as a company of consulting teams), real world simulations and shadowing, realistic role playing, and evolutionary prototyping with continuous feedback control loops (project time-boxed sprints). This mirrors well-known intervention mechanisms such as personal performance accomplishment and self-reporting. Frequent feedback control loops from judges in particular also mirror decision making modeling and strategy, individualized interpretations, goal negotiation, and personal performance accomplishment intervention mechanisms.

The fifth RWC design element is adaptive multidisciplinary training that is based on generic and specific project needs driven by demands of real world projects and the industry job market. This element mirrors known intervention mechanisms such as outside reading, modeling, and workbook and written exercises.

The sixth element is integrating joy and fun with learning experiences all the time as part of the teaching pedagogy, using carefully designed and implemented activities, games, ice breakers, simulations, tours, hands-on experiences and movies. This element reflects mechanisms such as anxiety reduction and motivation-based interventions.

The seventh element is post-program support and re-engagement of human resources such as alumni and advanced students. This long-term support goes beyond the class, beyond the class timeframe and beyond graduation, which helps again as a decision making model intervention mechanism.

Moreover, one of the very key elements in RWC is accommodating students' personal interests, respecting their preferences and choices, and customizing the entire program to meet their passions and ambitions.

Other intervention mechanisms used in RWC include computer-aided intervention mechanisms using web-based social networking, communication and collaboration tools, and online technologies as key enablers. Furthermore, the RWC design incorporates a complex recognition system that serves as personal performance accomplishment and motivation-based interventions.

This study suggests a revised socio-constructivist model for instructional design that aims at integrating various claimed sources of self-efficacy and providing support elements of self-efficacy in women related to IT-based STEM fields within the social cognitive career theory framework. It is statistically proven that improving self-efficacy in students increased their interest in the subject and impacted their career goal choices.

This revised model will be inspired by an existing model in real-world instructional design offered by the Real World Connections Program (RWC) for middle school and high schools students. Table 4.2 illustrates the intervention mechanisms in RWC.

Table 4.2 Intervention Mechanisms in Real world Connections Program

Intervention mechanisms in Real world Connections
Real world context:
In this program, students learn by carrying out real world projects for real clients or for their own start-up business.
Personal Relevance:
Students are surveyed in advance online and in person about their interests.
Students can choose projects they are interested in or propose other ideas if they can't find something that interest them.
Students are supported in whatever interest they have.
Students can choose projects and classes linked to their personal goals and dream careers.
Students form their own teams based on common interests.
Students choose their own tasks and roles in their teams.
Students feel the sense of freedom and independence in the program.
The program provides enough room for flexibility and innovation in solving real world problems.
Students are not driven by fear of losing grades or consequences from school and parents.
Students have personal and immediate access to the professor, project client and mentors.
Program activities and atmosphere let students feel relaxed and happy while in the program.
Students don't feel that this program has any school or parent pressure.
Students are not forced to participate in activities they are not interested in.
Students feel program leaders strongly care about their personal needs and success.
Sense of ownership
Students vote to elect their team leaders and program leaders.
Students vote to select program activities.
Students feel that they not only work to please client, school or parents, but that they own their success.
Students feel that they have real contributions to the success of their projects (sense of accomplishment).
Students feel that their suggestions and inputs are encouraged and taken advantage of.
Students feel that they are allowed to take important real world roles and make serious decisions about real world situations.
Students are allowed to improve their projects continuously in several iterations based on peer, client, mentor and professor ongoing feedback.
Emotional Relevance
Students work on exciting technology-related projects that keep them engaged.
Students are trained on how technology problems can be solved in a way easy to understand and use.
Students feel the way technology is introduced helps them understand its relevance to solve real problems.
Technology is introduced to students in a way that links it to other subjects they like.
Technology is introduced to students in a way that is related to helping people.
The program has strong emphasis on solving problems that provide services to community.
Social Integration
Students work with students who have similar background who are doing well in technology projects.
Students' friends in the program believe they can do well in their project.
Students have strong support from industry sponsors in the project.
Students have strong support from the university professor in the program.
Students have strong support from the university college students in the program.
Students in the program help and support each other.
Program activities enable students to make friends in the program all the time.
Students feel that the program helps make long term friendships and connections with its people.
Program online groups and communication enable students to enhance their social life.
The program recognizes personal accomplishments in various ways.

CHAPTER 5

METHOD

This chapter discusses research questions, describes the quantitative research design and lays out the procedures of data collection and analysis used to answer the research questions. Since this research is not only about re-examining an existing theory but rather about the emergence of a potential new framework or at least dramatically enhancing the foundation of SCCT at its core contributing factors, the best strategy was to adopt an iterative approach using an evolutionary instrumentation prototype. Such an approach required carrying out multiple studies with four major experimental steps. While using taxonomy as an initial step has helped building theoretical umbrella for the research model, the utilization of exploratory factor analysis (EFA) as a final step provided substantial guidance in re-shaping the final version of the research model. This approach can be illustrated as follows:

1- Use a taxonomical approach to develop a general framework that aims at revising the "learning experiences characteristics" factor in a comprehensive fashion.

2- Propose a revised research model based on the theoretical findings in the taxonomy strategy.

3- Formulate hypotheses based on the revised research model.

4- Create a multi-step approach to build valid instruments that can be used to finalize the model and test the hypotheses alike.

    a. Step 1: First Pilot study and summary of results (full details in the appendix)

    b. Step 2: Using Q-sort method as a qualitative approach to refine the outcomes in step 1.

c. Step 3: Second Pilot study and summary of results to refine the outcomes in step 2 (full details in the appendix).

d. Step 4: Final study to refine the outcomes of step 3 and provide exploratory factor analysis (EFA) to validate instruments, find additional latent constructs and finalize the research model (all details are included in this chapter).

5- Propose a final research model based on the 4-step approach in terms of defining the key factors (latent constructs).

This chapter builds on the literature review of the previous chapters to identify sources of self-efficacy toward a constructing a meaningful repository of intervention mechanisms as illustrated in the following diagram and explained in the following sections.

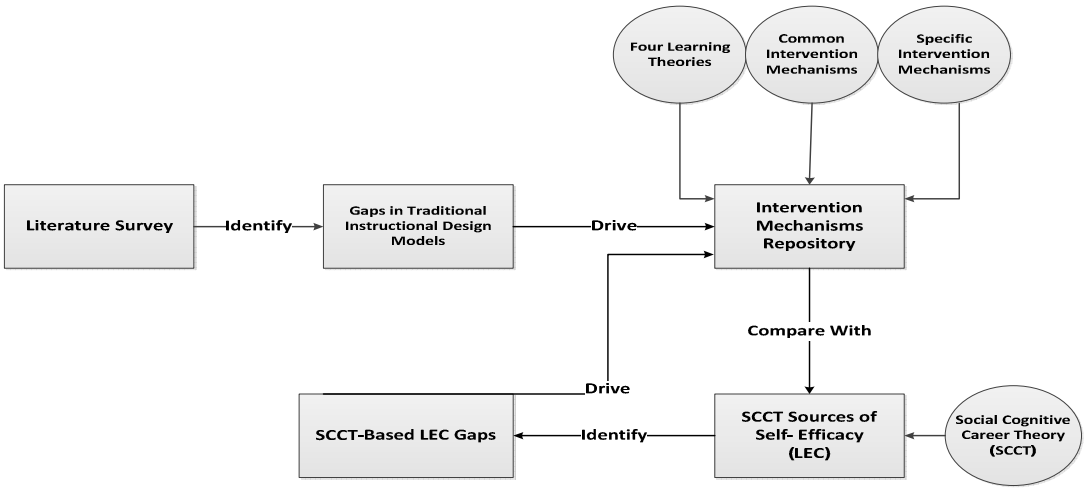


Figure 5.1: From literature survey to comprehensive intervention mechanisms.

Research Questions

The purpose of this study is to investigate whether SCCT- enhanced intervention mechanisms (Learning Experiences Characteristics) used in the Real World Connections learning model (RWC) can increase the self-efficacy and interest of pre-college and college students in technology; in particular, whether it can remove the gender barrier of technology-related career self-efficacy of adolescent women after experiencing the learning intervention mechanisms used in the Real World Connections program at NJIT.

The following are the research questions for this dissertation:

1. Does using the refined learning model have a positive impact on students' self-efficacy and interest in computer-based subjects?
2. Does re-designing the "learning experiences" construct in SCCT using the refined learning model ingredients make a significant difference in its impact on students' computer technology self-efficacy?
3. Does the refined learning model fit the SCCT framework?
4. Does using the refined learning model reduce the gender gap between boys and girls in their computer-based self-efficacy?
5. Which ingredient of the refined "learning experiences" construct is the most influential?
6. How does the impact of RWC model compare to traditional SCCT sources of self-efficacy?

5.1 Proposing a New Theoretical Framework for Project-Based Learning in Career Development with Emphasis on Adolescents

In order to have a holistic and practical approach in career development that is well-grounded in SCCT, several steps were to be followed. The first step was to explore and build a holistic

list of SCCT and non-SCCT key learning experience characteristics variables (or intervention mechanisms). These variables are expected to have impacts on self-efficacy and outcome expectations, and accordingly they are expected to increase interest. This step was to be followed by refining these variables to eliminate non-added value variables that are redundant, insignificant or irrelevant. The second step was to group related variables and then construct taxonomy of value-added variables. The third step was to create a theoretical framework in an effort to build a better SCCT from a "learning experiences" prospective. The fourth step was to refine the revised theoretical framework further toward proposing the dissertation model. The fifth step was to formulate hypotheses around the proposed dissertation model.

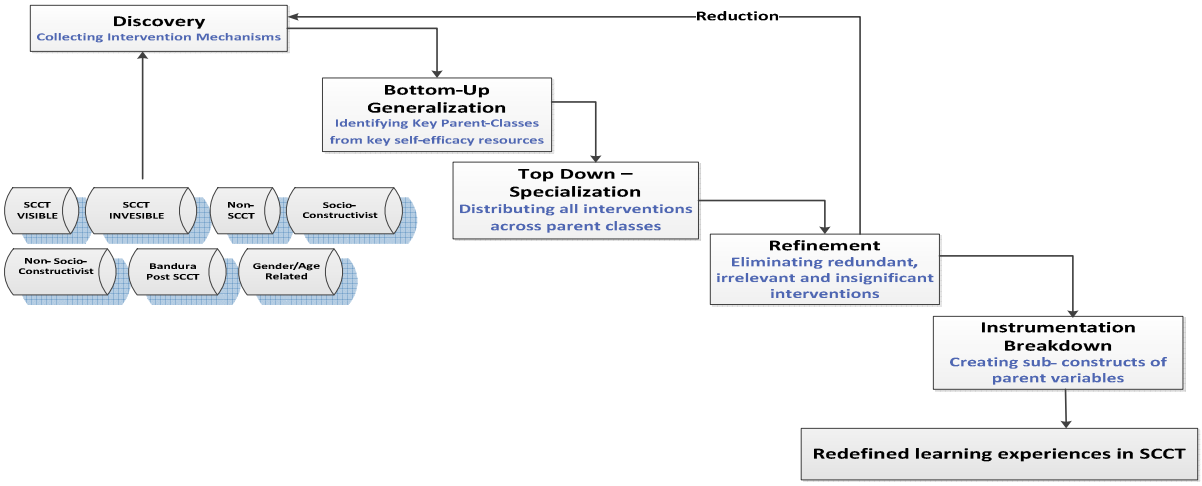


Figure 5.2 SCCT Learning Experiences Taxonomy Building Process.

5.1.1 Exploration: Building a Holistic Repository of Key "Learning Experiences"

Variables Involved: There are various groups of variables perceived as drivers of self-efficacy. Obviously, the first group of variables is based on the original SCCT theory (including sources of self-efficacy and other SCCT factors): variables that are expected to influence self-efficacy/ outcome expectations including performance accomplishments,

vicarious learning, social persuasion, emotional arousal, person inputs, background contextual supports and barriers, and proximal contextual supports and barriers.

The second group of variables is the informal variables of SCCT that were frequently reviewed in the literature and may have a direct or indirect impact on self-efficacy and outcome expectations. This group includes coping efficacy, collective efficacy, social efficacy and self-reflection.

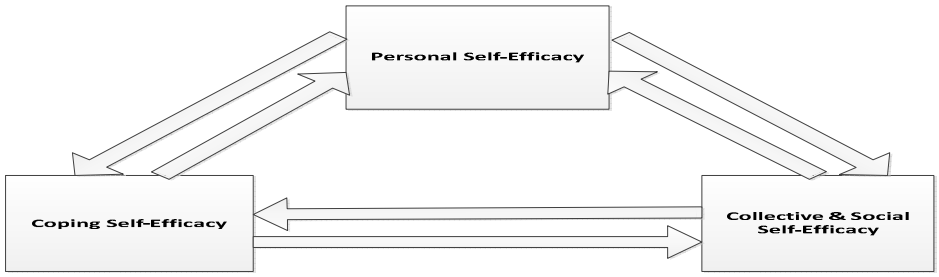


Figure 5.3 New Self-efficacy Reciprocal Triangle.

The third group encompasses variables from other career development theories or extended SCCT research such as Holland's big six, self-determination, organismic integration, personality attributes and big five (i.e.: optimism, self-esteem, attribution, emotions and self- actualization).

The fourth group of variables is generated from socio-constructivism literature, constructivist instructional design and related intervention mechanisms. This group includes authentic learning via real-world project-based learning (Karagiorgi and Symeou, 2005), multiple perspectives (Karagiorgi and Symeou, 2005), active learning (Karagiorgi and Symeou, 2005), self-regulation (and human agency), collaborative learning (Karagiorgi and Symeou, 2005), adaptive learning (i.e.: made-to-order curriculum), integral strategies (holistic view of human being), social bonding to peers, excitement and joy, parental support, conciseness (you are what you do), intentionality, object-orientedness, community, historical-

cultural dimension, tool mediation and collaboration (Jonassen and Rohrer-Murphy, 1999), self-discovery, autonomy and relatedness (Lebow, 1993), sense of accomplishment, and sense of ownership (Harper and Hedberg, 1997).

The fifth group of variables is extracted from non-constructivist learning theories including social presence, teaching presence and cognitive presence.

The sixth group of variables is based on Albert Bandura's most recent presentations and publications as the father of SCCT. This group includes power of emotional bonding, development of resilience of adversity, dramatization, personal relevance, aspirational linkage, critical period barrier, self-unworthiness and modeling prototypic situations and approaches to overcome them.

Finally, there are variables related to women, adolescents, or technology such as gender, age and educational background. In SCCT, such variables are referred to as person inputs.

5.1.2 Refinement, Generalization and Specialization: Constructing a Taxonomy of Value-added Variables

The purpose of this analysis is to find the true sources of self-efficacy at the most granular level after eliminating irrelevant, redundant and insignificant variables. This is an essential step toward building meaningful grouping of all sources of self-efficacy in a more holistic fashion. This in turn helps construct a better definition of the "learning experiences characteristics" main construct anticipated to have a significant influence on self-efficacy.

The four formal sources of self-efficacy are related to four perceptions that can be simply stated as:

Statement 1: Since I was able to do it before, *I can do* it again (personal performance accomplishments).

Statement 2: Since people similar to me can do it, *I can do* it too (vicarious learning).

Statement 3: Since people I trust believe *I can do* it, *I believe I can* (social persuasion).

Statement 4: If I can overcome some obstacles, I *will be able to do it* (emotional arousal).

Statement 1 implies that self-efficacy is a reflection of self-regulation, self-evaluation, accumulation of achievements perceptions and ideations over time, across location and tasks. This is also supported by our literature review in chapter 2.

Statement 2 implies that self-efficacy is socially-driven, collective and contagious.

Statement 3 implies that people's perception of other people influences their perception of themselves regardless of how accurate these perceptions are.

Statement 4 implies that the power of coping and resilience enables people to overcome obstacles of great significance.

These interpretations provide guidelines toward building self-efficacy taxonomy of sources in a bottom-up approach and generalize a few potential groups. Since the summative (versus reflective) ramifications of accumulative experiences (learning by doing) and emotional arousal (development of resilience of adversity) variables impact one's personal feeling about a task, subject or career path, these variables can be grouped under *personal relevance* as a parent group (or class). Also, because social learning (via role models) and social persuasion (via community support) influence one's feeling about fitness into the community that shares interest, these variables can be grouped under *social integration* as a parent class. Both personal relevance (PR) and social integration (SE) contribute to self-actualization (the ultimate psychological need of human beings, according to Maslow's hierarchy of needs), which clearly influence one's self-confidence, a critical part of self-efficacy.

However, personal relevance is not limited to previous performances and resilience of adversity (i.e., coping efficacy as a response to emotional arousal). Similarly, social integration is well beyond role models and social persuasion. Contributing factors such as PR and SE include other variables studied in Chapter 2 and surveyed earlier in this chapter as described below.

Personal relevance sources: Personal relevance can be intrinsic or situational, intellectual or emotional, and it is related to a person's perceived relevance of the object based on inherent needs, values, capabilities and interests. Personal relevance also relates to the sense of "who you are", the sense of who you are becoming and your relationships. Thus, personal relationship to a task or area of interest depends on various factors related to self-discovery, learning by doing, emotions, and sense of ownership:

One category of personal relevance is discovering what you are already capable of doing by default. This includes all **unlocked potentials** that are waiting to be revealed. *"It is personal to me because it is part of my potentials."*

Another category is discovering what you can do through **accumulation of time** of experience and/or exposure (accumulative accomplishments, Bandura (1989)). *"It is personal to me because it is part of my memorable experiences."*

A third category is self-constructing knowledge, skills and performances proactively (by intention) rather than reactively (by instruction) through authentic challenges (triggering resilience of adversity and coping efficacy) and via self-regulated learning (triggering adaptation to new challenges). This integrates person inputs and contextual supports and barriers as drivers of this variable. *"It is personal to me because I learned it by doing it and by self-finding resources to overcome real world challenges."*

A fourth category is building a strong sense of ownership of the process, the product and the learning environment. *"It is personal to me because I was part of all decision making and part of the innovation and because I can attribute part of the solution to my own work."*

A fifth category is connecting the subject to human-related subjects, role models (vicarious learning), values and emotions. *"It is personal to me because it touches my feelings, matches my values and introduces examples that are similar to me and my situation."*

A sixth and final category is connecting the subject to interests that have already been developed and current needs. *"It is personal to me because it relates to my individual interests and responds to my personal needs."*

Social integration sources: Feeling that our abilities are valued, heard, understood, embraced, recognized and supported by important people as well as peers, and feeling that others share the same interests, values and responsibilities. Sources of social integration include social persuasion (peer support and high status endorsement), collective efficacy, and social bonding (work and interest sharability).

These two generalized high level parent classes (personal relevance and social integration) have two roles. The first is that they include and frame all four traditional learning experience sources surveyed in SCCT literature (i.e.: accumulative accomplishments, vicarious learning and emotional arousal (as sources of personal relevance) and social persuasion (as one source of social integration)). They also include key variables surveyed before eliminating redundancy, irrelevancy and insignificant variables. Those high level essential variables are self-regulation and emotional relevance (as sources of personal relevance) and social bonding (as a key source of social integration).

The two-step resulting taxonomy construction is shown below in Figure 5.3. The first step was to analyze the detailed sources of self-efficacy while the second step was to refine these sources and incorporate the refinements into the SCCT framework.

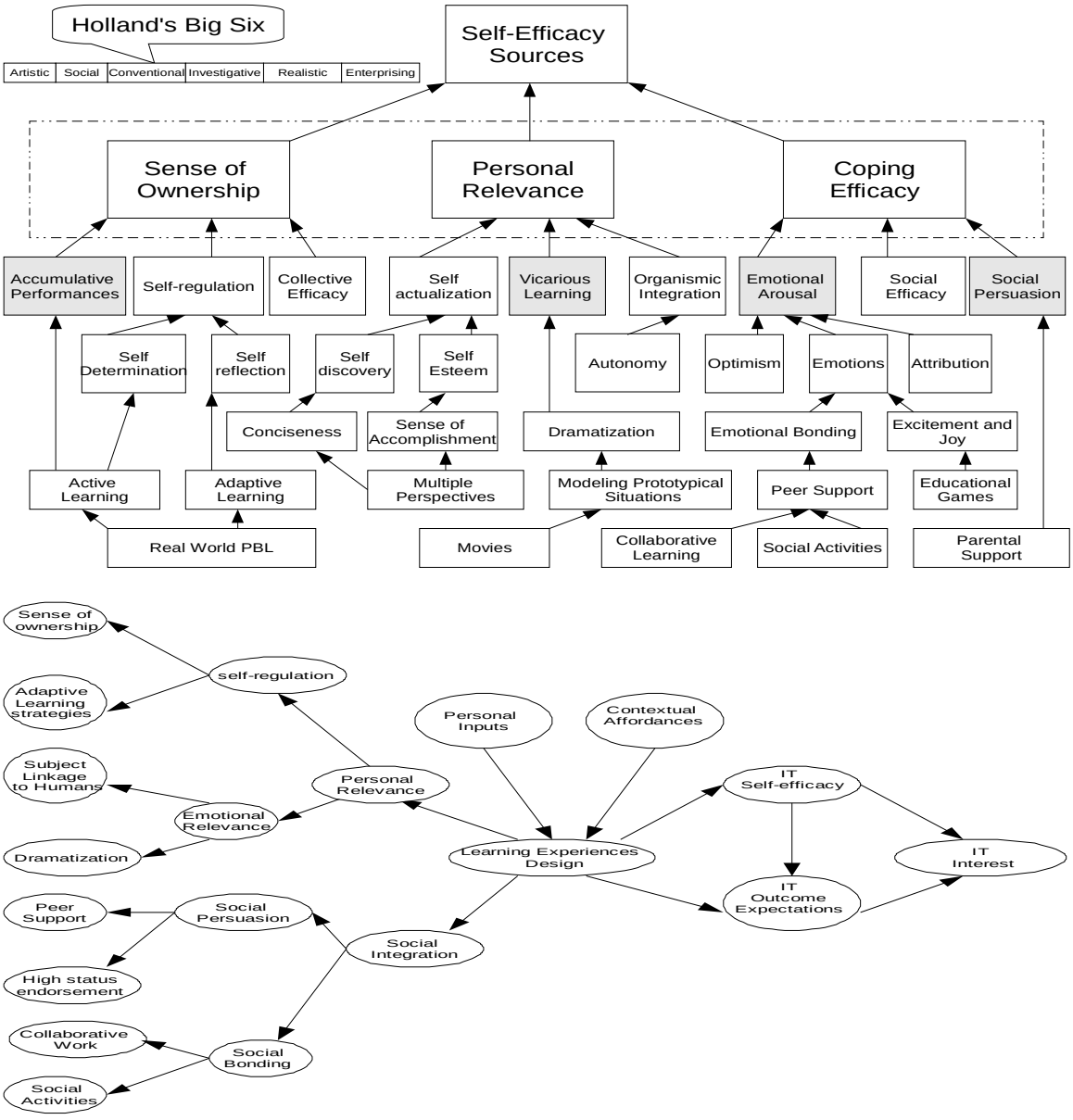


Figure 5.4: Constructing taxonomy of valued-added variables.

5.1.3 Real World Connections Program Interventions

In chapter 4, Real World Connections program (RWC) and interventions were introduced and the key ingredients are being re-incorporated here again due to their significance.

Table 5.1 illustrates the revised intervention mechanisms in RWC that would meet the taxonomy variables in Figure 5.1.

Table 5.1 Key Intervention Mechanisms in Real world Connections Program

Intervention mechanisms in Real world Connections
Real world context
In this program, students learn by carrying out real world projects for real clients or for their own start-up business.
Sense of Ownership and Personalization
Students are surveyed in advance online and in person about their interests.
Students can choose projects they are interested in or propose other ideas if they can't find interesting projects.
Students are supported in whatever interest they have.
Students can choose projects and classes linked to their personal goals and dream careers.
Students form their own teams based on common interests.
Students choose their own tasks and roles in their teams.
Students feel the sense of freedom and independence in the program.
The program provides enough room for flexibility and innovation in solving real world problems.
Students are not driven by fear of losing grades or consequences from school and parents.
Students have personal and immediate access to the professor, project client and mentors.
Program activities and atmosphere let students feel relaxed and happy while in the program.
Students don't feel that this program has any school or parent pressure.
Students are not forced to participate in activities they are not interested in.
Students feel program leaders strongly care about their personal needs and success.
Students vote to elect their team leaders and program leaders.
Students vote to select program activities.
Students feel that they not only work to please client, school or parents, but that they own their success.
Students feel that they have real contributions to the success of their projects (sense of accomplishment).
Students feel that their suggestions and inputs are encouraged and taken advantage of.
Students feel that they are allowed to take important real world roles and make decisions about real world situations.
Students are allowed to improve their projects continuously in several iterations ongoing feedback.
Social Bonding and Integration
Students work on exciting technology-related projects that keep them engaged.
Students are trained on how technology problems can be solved in a way easy to understand and use.
Students feel the way technology is introduced to them helps them understand its relevance to solving problems.
Technology is introduced to students in a way that links it to other subjects they like.
Technology is introduced to students in a way that is related to helping people.
The program has strong emphasis on solving problems that provide services to community.
Students work with students who have similar background who are doing well in technology related projects.
Students' friends in the program believe they can do well in their project.
Students have strong support from industry sponsors in the project.
Students have strong support from the university professor in the program.
Students have strong support from the university college students in the program.
Students in the program help and support each other.
Program activities enable students to make friends in the program all the time.
Students feel that the program helps make long term friendships and connections with its people.
Program online groups and communication enable students to enhance their social life.
The program recognizes personal accomplishments in various ways.

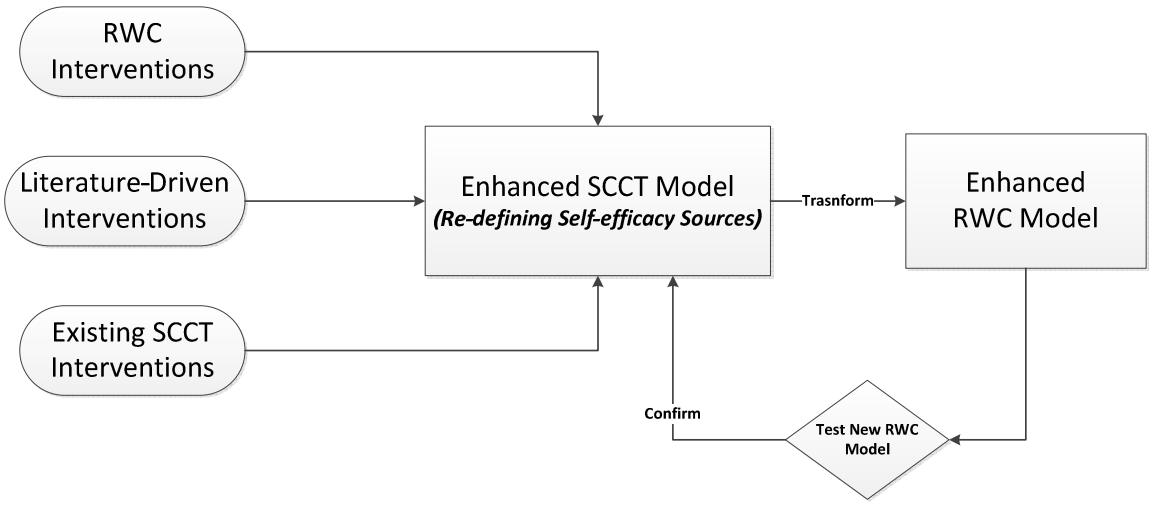


Figure 5.5: Real World Connection Program (RWC) as a feeder and a tester.

5.1.4 Creating a Theoretical Framework: Re-Building SCCT

Taking a holistic approach in defining the most effective learning experience characteristics for adolescent students, the following model (Figure 5.2) is proposed to replace the four traditional sources of self-efficacy by two parent drivers which are also considered the parents of a much larger group of variables surveyed in the literature. In this model, only the learning experiences construct was altered from the original SCCT (in its latest version).

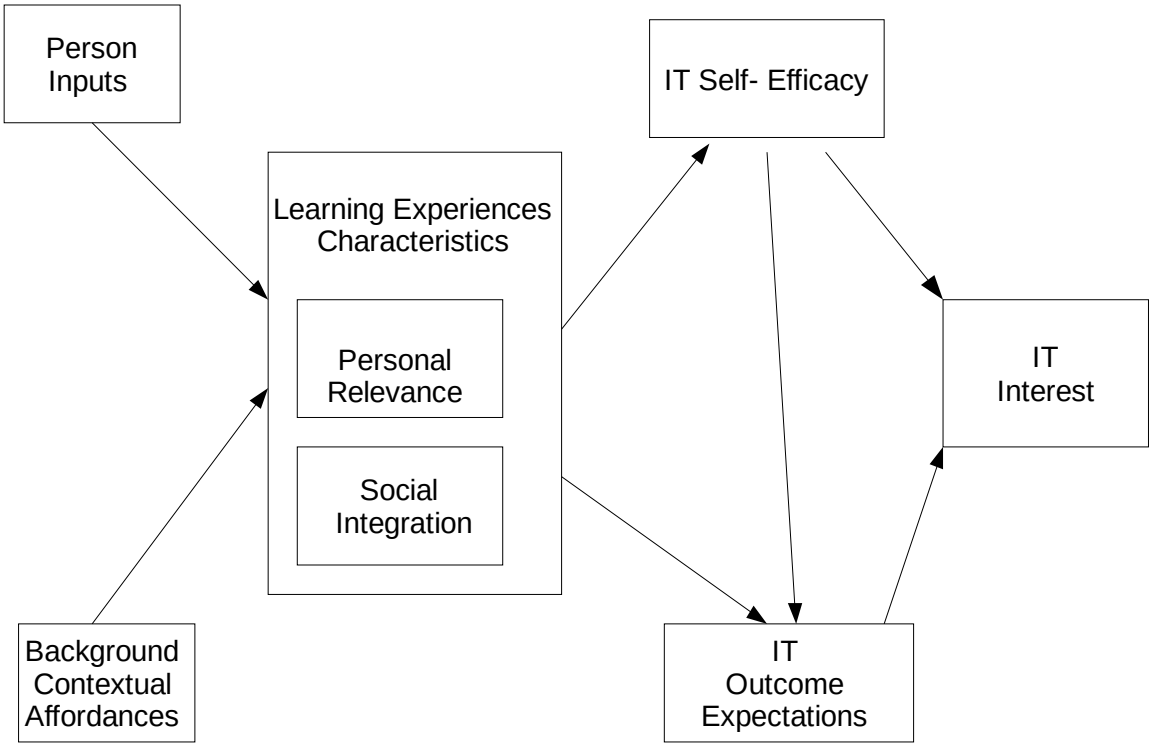


Figure 5.6 Re-defining learning experiences in the original SCCT model.

5.1.5 Proposing an Initial Dissertation Model

Since this study is focused on adolescent students with emphasis on the gender factor, person inputs such as gender and non-contextual background are of primary importance. While "contextual background affordances" is part of the original SCCT, it also overlaps with some ingredients of person inputs. In our study, person inputs and personal relevance include many of the contextually- relevant constructs. Thus, "contextual affordances" was not included in this study as a separate variable. Studying the impact of learning experiences on interest while excluding such variables is not unprecedented in the SCCT literature (Lopez et al. 1997) .

This also applies to outcome expectations. In most SCCT versions, "outcome expectations" intervenes between self-efficacy and interest. In our study, we are studying the impact of self-efficacy on interest regardless of the impact of outcome expectations.

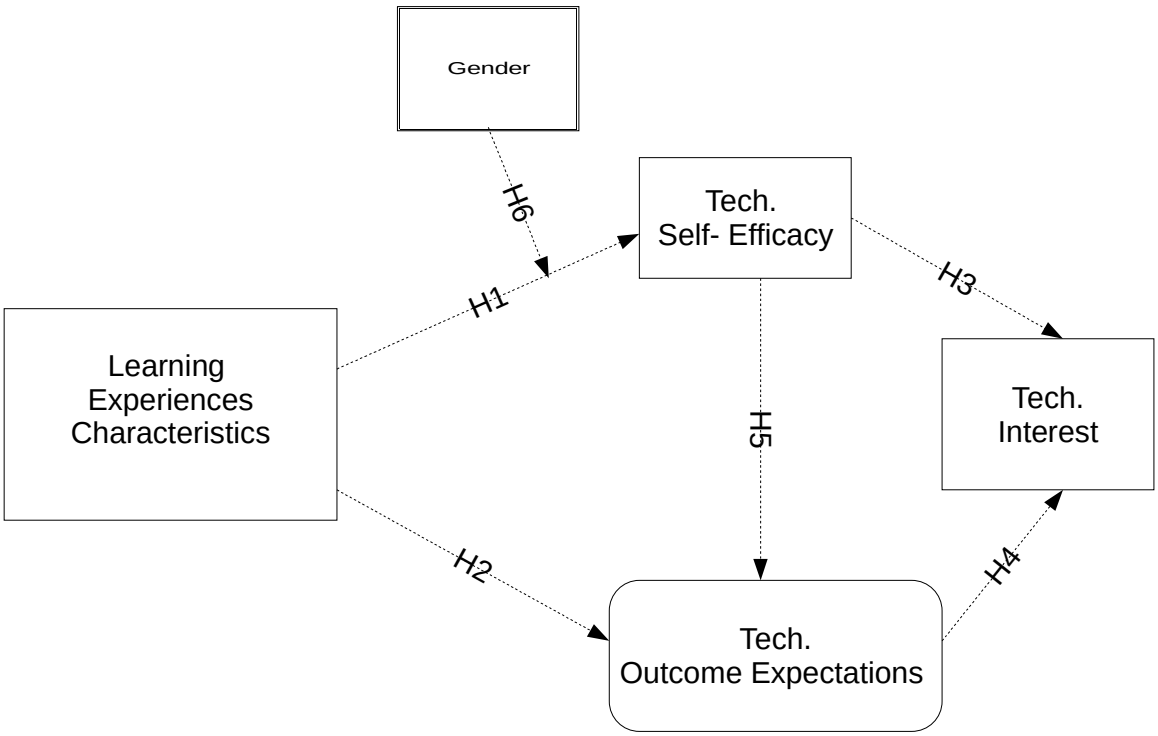


Figure 5.7: Refined Research Model

5.1.6 Formulating Hypotheses

Proposition 1: The positive relation between learning experiences and technology career interest will be reduced but not eliminated when the influence of computer technology self – efficacy is controlled.

Hypothesis 1 (H1): There will be a positive relation between refined learning experiences and computer technology self-efficacy.

Hypothesis 3 (H3): There will be a positive relation between computer technology self-efficacy and computer technology career interest.

Proposition 2: The positive relation between learning experiences and computer technology career interest will be reduced but not eliminated when the influence of computer technology outcome expectations is controlled.

Hypothesis 2 (H2): There will be a positive relation between learning experiences and computer technology outcome expectations..

Hypothesis 4 (H4): There will be a positive relation between computer technology outcome expectations and computer technology career interest.

Proposition 5. Computer technology self-efficacy influences technology outcome expectations directly.

Hypothesis 5 (H5): There will be a positive relation between computer technology self-efficacy and computer technology outcome expectations.

Proposition 6. Learning experiences impact on computer technology self-efficacy will be independent from gender.

Hypothesis 6 (H6): The positive relationship between learning experiences and computer technology self-efficacy will not vary significantly between male and female students.

Proposition 7. Which ingredient of refined ""learning experiences" is the most influential?

Hypothesis 7 (H7): Ingredients of the refined learning experiences have differences in their impact on computer technology self-efficacy.

Proposition 8. How does the impact of the refined learning model compare to traditional SCCT sources of self-efficacy?

Hypothesis 8 (H8): Refined learning experiences have greater impact on computer technology self-efficacy than the four original SCCT sources.

Study Variables: The dependent variable in this study is Interest. The independent variable is redefined learning experience characteristics where personal relevance (or personalization) and social integration are the ingredients of the design of the learning experiences. The mediating variable is self-efficacy. The moderating variable is person

inputs. Formal definitions of each variable in this research are provided below. For each variable, a conceptual definition is provided followed by an operational definition.

Several types of variables were defined to create a better understanding. Their classifications follow:

A. Dependent Variables

Interest (Conceptual Definition): This research considers "career interest" as the main dependent variable of interest in the social cognitive career theory. As indicated by Gla¨ ser-Zikuda et al. (2005), interest is a type of emotion that has both a value-related and a feeling-related valence. Interest-value results from an experience relevant to an object of interest whereas interest-feeling results from positive emotions (such as enjoyment) while participating in an interest-based activity. After referring to interesting things as something one likes and would like to find out more about, Askell-Williams and Lawson described the conception of interest as an actualized state, featuring emotional components such as happiness, effort, enthusiasm, enjoyment and desire (Askell-Williams and Lawson, 2002). Askell-Williams and Lawson also distinguished between two categories of interest (situational interest (short-term) and individual interest (long-term)) as well the various levels of domain-based interest from very general to very specific.

While measuring interest is usually simple and straightforward, it is important to note the strong connections among personal factors, self-efficacy and interest in terms of Holland's theory's Big Six areas of interest (Nauta's, 2004). Holland's big six types of career interests are: realistic, investigative, artistic, social, enterprising and conventional.

Interest (Operational Definition): Even though the Strong Interest Inventory (SII) is one popular option to measure interest, it is not the scale of choice. This measure has three types of scales (i.e.: basic interest scales, general occupational theme scales (GOTs), and personal styles scales), so GOT's would be the scale to use due to its adequacy for both middle school and high school students and it has strong roots in Holland's six career areas. However, other studies criticized Holland's theory - based approach as quite difficult to quantify with a high level of confidence. Therefore, the researcher chose more reliable measures of interests that reflect the key components in the conceptual definition. These scales are also supported by educational psychology literature. Such scales include positive feeling about a subject (in our study, it is technology), magnitude of such a positive feeling, and comparison with feeling about other subjects.

B. Independent Variables

Self-Efficacy (Conceptual Definition): Bandura (1994) defines self-efficacy as "people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives". Self-efficacy is generally measured in terms of magnitude (what is the maximum level of difficulty of a certain task one believes he or she is capable of executing?) and strength (what is the level of certainty one has toward his or her ability to execute a certain task?) (Bandura, 1977; Stajkovia and Luthans, 1998).

Self-Efficacy (Operational Definition): After reviewing various scaling models including the 30-item Computer self-efficacy (CSE) scale, it was realized that the scale

needs to be modified to indicate perceptions of IT-based knowledge and skills in general as opposed to computer skills alone. However, I found this scale quite focused on using computers rather than using computer technology to solve real world problems.

Torkzadeh and others (Torkzadeh et al. 2003) developed a better scale that provides a breakdown of some basic computer-based development skills beyond just simply using a computer. Earlier Torkzadeh et al. (2001) provided a similar breakdown for internet-based self-efficacy. The researcher has integrated the strategy of these scales with a generic self-efficacy scale reflecting the New General Self-Efficacy scale (NGSE) developed by Chen et al. (2001). This hybrid scale is used in this study to measure technology-driven STEM self-efficacy which assesses self –perception of technology skills and knowledge in a 5-point Likert scale.

Outcome Expectations (Conceptual Definition): Outcome expectations are defined as personal beliefs about probable response outcomes. If self-efficacy implies “Can I do this”?, outcome expectations implies “If I do this, what will happen” ?(Lent, Brown and Hackett, 1994).

Bandura classified outcome expectations into three categories. These categories are physical expectations (such as increase in salary), social expectations (such as approval by the community), and self – evaluation (such as self-satisfaction).

While Bandura confirmed the importance of outcome expectations in SCT - which is also a crucial element in several past career development and counseling theories, he argued that self-efficacy is more dominant since people may avoid a promising action if they doubt their capabilities and not the other way around (Lent, Brown and Hackett, 1994). It should be noted though that on some occasions, high self-efficacy with

considerably low outcome expectations might result in avoidance as well.

In a study by Lopez et al. (1997), outcome expectations for high school students in math were empirically found to be explanatory for an increase in interest to the extent it depends on self-efficacy.

5.1.7 Redefined Learning Experiences Characteristics

Personal relevance and social integration are the two parent characteristics of learning experiences in the design of the redefined learning experiences model that is also mirrored in the Real World Connections program model.

Personal Relevance (Conceptual Definition): According to Petrina (Petrina, 1992), personal relevance curriculum design implies five things. One aspect is participation through consent, power sharing, negotiation and joint responsibility by co -participants with no authority. Another aspect is integration via interaction and integration of thinking, feeling, and action. A third aspect is relevance, connecting the subject matter to the basic needs and lives of the participants and signifying it to them, both emotionally and intellectually. Additionally there is the aspect of self that becomes a legitimate object of learning. Finally, the aspect of a social objective is to develop the whole person within a human society.

Personal Relevance (Operational definition): According to Thompson and Windschitl (2002), there are three dimensions in measuring personal relevance: personal values and beliefs, future goals and careers, and relationships.

By combining these three dimensions with the five PR conceptual elements and our earlier extensive analysis in this chapter, key integrated constructs of personal relevance

are suggested in this research, particularly for adolescent women. One of these key dimensions is a sense of ownership, which includes self-discovery of potential via learning by doing, self-construction of new capabilities, and resilience of adversity via experiencing authentic challenges and participation, sharing, voting and joint responsibility. Another key dimension is self-regulation, using adaptive learning via evolutionary prototyping and feedback control loops through real world project experiences. A third dimension is role models (or vicarious learning), including peers and experts. A fourth dimension is subject linkage to humans, both emotionally and intellectually in a holistic and cross-disciplinary fashion, personal needs, values and interests, and career objectives.

Accordingly, a special scale was developed or personal relevance related to the intervention mechanisms used in the Real World Connections program which reflects all of the above.

Social Integration (Conceptual Definition): Social integration means different things to different people. In our study, social integration is a combination of two concepts: social persuasion (peer support and high status endorsement) and social bonding (team chemistry and team collaboration). In other words, it mirrors the extent at which the learning environment functions as a true community and the level of social interaction and harmony between each individual and this community-based environment. This is also related to our critique of SCCT in terms of lack of organismic integration of learners in the social contexts and its impact on their intrinsic motivation (Deci and Ryan, 1990).

Social Integration (Operational Definition): Measuring social integration is carried out by measuring its two components: social persuasion and social bonding.

Accordingly, a special scale was developed for social integration related to the intervention mechanisms used in the Real World Connections program which reflects all of the above.

Person Inputs (Conceptual Definition): Person factors in SCCT mainly include gender, ethnicity, and socio-economic status (SES) (Ali, McWhirter and Chronister, 2005). However, factors such as individual differences, cognitive and learning styles, prior knowledge, prior experience predispositions, disabilities, parental and family influence, and contextual affordances could play a crucial role. Since this study focuses on the impact of a new theory of instructional design on adolescent women, gender is the primary person input of interest. Age will be controlled as all participants in this study will be of adolescent age by default since all subjects are middle and high school students.

5.2 Data Collection

The data collection process was evolutionary in nature. It was conducted in two phases of quantitative internal pilot studies, one phase of qualitative study (Q-sort) and one final dissertation study. The first pilot study included 41 subjects, the second pilot had 60 subjects, the Q-sort had five peer judges and the last round included 57 valid responses (out of 95 initially surveyed). The total number of valid responses in all studies was 158 subjects. The first pilot study had some weak validity results which triggered a full review of the questionnaire design using quantitative and qualitative methods in addition to an extended scale-based literature review of all related instruments. As a result, the survey was redesigned iteratively and the new survey was given to new groups of

subjects in three rounds. The validity results of the new survey were excellent. Therefore, the resulting survey was adopted for to test the hypotheses of final dissertation model.

5.2.1 First Pilot Study

A. Sampling and Participants (N = 41)

A sample of 41 middle and high school students participating in the Real World Connections program was used, 20 female and 21 male students. Of these students, 26 (63.4%) were between the ages of 15 and 18, 9 (21.9%) were between the ages of 11 and 14, and four students were between the ages of 19 and 20. Twenty- four percent of the participants were Caucasian, 43.9% were Asian, 14.6% were African American, 7.3% were Hispanic and 4.9% were from other ethnicities. 61% of these students indicated very strong support from their families and 51.2% indicated very strong support from their friends if they decided to pursue a technology-related career. Only 17.1% of the participants indicated they had previous knowledge in one or more of nine popular computer-related knowledge areas. 53.7% of the sample indicated that they speak only English at home while 39% indicated that they speak multiple languages at home. Students who spoke Spanish were only (2.4%), Italian only (2.4%) and other languages (2.4%).

These 41 students were participants in a six-week summer Real World Connections experience at New Jersey Institute of Technology.

B. Reliability of Measures

Internal consistency measured by Cronbach's alpha has been reported as .921 for the entire interval scale, .873 for the learning experiences characteristics scale and .897 for technology self-efficacy scale.

C. Validity Analysis

A preliminary three-component factor analysis was produced using SPSS since the study has three original variables (i.e.: LEC, SE and ITI).

The results of the factor analysis were as follows:

Table 5.2 Preliminary Three-Component Factor Analysis

	1	2	3
LEC1	.597	-.367	.431
LEC2	-.107	.360	.729
LEC3	.051	.531	.160
LEC4	-.108	.712	.045
LEC5	-.076	.539	.394
LEC6	-.032	.869	.289
LEC7	.275	.684	.289
LEC8	-.056	.658	.527
LEC9	.372	.573	-.218
LEC10	.173	.649	.595
LEC11	.297	.513	-.059
LEC12	.396	.149	.641
LEC13	.314	.544	.339
LEC14	.466	.396	-.130
LEC15	.072	.704	.256
LEC16	-.125	.487	.028
LEC17	.015	.249	-.070
LEC18	-.098	.106	.534
SE1	.847	.045	.128
SE2	.753	-.099	-.055
SE3	.788	-.110	.001
SE4	.731	-.049	.225
SE5	.237	.089	.270
SE6	.574	-.025	.610
SE7	.668	-.212	.245
SE8	.713	-.161	.175
SE9	.574	.253	-.395
SE10	.375	.327	.119
SE11	.787	.138	.037
SE12	.587	.070	-.045
SE13	.691	.116	.064
SE14	.563	.258	.195
SE15	.522	.441	-.249
ITI1	.813	.229	-.017
ITI2	.833	.175	-.063
ITI3	.867	.248	-.019

When viewing the results in Table 5.1, the following items had high factor loadings and low cross-loadings:

- LEC 2, 3, 4, 5, 6, 8, 15
- SE 1, 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, 14, 15
- ITI 1, 2, 3

C. Communalities and Variance Explanation

Communalities were generally low with only 13 variables above .6 and many items well below .5. Accumulative total variance explained was only 53.24%. Clearly, this indicates the importance of redesigning the questionnaire in his internal pilot study.

D. Convergent and Discernment Validity

When two items measuring the same variable correlate highly (or load highly on one component), this is an indication of high convergent validity. On the other hand, when measures related to different variables (components) correlate highly (have high cross-loadings), this is an indication of low discernment validity.

Looking again at the 3-component analysis, rotated component matrix confirms that there is multiple cross-loading between components 2 and 3. However, looking at the "component matrix" shows significant load with minimal cross-loading.
0.4 was used as the standard cutoff but 0.7 was chosen as the preferred cutoff number for refinement decisions.

Accordingly, it is concluded that when using standard 0.4 as a cutoff (eliminating items with significant cross-loading), this will support more items in LEC instrumentation using the component matrix only (i.e., LEC 6, 8, 4, 5, 2, 3 and 16). LEC 1, 11, 12, 17 and 18 were eliminated because of low loading on component 2 and LEC 7, 10, 13 and 15 were also excluded because of significant cross-loading.

E. Content Validity

Component 1 loadings yield some confusing results when the component matrix is used. When the component matrix is used, some items measure both ITI and SE with significant loading on component 1 and low loading on component 3 (since component 2 is clearly linked to LEC). The heavy loading on component 1 by two different groups of instruments could be a sign of inadequate wording with this particular age group, which is a challenge to content validity that relies on adequately measuring the concept. Ironically, both SE and ITI are expected to have good face validity since many of the items used to measure these variables were based on certified instrumentation designed by experts. Yet, those items were not introduced into the same context or age group.

When using the rotated component matrix, we can get better results but with clear cross-loadings. Therefore, it was imperative to run another factor analysis test with SPSS using LEC 6, 8, 4, 5, 2, 3 and 16 (eliminating all failing items) and only ITI and SE items that loaded highly with minimum cross loadings.

According to the outcomes of the analysis of the first three-component iteration, the new factor analysis results were as follows:

Table 5.3 Final-round Three-Component Factor Analysis

Rotated Component Matrix[a]			
	Component		
	1	2	3
SE1	.592	.603	-.020
SE2	.284	.785	-.150
SE3	.389	.722	-.127
SE4	.403	.655	.006
SE7	.608	.382	-.119
SE8	.472	.563	-.099
SE9	.239	.664	.080
SE10	-.045	.591	.351
SE11	.508	.610	.052
SE12	.492	.335	-.035
SE13	.757	.242	.091
SE14	.730	.092	.261
ITI1	.840	.078	.014
ITI2	.825	.299	.041
ITI3	.792	.391	.123
LEC2	-.142	.021	.654
LEC3	-.087	.319	.640
LEC4	-.083	.185	.756
LEC5	.400	-.426	.573
LEC6	.244	-.149	.853
LEC8	.257	-.107	.739
LEC16	.052	-.074	.539

When the component matrix is produced, it does not show much difference from the last step except for increasing the variance explanation dramatically to 60.326%. However, the rotated component matrix provided much better results in support of the study's three key variables. ITI 1, 2 and 3 had the highest loading on component 1 (more than 0.8). SE 2, 3, 4, 9, 10 and 15 had the highest loading on component 2 (but with a little bit above the average cross-loading in SE 3 &4). LEC 2, 3, 4, 5, 6, 8, 15 all had high loading on component 3. Item LEC 4 has some cross-loading with component 2. This is

the best result in this iterative process since the three variables' instruments (LEC, SE, ITI) loaded much better than before on the three components. On the basis of these results, linear regression and correlation analysis will be carried out in chapter 4.

The conditions and terms used in extracting factor loadings on the three components were:

- Principal component analysis (PCA) since the alternative principal axis factoring (PAF) yielded no results most of the time. PCA is the most commonly used method generally, especially as a starting point.
- Varimax rotation method. Direct Oblimin and Promax methods were avoided since we are not assuming that the factors are related to each other.
- Coefficient display format was "sorted by size" with suppressing absolute values less than 0.1.
- Eigenvalues over 1 were used in the beginning as early steps. In later refinements, results were based on a number of components equal to the number of variables in the study.
- Maximum iterations for convergence were set to the default 25.

A four-component factor analysis was eliminated since personal relevance and social integration are key sources of LEC (learning experiences characteristics) but are not primary purpose of this internal pilot study.

F. Threats to Internal Validity

Threats to internal validity are usually related to the degree of influence caused by the predictors and not by some additional extraneous factors. In our study, the students were asked to report their strength of interest before and after the RWC experience which was actually a validity threat since this was asking them to use their long-term memory to recall after the RWC experience how they felt before the RWC. As we know, subjects are very poor at recalling their initial attitude after they have been exposed to a treatment.

This can be attributed both to history and maturation effects. A solution to this problem is to ask the subjects before and after they participate in the Real World Connections experience.

Another threat to internal validity is in motivating participation via a raffle which was an important incentive for some subjects. It is known to pose a threat to certain types of experiments. This threat is usually called selection bias.

As for the sample size, it was difficult to run the experiment online since parents' approval is required for IRB approval which made this option logistically infeasible and limited participation volume. The students' age was also a challenge in survey design and instrument wording since students may not be too familiar with some terminologies or concepts used in the survey. However, only (4) responses were rejected due to the obvious lack of reliability in their responses including a large number of missing or redundant values.

G. Threats to External Validity

Threats to external validity are usually related to the degree of generalizability of the findings of the experiment in other settings. One issue with the Real World Connections model is that it usually attracts gifted and talented students as opposed to average students. Another issue is that this experiment was carried out after an intensive summer program. Such an experiment is not easy to have in regular academic semesters. Also, Real World Connections operates in the space of informal instruction versus formal high structured school environments.

5.2.2 Second Pilot Study

A. Survey Design

The design process of the new survey included several steps. One step was revising measurements and scales of all constructs intensively through literature and making sure that the new survey synthesizes and mirrors all findings.

The second step was using both LEC and TSE as formative versus reflective constructs. The third step was reverse engineering RWC activities into interventions, interventions into items, items into dimensions, and dimensions into the "learning experience characteristics" construct to ensure complete synchronization with theory and practice throughout all chapters. The fourth step was re-integrating "outcome expectations" to mirror all key elements of SCCT. The fifth step was removing items that did not load well on their constructs or loaded with a high level of overlap in factor analysis. The sixth step was maintaining items with very good validity results after revising and refining their wording and application. The seventh step was revising the language of the survey to make it as simple, clear and less ambiguous as possible while maintaining face and content validity. The eighth step was selecting and conducting a qualitative method to refine the questionnaire (Q-sort) involving experienced peers as judges to represent the various clusters of the target population.

B. Literature-Based Scale Revision

The first step in revising the questionnaire was to revisit the measurements and scales of all constructs intensively through literature and making sure that the new survey synthesizes and mirrors all findings. The following table (5.4) includes literature-only scale items that match our preliminary scale, replace or reword items or add new items.

The full resulting revised questionnaire is provided in Appendix B.

Table 5.4 Revised-Scale Items Based on Intensive Literature Review

Learning Experiences Characteristics
The program allows me to be part of a real world project for real clients.(Williams and Lawson, 2001)
The programs allows me to have many hands-on activities.(Williams and Lawson, 2001)
The program allows me to choose people in my team based on common interests.(Williams and Lawson, 2001)
The program allows me to have a say in what I learn.(Williams and Lawson, 2001)
The program allows me to work on my own space. (Williams and Lawson, 2001)
Challenges, presentations and feedback from judges encourage me to put up work so others can see it. (Williams and Lawson, 2001)
My peer in the program told me I was good in one or more computer skills. (Anderson and Betz, 2001)
My family encouraged me while in the program to be proud of my computer skills. (Anderson and Betz, 2001)
My family encouraged me while in the program to develop my computer skills. (Anderson and Betz, 2001)
I have friends in the program in my age that has excellent computer skills. (Anderson and Betz, 2001)
The program allows me to evolve my computer skills gradually from scratch. (Anderson and Betz, 2001)
Technology Self-Efficacy
I feel I understand computer work I am doing. (Williams and Lawson, 2001)
I feel I can get better at computer skills. (Williams and Lawson, 2001)
I feel am good at computer skills. It is easy for me. (Williams and Lawson, 2001)
I feel confident making selections from an on screen menu. (Barbeite and Weiss, 2004)
I feel confident using the computer to write a letter or essay. (Barbeite and Weiss, 2004)
I feel confident escaping or exiting from a program or software. (Barbeite and Weiss, 2004)
I feel confident calling up a data file to view on a computer screen. (Barbeite and Weiss, 2004)
I feel confident finding most kind of information on the internet. (Ioannoa et al., 2005)
I feel confident troubleshooting computer problems. (Barbeite and Weiss, 2004)
I feel confident if I saw a new type of computer program I can figure it out. (Ioannoa et al., 2005)
I feel confident understanding terms/words relating to computer hardware. (Barbeite and Weiss, 2004)
I feel confident explaining why a program (software) will or will not run on a given computer. (Barbeite and Weiss, 2004)
I feel confident that I can learn very difficult skills on a computer. (Ioannoa et al., 2005)
I feel confident I can learn lots of information when I do a lot of research on the computer. (Ioannoa et al., 2005)
I feel confident writing simple programs for the computer. (Barbeite and Weiss, 2004)
I feel confident to apply character (letter) effects such as bolding, italicizing, or subscripting in a word processing document.(Downey and McMurtry, 2007)
I feel confident to write a simple formula in a speared sheet to perform math calculations. (Downey and McMurtry, 2007)
I feel confident to use a graphic presentation program (e.g., power point) to convey information to others. (Downey and McMurtry, 2007)

Table 5.4 continued…

I feel confident to create and work with database tables in a database application. (Downey and McMurtry, 2007)
I feel confident to reply to individual and multiple recipients of an email. (Downey and McMurtry, 2007)
I feel confident to design a simple web page using HTML. (Downey and McMurtry, 2007)

Outcome Expectations

I'll need computer technology for my future work. (Smith, 2002)
I study computer technology because I know how useful it is. (Smith, 2002)
Knowing computer technology will help me earn a living. (Smith, 2002)
Computer technology is worthwhile and necessary subject. (Smith, 2002)
I'll need a firm mastery of computer technology for future work. (Smith, 2002)
I will use computer technology in many ways as an adult. (Smith, 2002)
Using computer technology effectively will make me more productive. (Niederhauser and Perkmen, 2010)
Using computer technology effectively will make my work more exciting. (Niederhauser and Perkmen, 2010)
Using computer technology effectively will make my work more satisfying. (Niederhauser and Perkmen, 2010)
Using computer technology effectively will increase my status among my peers. (Niederhauser and Perkmen, 2010)
Using computer technology effectively will increase others respect of my capabilities. (Niederhauser and Perkmen, 2010)

Technology Interest

In general, I find working on computer-related projects interesting. (Roeser et al, 1993)
Compared to most of my other activities, I like doing computer-related activities. (Roeser et al, 1993)
I like reading computer magazines and books. (Nurulazam et al, 2010)
I like to attend workshops or classes related to computer software or hardware often.(Wigfield and Cambria, 2010)
I like to participate with teams concerned with computer software or hardware often. (Wigfield and Cambria, 2010)
I know a lot about computers. (Wigfield and Cambria, 2010)
Computer technology is important to me. (Wigfield and Cambria, 2010)
I am interested in spreadsheets programs such as excel. (Wigfield and Cambria, 2010)
I am interested in word processing programs. (Wigfield and Cambria, 2010)
I am interested in graphic programs such as PowerPoint. (Wigfield and Cambria, 2010)
I am interested in databases. (Wigfield and Cambria, 2010)
I am interested in computer hardware. (Wigfield and Cambria, 2010)
I am interested in computer programming. (Wigfield and Cambria, 2010)
I like to learn advanced skills in word, excel or PowerPoint. (Wigfield and Cambria, 2010)
I like to learn how to design a website. (Wigfield and Cambria, 2010)
I like to build or upgrade a computer. (Wigfield and Cambria, 2010)
I like to learn new programming languages. (Wigfield and Cambria, 2010)
If I heard a new computer term I would be interested in understanding its meaning and where it came from. (Wigfield and Cambria, 2010)
I think computer workshops are interesting. (Wigfield and Cambria, 2010)
I like my computer instructor. (Wigfield and Cambria, 2010)
I think what we are learning about computer software and hardware is important (Wigfield and Cambria, 2010)

Table 5.4 continued…

Being involved with the subject matter of computers affects my mood positively. (Wigfield and Cambria, 2010)
It is of great personal importance to me to be able to study computer software or hardware. (Wigfield and Cambria, 2010)
I would like to become a computer specialist or teacher. (Nurulazam et al, 2010)
I would like to do more computer work at school. (Nurulazam et al, 2010)
I like watching computer programs on TV. (Nurulazam et al, 2010)
Practical computer work is exciting. (Nurulazam et al, 2010)

C. Using the Q-sorting Method

The table below is the "actual versus theoretical matrix" of item placement and calculation of item placement scores & hit ratios.

The Excel spreadsheet includes three sheets (tabs): the initial data collected from the five judges as described earlier, the initial loading of the collected data as described earlier, and the main sheet "Integrated Data" that includes eight tables. These tables are: data four-construct integration after merging two judges' generated sub-groups, theoretical calculations, collective actual versus theoretical matrix (i.e.: the major outcome of the entire process), five individual actual versus theoretical matrices (one per judge), five full tables of all judges' assessments. This is in addition to the same tables mentioned above filtered and sorted by construct with full comparison with the four theoretical constructs to examine matches.

As suggested by Moore and Benbasat (1991), examination of the diagonal of the matrix shows that with a theoretical maximum of 386 target placements, a total of 337 hits were achieved for an overall hit ratio of 87.3%. Reviewing row-based results indicate various conclusions. One conclusion is that the technology self-efficacy had 82-item placements within the target construct (86.6%). Another conclusion is that the learning

experience characteristics variable had 142-item placements within the target construct (97.6%). The third conclusion is that the technology outcome expectations had 43-item placements within the target construct (78.2%). This weaker result can be attributed to the third judge who had only three labeled groups omitting TOE completely, which resulted with more overlap with other constructs. Also, the same judge considered one survey item as ambiguous. None of other judges found any items to be ambiguous. A fourth conclusion is that technology interest had 70-items within the target construct (84.3%).

Despite the results above, the items underlying most constructs' placements did not indicate they cannot be differentiated enough from items created for other constructs which is good.

Off-diagonal entries for columns of actual entries or just off-diagonal items are indicators of ambiguity and factorial complicity as indicated by Moore and Benbasat (1991). Our results indicate that LEC was the best off-diagonal results (a total of 3) and TI as the highest (a total of 18). The worst case scenario for a single item was TI (actual) versus TOE (theoretical) which can be attributed again to the elimination of TOE completely by the third judge.

The next step was to use these results to help reduce the 78-item survey to 50 items.

Table 5.5: Summary of Q-Sort Results

Theory	Actual Categories					
Target Categories	LEC	TSE	TOE	TI	TOTAL	TGT %
LEC	142	9	7	6	164	86.6%
TSE	0	82	1	1	84	97.6%
TOE	0	1	43	11	55	78.2%
TI	3	5	5	70	83	84.3%

D. The Survey of the Second Pilot Study (N= 60)

After redesigning the survey based on Q-sort analysis above, a first round of the new survey was conducted, but the response level was limited to 23 subjects only due to a number of constraints regarding subjects' recruitment. One constraint was that the program is not running all the time, and when it runs it has to go through demanding logistical requirements until the actual treatment starts (staff training, students' and sponsors' recruitment, project open house, team building, students' training, etc.*)*. Another constraint was that the program needs a sufficient amount of time to take effect and integrate all of its personal and social interventions in the treatment (which is at least 4-6 working weeks in Fall and Spring (one 3-hour meeting a week) and 2-3 working weeks in summer (6-hours meeting a week)). Furthermore, the majority of participants are minors who need parents' hardcopy-based signatures to participate. Parents in urban areas in the program (i.e.: Newark and Orange) are rarely available to participate, while students from such areas have become a large majority of the participants. Moreover, the program ability to carry out activities and attract students' participation depends on reservations, budget, availability of human & technical resources, and students'

transportation. Additionally, the participation in the survey can only be encouraged by prizes since this is not a regular class and the students' participation in the program itself is completely optional.

It is also noted that the students' population is a mixture of middle school and high school students with few college peers. This diversity of subjects' age impacts the level of participation and the maturity of survey responses alike.

As a result of the logistical difficulties mentioned above, new strategies and solutions were adapted to increase N. One of these strategies was broadening the target subjects' community to include advanced peers from program alumni and freshmen and sophomore college students participating in the recent expansion of RWC at freshman and sophomore college levels. Another strategy was adding new incentives to encourage participation, which includes a gift to each participant just for completing the survey as well as maintaining larger cash prizes for raffle winners. Other strategies included creating a special event to include parents and students so hard copy signatures could be guaranteed, exploring a new technology that would facilitate remote parent signatures while still in full compliance with IRB expectations, and assigning a dedicated person to subjects' recruitment to help in recruiting new students to the program and encouraging existing and new students to complete the survey whenever applicable.

E. Post Summer and Fall 2010 Validity Analysis For The New Survey Results

At the end of the first summer round with only 23 respondents, and after running many factor analysis tests using various methods and variations of inputs and outputs, it has become apparent that the sample size is not quite sufficient to give concrete conclusions. There were 51 items in the questionnaire but only 23 subjects who responded in the first

round. This was too small as a sample size to draw clear conclusions which limited the value of using "factor analysis" in such a case, according to Costello and Osborne (2005). Round 2 and 3 of data collection during Fall 2010 added 37 more responses taking the total sample to 60 subjects.

F. Sampling and Participants

A sample of 60 middle and high school students participating in the Real World Connections program was used, 25 female and 35 male students. Of these students, 32 (46.3%) were between the ages of 15 and 18, 20 (28.9%) were between the ages of 11 and 14, and seven students were between the ages of 19 and 20. 65.7% of these students indicated very strong support from their families, and 48.6% indicated very strong support from their friends if they decided to pursue a technology-related career. 88.6% of the sample indicated that they speak only English at home while 11.4% indicated that they speak multiple languages at home. These 60 students were participants in the Real world Connections experience at New Jersey Institute of Technology during summer and fall of 2010.

G. Reliability of Measures

Internal consistency measured by Cronbach's alpha has been reported as .9 for the entire interval scale now with 60 subjects and 50 interval questions.

H. Communalities and Variance Explanation

Communalities were exceptionally low with only 12 variables above .6, and many items are below .5. Accumulative total variance explained was only 52.24%. Clearly, this indicates that the 33% increase of the sample size was not sufficient alone to make dramatic improvement in the validity of the instrumentation.

K. Content Validity

According to the rotated component matrix (table 3.4 below) for the redesigned survey (cut off limit is .60), there are important conclusions. For learning experience characteristics, LEC 4, 5, 6, 7, 9, 10, 11, 12, 13, 16, 17, 18, 19 and 20 items all loaded high on the first component. However, LEC 2, 3 and 10 had lower loadings on the first component than .60. Also, LEC 1, 14 and 15 had high cross loadings with other components. This implies that at least 14 out of 20 items measuring learning experience characteristics demonstrated very good validity results.

For outcome expectations, it was also noticed that OE 3, 4, 5, 6 and 7 loaded high on the second component while OE 1, 2 and 8 had lower than .60 values. Similarly for technology self-efficacy, SE 1, 4, 6, 9, 11 and 13 had high loadings on the third component while SE 2, 3, and 8 had low loadings. SE 5 and 7 had cross loadings with other components. This implies that at least 5 OE and 5 SE items had valid results considering the high cutoff rate of .6 (versus .4 as the minimum acceptable limit).

On the other hand, and for technology interest, IT 1 and 2 were the only items that had cross loadings with the- second component while items 3,4,5,7, 8, 9 and 10 all had lower scores than .6 results. However, when another factor analysis report was generated with .4 as the minimum value, technology interest items IT 3, 4, 5, 7, 8, 9 and 10 scored higher than .4 when loading on component 4. Yet, with the exception of IT5, all other items had cross loadings. This implies that IT 5 and 6 were the most valid items in measuring technology interest among the students in our sample.

Table 5.6: Factor Analysis for the Second Pilot Study

	1	2	3	4
LEC1		.685		
LEC2				
LEC3		.750		
LEC4		.759		
LEC5		.717		
LEC6		.703		
LEC7				
LEC8				
LEC9				
LEC10				
LEC11		.719		
LEC12			.650	
LEC13				
LEC14				
LEC15				
LEC16		.644		
LEC17		.626		
LEC18		.652		
LEC19		.654		
LEC20				
SE1				
SE2				
SE3		.705		
SE4			.696	
SE5		.726		
SE6			.752	
SE7				
SE8				
SE9	.709			
SE10	.778			
SE11	.654			
SE12			.690	
SE13				
OE1				
OE2	.603			
OE3	.629			

Table 5.6: Factor Analysis for the Second Pilot Study (continued…)				
OE4	.752			
OE5				
OE6	.634			
OE7	.616			
OE8				
TI1				
TI2	.725			
TI3	.642			
TI4				
TI5			.784	
TI6				-.607
TI7			.630	
TI8				
TI9	.758			
TI10	.773			

L. Convergent and Discernment Validity

In the new questionnaire, it was clear that we had a high percentage of instruments that correlated highly (or loaded highly on one component), which is an indication of high convergent validity. On the other hand, with the exception of technology interest, the vast majority of the instruments related to different components did not correlate highly (or had high cross-loadings), which is an indication of good discernment validity.

5.2.3 Final Round

A. Sampling and Participants

A comprehensive sampling method was used in the final study where all available groups that met the criteria were chosen to participate. The participants for this study were recruited from multiple precollege and college students groups across several high schools and universities. Thirty students completed the first experiment, twenty seven completed the second set, and fourteen completed the third experiment. Only 57 students

completed all two sets of data. This final participant pool (N = 57) consisted of 24 men and 33 women. There were 10.5% students between the age of 13 and 14, 15.8% between the age of 15 and 15, 21.1% between the age of 17 and 18 and 52.7% above the age of 18. Of the participants, 35.7% were Caucasian, 17.9% were Asian, 8.9% were African American, 8.9% were Hispanic, 10.7% were from other ethnicities and 17.9% from multiple ethnicities. 79% of these students indicated very strong support from their families and 66.6% indicated very strong support from their friends if they decided to pursue a technology-related career. Of the sample, 46.4% indicated that they speak only English at home, 3.6% speak only Spanish at home, 1.8% speak only Hindi at home, 5.4% speak other languages at home, while 42.8% indicated that they speak multiple languages at home.

B. The Redesigned Experiment

The experiment has been redesigned to simulate the RWC program interventions in a shorter duration to enhance its feasibility and measurability alike. Participants were asked to take part in two activities. One activity would simulate traditional learning where participants receive no interventions (to serve as a control group with no treatment) while the other activity simulates RWC intervention mechanisms in Real World Connections' revised learning model (to serve as the group after receiving treatment). The role of the instructor in the traditional activity represents a cognitivist while the instructor ion the second activity represents an RWC-style constructivist. Activities were related to computer skills such as database using MS Access, advanced spreadsheets using MS Excel or advanced presentation techniques using MS PowerPoint. Accordingly the two activities included the interventions illustrated in Table 5.7 followed by providing the

same questionnaire to the same group after completing each activity. Full description of these activities is included in Appendix B.

Table 5.7 Experiment Redesign Illustration for the Final Study

Treatment	Intervention Mechanisms
Traditional Learning *(No treatment)*	• No Accumulative accomplishments = learning by lecture style • No Social persuasion = No recognition by high-status people such as advanced peers, faculty and industry experts • No Vicarious learning = No use of similar role models or dramatization • Emotional arousal = No removal of stress and anxiety (traditional testing is part of the process)

SCCT Learning with RWC interventions	• Accumulative accomplishments = learning by doing = using PBL
	• Social persuasion = recognition by high-status people such as advanced peers, faculty and industry experts
	• Vicarious learning = using similar role models including dramatization
	• Emotional arousal = removing stress and anxiety (no exam, no class stress, etc.)
	
	• Plus (RWC-own groups of additional ingredients):
	
	  • **Sense of Ownership Interventions:** choice of project, election of leaders, decision on activities, independency in defining problem & product, freedom to express opinion and come up with innovation, freedom in using time, independency in presenting and claiming credit for product.
	  • **Social Bonding Interventions:** social bonding activity, U-shape seating style, basing projects on teams, **sharing**/exchanging ideas with every one, facilitating friendships, creating a community atmosphere, encouraging and rewarding collaboration.
	  • **Joyful learning Interventions:** high degree of engagement, educational games, zero stress, hands-on activities, challenges & competitions, intellectual energizers, meeting physical and psychological needs (food, breaks, etc.).
	  • **Multidisciplinary linkage Interventions** of technology with socially-driven applications: connecting technical tasks to human-related tasks, using technology to solve a social problem, connecting technology skills to art skills, connecting technology to education and medicine.

Examples of computer-related skills suggested for the re-designed experiment:

- Showing students how to use Word to create professionally styled posters and other documents
- Using Excel to show students how to manipulate data using the available functions (Sum, Average, Min, Max, etc.) and create formatted visual displays (like Graphs, Pie Charts, Bar Charts, etc.).
- Using PowerPoint presentation to teach the concept of creating visually attractive and effective presentations using the technology that PowerPoint provides. After about 15 minutes of teaching, the students will break up into teams and compete to create the most aesthetically pleasing and effective presentation. The same method applied to MS Access.

C. Data Collection and Processing

Students were solicited on a voluntary basis after a full explanation of informed consent and confidentiality. Students were also asked to sign a consent form, which further explained the study. If the students were minors, students were permitted to participate in the survey upon receiving parents or guardian approval. Appendix B contains a copy of the consent form. Questionnaires were kept in a locked file cabinet until data was ready to be entered manually in SPSS. All data were collected in a manner that insured anonymity of participants and was treated confidentiality. The packets containing consent forms, pencils, questionnaires, and instructions were hand delivered immediately following Institutional Review Board approval. Once students completed the questionnaires, they were picked up immediately.

D. Reliability of Measures

Internal consistency measured by Cronbach's alpha has been reported as .944 for the entire interval scale now with 57 subjects and 34 interval questions.

E. Sample Size Analysis

After iterative refinements of 34 variables used in the newest questionnaire and based on their loadings and cross-loadings in our Varimax rotated component matrix and factor analysis, 25 items were concluded as most valid in measuring the five factors explored. With 57 subjects, this gives an acceptable subject-to-variable ratio of 2.28:1 which exceeds the bottom line of 2:1. However, it should be taken into consideration that such an evolutionary process in refining variables and their validity has undergone two previous pilot studies which brings the total N that contributed to the final outcomes across all three studies to 158 subjects. It is also known that sample size requirements in humanities (including educational psychology) are not as demanding as experiments in science and engineering fields.

Nevertheless and according to numerous validation studies, there are three critical dimensions that are of significant importance in factor recovery and variables validation regardless of the size of the sample (N) or subject-to-variable ratio (STV) since the minimum level of N is dependent of these aspects of design (Sapnas KG and Zeller RA, 2002). These dimensions are size of loading, degree of over determination and communality of variables. Meeting any of these dimensions is sufficient to give confidence in the validation of proposed instrumentation.

A. Communality of the Variables: The rule of thumb is that communalities should all be greater than .6 or the mean level of communality to be at least .7 to

disregard the sample size in validating the instruments according to MacCallum, Widaman, Zhang, and Hong (1999). Our results have met both metrics quite successfully. As shown in the SPSS communalities table below, all 34 communalities original items used in the questionnaire exceeded .6 and also their average was .724 (i.e., > .7).

B. Size of Loading: The main principle is that if any component possesses four or more variables with loadings above .60, the pattern may be interpreted whatever the sample size used *(*Guadagnoli & Velicer, 1988, p. 274). This *has been* easily achieved in our data for the first three components. The same conclusion can also be drawn with the combined effect of the third and sixth components considering that both were two dimensions of the same hypothesized "personal relevance" construct especially when adopting a "formative versus reflective indicator" strategy which is the only applicable method in this research effort. The fourth component had only three items but all these items were above .6 while the fifth component had one item below .6 and it was also just one degree below the requirement level of four items per component. Nevertheless, since all communalities yielded what can be considered beyond satisfactory results, this can indicate that while validation is strongly achieved regardless of the sample size in our data, a larger sample size in future studies should improve the size of loading across all confirmed or explored components .

C. Degree of Over Determination: The ground rule is that it is critical to have variable-to-factor ratio not less than three (T. W. Anderson and Rubin, 1956; McDonald & Krane, 1977, 1979, Rindskopf, 1984, Velicer, & Fava, 1998).

This condition was met in most components except for the sixth which had only two items with very high loading. Once again and as in our "size of loadings" interpretation, the formative (versus reflective) analysis of the collective impact of all items leading considerably highly on components three and six (as "personal relevance" hypothesized dimensions) can provide a solid ground to resolve this issue with such excellent communalities results. While this can be further supported with increasing the sample size in future studies, it can also indicate that the two dimensions of "personal relevance" (interpreted as "sense of ownership" and "sense of importance" are loosely coupled (between sub-constructs) and highly cohesive (within each sub-construct) alike.

Table 5.8 Communalities Results of the Final Study

Communalities		
	Initial	Extraction
Q1M	1.000	.724
Q2M	1.000	.703
Q3M	1.000	.701
Q4M	1.000	.662
Q5M	1.000	.731
Q6M	1.000	.839
Q7M	1.000	.767
Q8M	1.000	.671
Q9M	1.000	.699
Q10M	1.000	.720
Q11M	1.000	.661
Q12M	1.000	.721
Q13M	1.000	.603
Q14M	1.000	.740
Q15M	1.000	.674
Q16M	1.000	.742
Q17M	1.000	.676

Table 5.8 Communalities Results of the Final Study (continued…)

Q18M	1.000	.821
Q19M	1.000	.757
Q20M	1.000	.739
Q21M	1.000	.870
Q22M	1.000	.658
Q23M	1.000	.713
Q24M	1.000	.727
Q25M	1.000	.669
Q26M	1.000	.712
Q27M	1.000	.732
Q28M	1.000	.820
Q29M	1.000	.832
Q30M	1.000	.660
Q31M	1.000	.660
Q32M	1.000	.817
Q33M	1.000	.691
Q34M	1.000	.706

Furthermore, considering that the pilot studies were not distinct from the larger study since the revised SCCT framework and its instrumentation ingredients were maintained across all pilot studies, the sample sizes of pilot studies were not relatively small and the multi-stage design were adopted permitting the refinement of parameters used in initial studies, this can mirror a internal piloting strategy. Such a strategy may potentially present several benefits in regard of the sample size. One obvious benefit is the accumulative impact of four samples (including Q-sort sample) receiving the same treatment on the validity of instruments due to numerous iterations of refinement. A second benefit for future studies is allowing the merger of samples across various studies to examine additional components of the RWC learning model and their relationship with other constructs in the main SCCT theory, which should be used cautiously. Another

potential benefit is the possible reduction of earlier sample size requirements after re-calculation.

F. Validity Analysis

Confirmatory (CFA) and exploratory (EFA) factor analysis: Both confirmatory and exploratory factor analysis were necessary in the final round. CFA was used to confirm the SCCT theory within the new context of RWC-driven intervention mechanisms (Learning experiences characteristics). EFA was used to investigate the sub-constructs of learning experiences characteristics further since the taxonomical grouping and classification was theoretical in nature not to mention that Real World Connections (RWC) is a brand new learning model with limited literature. The integration of both techniques has provided the optimal outcome desired to fine tune the research model and formulate the final study hypotheses as the foundation of inferential statistics provided in chapter 6.

G. Content Validity

According to the rotated component matrix table below for the final survey (cut off limit is .55), there are important conclusions. For learning experience characteristics (LEC) items 2, 8, 9, 11, 12, 15, 16 and 17 all loaded highly on the first component at the .55 cut off value. Items 8, 9, 11 and 12, however, had the highest loadings. Since these items are all related in a formative fashion to social impact, they have been associated with the hypothesized "social integration" construct.

For outcome expectations, it was also noticed that items 23, 24, 25, 26, 27 and 28 loaded highly on the second component giving the "cleanest" loading ever achieved in this evolutionary study. Similarly for technology self-efficacy, SE 20, 21 and 22 had high

loadings on the fourth component. This implies that at least five OE and three SE items had valid results considering the high cutoff rate of .55 (versus .4 as the minimum acceptable limit in most studies).

For the first time, and for technology interest, three items 32, 33 and 34 loaded highly and cleanly on the fifth component. This implies that our instrumentation power of validation has increased dramatically after several iterations and refinements especially for the technology interest latent construct.

H. Convergent and Discernment Validity

In the final questionnaire, it was clear that we had the highest percentage of instruments that correlated highly (or loaded highly on one component) across all studies, which is a strong indication of achieving a considerably high convergent validity in the final round and this time technology interest is no exception. This round, all of the instruments related to different components did not correlate highly in any form at the .55 cut off value - which is even lower than the .6 value used in the second pilot study (or had high cross-loadings). This is an indication of excellent discernment validity.

L. Cumulative Percentage of Variance and Eigenvalue > 1 Rule

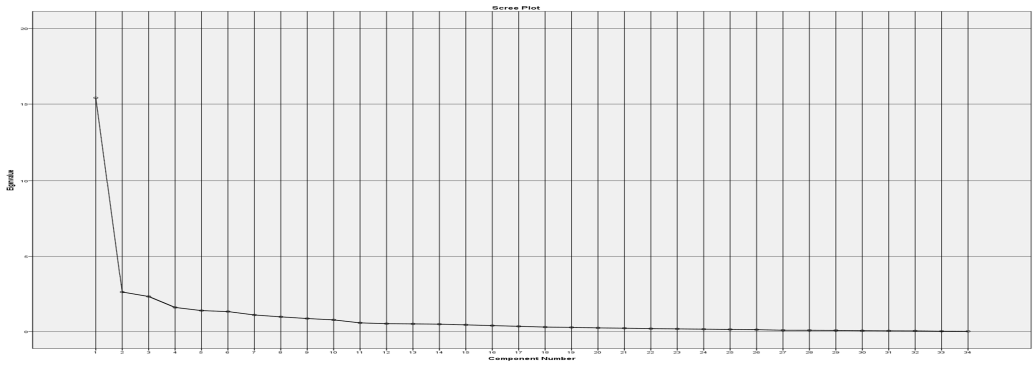
While in the humanities, the explained variance is commonly as low as 50-60%, in our final study results below, Table 5.9 demonstrates a cumulative percentage of explained variance of 74.939 % and a total of 6 components (factors) having an eigenvalue > 1. This is an outstanding result given N used in the final round.

Scree plot: The inspection of the Scree plot below and eigenvalues produced a departure from the semi- linearity coinciding with a 6-factor result. Therefore and despite the

semi-linearity and using the best researcher best judgment, this Scree Test indicates that the data should be analyzed (approximately) for 6 factors.

Table 5.9: Variance Explanation, Scree Plot and Factor Analysis for the Final Study

Total Variance Explained			
Component	Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	4.847	18.642	18.642
2	3.919	15.073	33.715
3	2.948	11.338	45.053
4	2.889	11.112	56.165
5	2.758	10.608	66.773
6	2.123	8.166	74.939



	Component					
	1	2	3	4	5	6
Q1M						
Q2M	.601					
Q3M						
Q4M						
Q5M						
Q6M						.780
Q7M						.824
Q8M	.620					

Table 5.9: Variance Explanation, Scree Plot and Factor Analysis for the Final Study (Continued…)

Q9M	**.573**					
Q10M			**.800**			
Q11M	**.780**					
Q12M	**.701**					
Q13M						
Q14M						
Q15M	**.615**					
Q16M	**.821**					
Q17M	**.665**					
Q18M			**.689**			
Q19M			**.660**			
Q20M				**.728**		
Q21M				**.886**		
Q22M				**.633**		
Q23M		**.766**				
Q24M		**.574**				
Q25M		**.728**				
Q26M		**.683**				
Q27M		**.555**				
Q28M		**.765**				
Q29M			***.656***			
Q30M		***.564***				
Q31M						
Q32M					**.650**	
Q33M					**.555**	
Q34M					**.824**	

5.2.4 Conclusion

The final survey results indicate strong validation of most instruments used to measure the variables in the proposed theoretical model. By comparing the two internal pilot studies with the final study in terms of communalities and accumulative explanation of variance, we can obtain the results in the *following table*. Obviously, these results mirror the instruments validation power of the final study as a product of numerous iterations of

surveys, refinements, literature reviews, quantitative and qualitative analysis.

Table 5.10 Three Studies Comparison in Key Validity Metrics

	Percentage of items with communalities above .6	Accumulative explanation of variance
First internal pilot study	36.11%	53.239%
Second internal pilot study	23.53%	52.237%
Final study	100%	74.939%

"Learning experience characteristics" has a significant validation of at least 75% of its proposed instruments (25 out of the proposed 34 items) at a considerably high cut-off rate. None of the remaining items had low loading but they were removed either for cross loading, ambiguity or because they loaded a little bit less than the high- standards bottom line of cut-off rate. Therefore, such few items are not considered in the final analysis. Similarly, the majority of technology self-efficacy and technology outcome expectations instruments were valid with high correlations with each other.

Exploratory factor analysis (EFA) has revealed three key groups of the learning experiences characteristics, two are associated with personal relevance (i.e.: sense of ownership and sense of self-importance) and one associated with social integration as illustrated in the Table 5.11.

Table 5.11 RWC New Sources of SCCT
(Formative indicators instead of reflective)

RWC source (Factor) of Self-efficacy	**Related variables (Questionnaire items)**
Social integration (8 items) ***a- How much did the experiences connect me to people?*** ***b- How much did the experiences connect me to tasks and activities?***	**2, 8 ,9 , 11 ,12 ,15 ,16 ,17** **Item 12:** community impact **Items 8 and 9:** social support **Item 2:** sense of community **Item 11:** social influence **Items 15, 16 and 17:** social engagement and relevance
Outcome expectations (6 items)	**23, 24, 25, 26, 27, 28**
Sense of ownership (3 items)	**10, 18, 19**
IT self-efficacy (3 items)	**20, 21, 22**
IT interest (3 items)	**32, 33, 34**
Sense of importance (2 items)	**6, 7**

Accordingly, EFA/ CFA analysis has played dual roles. On the one hand, it led to a refinement of the final research model to include sense of ownership, sense of self-importance and social integration as illustrated in the research model diagram below. On the other hand, EFA/ CFA analysis has re-confirmed the two sub-constructs identified originally using the taxonomy build strategy earlier in this chapter.

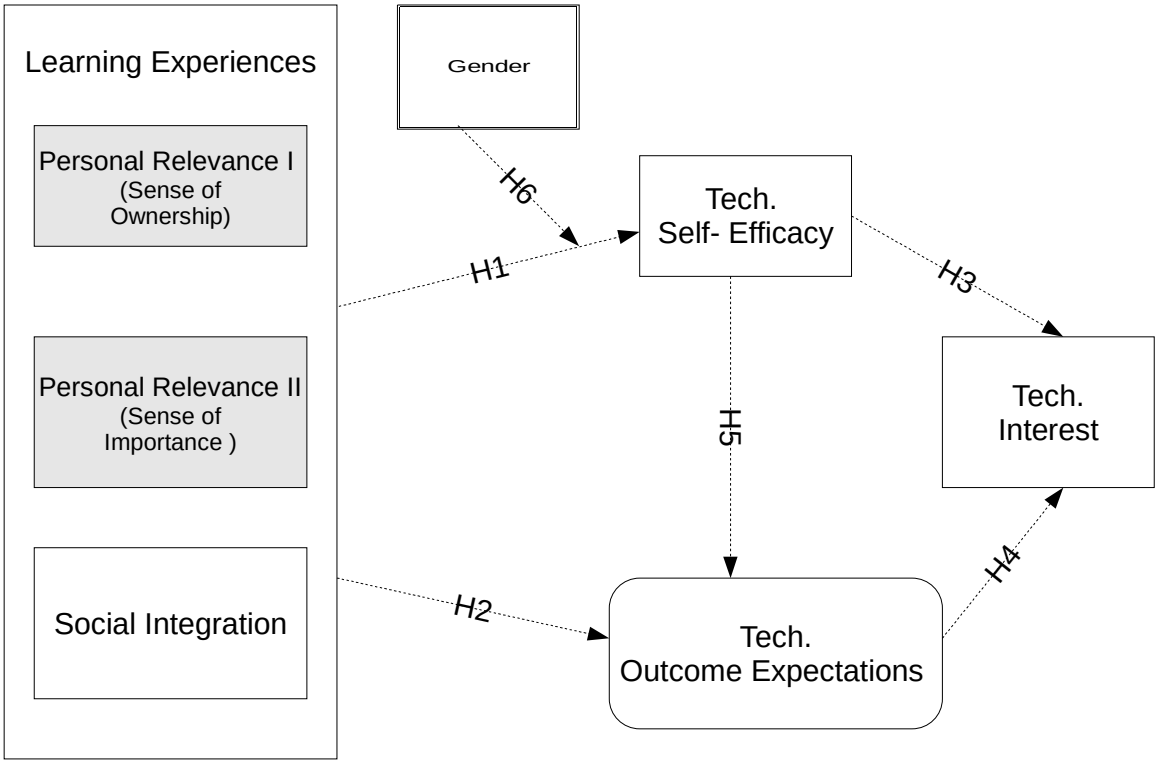


Figure 5.8 Refinement of final research model to integrate sub-constructs.

CHAPTER 6

RESULTS OF THE FINAL STUDY

The purpose of this study is to investigate whether SCCT- enhanced intervention mechanisms (Learning Experiences Characteristics) used in the Real World Connections learning model (RWC) can increase the self-efficacy and interest of pre-college and college students in technology; in particular, whether it can remove the gender barrier of technology-related career self-efficacy of adolescent women after experiencing the learning intervention mechanisms used in the Real World Connections program at NJIT. The following are the research questions for this dissertation:

1. Does using the refined learning model have a positive impact on students' self-efficacy and interest in computer-based subjects?
2. Does re-designing the "learning experiences" construct in SCCT using the refined learning model ingredients make a significant difference in its impact on students' computer technology self-efficacy?
3. Does the refined learning model fit the SCCT framework?
4. Does using the refined learning model reduce the gender gap between boys and girls in their computer-based self-efficacy?
5. Which ingredient of the refined "learning experiences" construct is the most influential?
6. How does the impact of RWC model compare to traditional SCCT sources of self-efficacy?

6.1 Descriptive Statistics: Measures of Central Tendencies and Dispersion

Means, standard deviations and variance for female and male students on the interval-scaled independent and dependent constructs measured are reported in Table 6.1. All variables were tapped on a five-point scale. From the results, it may be seen that the mean of learning experience characteristics (LEC), technology self-efficacy (SE), outcome expectations (OE), and technology career interest (ITI) variables are all well above average with technology interest as the lowest among the four. The technology career interest minimum of 1.0 indicates that there are some students who have a lack of interest in a career in technology, and the maximum of 5 indicates that some are seriously interested in technology as a career path.

The variance of the LEC is relatively low (.447) in Table 6.1b which indicates that most respondents are very close to the mean of learning experience characteristics as opposed to the results in Table 6.1 after being exposed to the RWC treatment. On the other hand, the variance of ITI is relatively higher which implies that a good percentage of respondents were a little bit far from the mean regarding the technology career interest. The variance of outcome expectations was the highest while the variance of self-efficacy was close to average. Both have decreased significantly after using the RWC treatment as seen in Table 6.1.

In sum, all variables scored high with LEC and OE as the highest but ITI results were relatively the most dispersed.

Table 6.1 Means, Standard Deviations and Variance on Pre/Post Experiment

Descriptive Statistics													
	N	Range		Minimum		Maximum		Mean		Std. Deviation		Variance	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Learning Experiences Characteristics	57	4.00	3.38	1.00	1.63	5.00	5.00	3.5614	3.8976	.78672	.66856	.619	.447
Technology Self-Efficacy	57	4.00	3.33	1.00	1.67	5.00	5.00	3.2222	3.4795	.99469	.79935	.989	.639
Technology Outcome Expectations	57	3.00	2.50	2.00	2.50	5.00	5.00	3.6550	3.7368	.74726	.64546	.558	.417
Technology Interest	57	4.00	4.00	1.00	1.00	5.00	5.00	2.8363	3.0906	.84544	.87405	.715	.764

6.2 Inferential Statistics

The Pearson Correlation Matrix obtained for the four interval-scaled variables is shown in Table 6.2 for the pre and post experiment results. From the results in post-experiment correlations, it can be observed that "learning experience characteristics" is positively correlated with self-efficacy and outcome expectations in technology. It can also be seen that self-efficacy is positively correlated with interest. The correlation between self-efficacy and interest is in line with the original Social Cognitive Career Theory (SCCT). These results provide good support to our hypothesis. It is noticed also that the direct correlation between LEC and ITI is among the lowest correlations, which mirrors SCCT outcomes as well.

By comparing results in Table 6.2, it is also clear that these correlations have increased in the post-experiment outcomes as a result of the treatment. Similarly, the correlation between self-efficacy and outcome expectations had a relatively significant increase considering the size of the final study. Also by comparing Learning Experiences Characteristics correlations with three other variables in Table 6.2 and their counterparts in Table 6.3, it is apparent the Learning Experiences Characteristics have almost doubled most correlations in the final study over the primary pilot study.

Since the variance inflation factor (VIF) is an important measure of multicolinearity (or mutual exclusiveness), it was calculated here using the ($1/1-R^2$) formula where R is the largest correlation coefficient in the post-treatment correlation matrix. Calculated VIF was 1.6 which is an excellent indication of the clean independency and mutual exclusiveness among the four key factors in the final study. It is important to note that no correlation exceeded 0.667 in these results. If correlations were higher (for example .75), we might need to question whether or not the correlated variables are too distinct from each other and would have doubted the internal validity of the instruments.

Table 6.2 Pearson Correlation Matrix Pre/Post Experiment Comparison (Final Study)

		LEC		SEA		OEA		ITIA	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post
LEC	Pearson Correlation	1	1						
SEA	Pearson Correlation	.398**	**.468****	1	1				
OEA	Pearson Correlation	.542**	**.591****	.449**	**.580****	1	1		
ITIA	Pearson Correlation	.471**	.449**	.422**	.441**	.652**	.611**	1	1

Table 6.3 Pearson Correlation Matrix for LEC, SE, OE and ITI (Pilot Study N=60)

		LEC POST	SE POST	OE POST	TI POST
LEC POST	Pearson Correlation	1			
	Sig. (2-tailed)				
SE POST	Pearson Correlation	**.272***	1		
	Sig. (2-tailed)	.035			
OE POST	Pearson Correlation	**.292***	**.667****	1	.
	Sig. (2-tailed)	.024	.000		.000
TI POST	Pearson Correlation	**.062**	**.653****	**.617****	1
	Sig. (2-tailed)	.638	.000	.000	

6.3 Hypotheses Testing

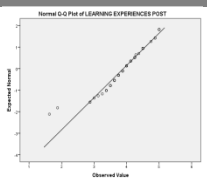
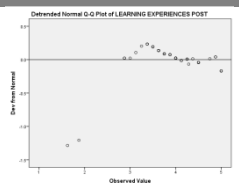
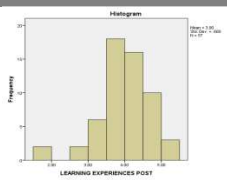
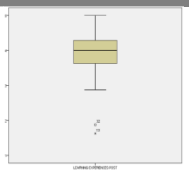
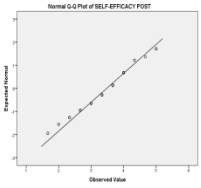
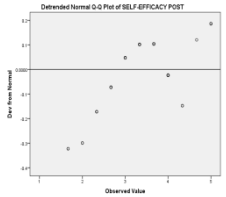
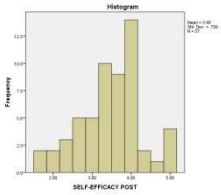
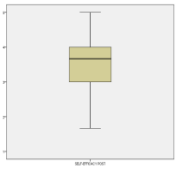
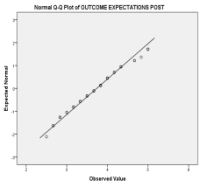
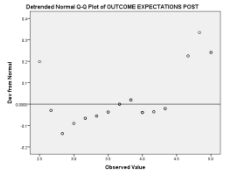
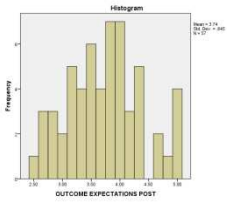
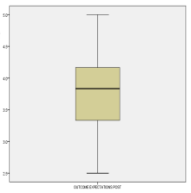
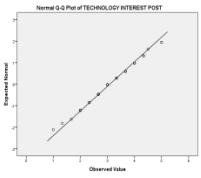
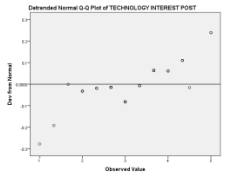
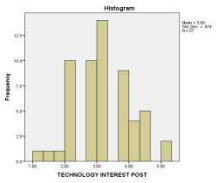
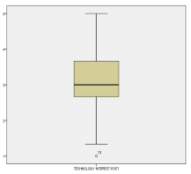
Table 6.4 A Road Map for Answering the Research Questions

Research Question Component	Hypothesis	Hypothesis Narrative	Statistical Tests
Q1-A Does using the RWC learning model have a positive impact on students' self-efficacy in computer-based subjects?	**(H1)**	There will be a positive relation between learning experiences characteristics in RWC and technology self-efficacy.	T-Test Paired Sample
			Correlation Tests (Pearson AND Spearman)
Q2 Do re-designing "learning experiences" in SCCT using the RWC model ingredients make a significant difference in its impact on students' technology self-efficacy?	**(H1)** & **(H8)**		Wilcoxon Signed Ranks Test
			ANOVA
Q1-B Does using the RWC learning model have a positive impact on students' interest in computer-based subjects?	**(H2)** & ***(H1), (H3) (H4)***	There will be a positive relation between learning experience characteristics and technology outcome expectations.	T-Test Paired Sample
			ANOVA
			Correlation Tests (Pearson AND Spearman)
			Wilcoxon Signed Ranks Test
Q3 Does the RWC learning model fit the SCCT framework?	**(H3)**	There will be a positive relation between technology self-efficacy and technology career interest.	Regression F- Test
	(H4)	There will be a positive relation between technology outcome expectations and technology career interest	Regression F -Test
	(H5)	There will be a positive relation between technology self-efficacy and technology outcome expectations.	Regression F- Test
Q4 Does using the RWC model reduce the gender gap between boys and girls in their computer-based self-efficacy?	**(H6)**	The positive relationship between learning experiences and self-efficacy will not vary significantly between male and female students.	Chi Square Test
			Independent Sample T-Test
			Mann-Whitney Test
Q5 Which ingredient of RWC-based ""learning experiences" is the most influential?	**(H7)**	Ingredient of RWC-based ""learning experiences" have differences in their impact on self-efficacy.	F-Test Regression
			Step-wise Regression
			Pearson Correlation
Q6 How does the impact of RWC model compare to traditional SCCT sources of self-efficacy?	**Hypothesis (H8)**	RWC ingredients have greater impact on self-efficacy than the four original SCCT sources.	Regression Pearson Correlation

A road map for research questions and their corresponding hypothesis and statistical tests is shown is Table 6.4. Since the sample size is more than 30 subjects, we will assume normal distribution. Therefore, parametric tests can be used to test the hypotheses of this study. This is according to the large number theory where normal distribution can be approximated in case the K-S hypothesis was not substantiated. Since the sample size was smaller than 200 subjects, linear regression analysis is used to carry out hypothesis testing rather than structured equation modeling (SEM). It is known that SEM requires a minimum of 200 subjects to yield reliable outcomes.

Normal Distribution Test: First Method: Normality Graphs

Table 6.5 Four Key Graphs to Test Normality for Four Key Constructs

SPSS Output / Constructs	Q-Q Plots	Detrended Normal QQ Plot	Histogram	Boxplot
Learning Experiences Characteristics				
Technology Self-Efficacy				
Technology Outcome Expectations				
Technology Interest				

In most statistical analysis, it is assumed that continuous variables are normally distributed. Once distributions are obviously not normal or extremely skewed they can be transformed before further analysis using various methods. In general, normality is assessed for continuous variables. In our study and as shown in Table 6.5, four key normality-testing graphs were generated to determine if our four key continuous constructs (main variables) have normal

distributions as follows:

• **Histograms Test:** The Y axis shows frequency of cases. The x-axis values are the midpoints of the value ranges (each bar covers a range). Compared to the ideal normal distribution curve, the histogram shape is almost positively skewed for self-efficacy and interest constructs and negatively skewed for learning experiences. However, the skewedness is not extreme and is usually acceptable for normal distribution.

• **Boxplots Test:** The median line is slightly de-centered in the box for the four constructs and the whiskers are not of equal length with few outliers are present. This reconfirms the slight skewedness which is usually acceptable for normal distribution.

• **Scatterplots:**

- **Normal (QQ) Probability Plots:** Since in the Normal Probability (QQ) Plot, cases will follow a straight line along a diagonal if the distribution is normal, we can conclude that all constructs except for learning experiences are normally distributed with no systematic departures from the diagonal line. Despite slight skewedness, "learning experiences" shows very little lack of normality.
- **Detrended Normal QQ Probability Plots:** Self-efficacy and Interest values are scattered and do not appear to be aligning, but some values are far from the zero line. Learning experiences and Outcome expectations exhibited a similar behavior but with some slight potential aligning.

❖ **Second Method: Normality Statistics**

Mean and Median Comparison

As a rule of thumb, mean and median are equal in normal distributions. By reviewing the values for the four main valuable in our study below, all means and medians highlighted in

bold are nearly equal with the highest difference in self-efficacy.

Table 6.6 Normality Test Descriptives

Normality Test Descriptives

		Statistic	Std. Error
LEARNING EXPERIENCES POST	Mean	**3.8976**	.08855
	Median	**4.0000**	
	Skewness	-.990	.316
	Kurtosis	2.303	.623
SELF-EFFICACY POST	Mean	**3.4795**	.10588
	Median	**3.6667**	
	Skewness	-.260	.316
	Kurtosis	-.038	.623
OUTCOME EXPECTATIONS POST	Mean	**3.7368**	.08549
	Median	**3.8333**	
	Skewness	.177	.316
	Kurtosis	-.487	.623
TECHNOLOGY INTEREST POST	Mean	**3.0906**	.11577
	Median	**3.0000**	
	Skewness	.040	.316
	Kurtosis	-.215	.623

The Kolmogorov-Smirnov and Shapiro-Wilk statistics mirror the QQ and Detrended probability plots. If the significance level (.Sig) is higher than .05 then the data is assumed to fit the normal distribution. Shapiro-Wilk should be calculated if the sample size is less than 100 which is applicable to our final study here (N=57).

It is observed that the p-value for the Shapiro-Wilk test for “Learning Experiences” and “Self-efficacy” are 0.004 and 0.043 respectively (in the last column under “Sig.”). This implies that the data sets for these two constructs don’t meet normal criteria here because the p-value was smaller than alpha=.05. It is also observed that the p-value for the Shapiro-Wilk test for outcome expectations and technology interest are 0.204 and 0.459. This implies that the data sets for these variables meet normal criteria here because the p-value

was larger than alpha=.05.

Combining our previous analysis of graphs and statistics for normality, conclusion can be drawn that although our four main study variables are not perfectly distributed, they are not extremely skewed. Therefore, a transformation of the data is not necessary. The four variables have a near-normal distribution.

Shapiro-Wilk test

Table 6.7 Shapiro-Wilk Tests of Normality

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
LEARNING EXPERIENCES POST	.101	57	.200*	.934	57	.004
SELF-EFFICACY POST	.135	57	.012	.957	57	.043
OUTCOME EXPECTATIONS POST	.079	57	.200*	.972	57	.204
TECHNOLOGY INTEREST POST	.120	57	.039	.980	57	.459

Several hypotheses were generated in the research as stated earlier. Level of confidence is set to 95% which is the accepted level in this study. Assuming that the data follows the normal distribution, the regression test (F) was used.

Where the decision rule: *Accepting Ho if: F (calculated) < F (tabulated).*

"Spearman Rank Correlation Coefficient Test" is a non-parametric test which does not depend on the type of the probability distribution where the decision rule is:

Accept Ho if: r (.005) tabulated < r (calculated) < r (.995) tabulated taking into consideration that N > 25, a = 0.01 and this test is a two-tailed r (0.005 tabulated) = -2.576, and r (0.995 tabulated) = 2.576.

Table 6.8a Spearman's Non-Parametric Correlations Test (New study)

			LEC Post	SE Post	OE Post	ITI Post
Spearman's rho	LEC Post	Correlation Coefficient	1.000			
		Sig. (2-tailed)	.			
	SEA Post	Correlation Coefficient	**.389****	1.000		
		Sig. (2-tailed)	.003	.		
	OE Post	Correlation Coefficient	**.581****	**.498****	1.000**	
		Sig. (2-tailed)	.000	.000	.	
	ITI Post	Correlation Coefficient	**.436****	**.337***	**.541****	1.000*
		Sig. (2-tailed)	.001	.010	.000	.

Table 6.8b Spearman's Non-Parametric Correlations Test (Pilot study)

Correlations

		LEC POST	SE POST	OE POST	TI POST
Spearman's rho	LEC POST	1.000			
	SE POST	.302*	1.000		
	OE POST	.347**	.617**	1.000	
	TI POST	.074	.625**	.589**	1.000

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

6.4 Studying Refined Learning Model Impact on SCCT Factors

6.4.1 The Parametric Approach: T-Test Paired Sample Statistics

Learning Experiences Characteristics

Table 6.9 Paired Samples Statistics for Learning Experiences

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	LEC PRE	3.5614	57	.78672	.10420
	LEC POST	3.8976	57	.66856	.08855

From the paired samples statistics table, the post-test mean scores are higher than the pre-test for "Learning Experiences Characteristics"**.** Since this is just on face value, we still do not know if this difference is statistically significant. Next, the correlation between the two variables is examined. Since the groups are paired / the same and the correlation coefficient is slightly above .4 but below .7 in the positive direction, we assume that there is a low moderate correlation between the first and second measurement. If there was a stronger positive correlation, this should imply that the same people who did well on the pre-test also did well on the post-test.

Table 6.10 Paired Samples Correlations for Learning Experiences

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	LEC PRE & LEC POST	57	.538	.000

Finally, the results of the Paired Samples T Test are examined. As this test is based on the difference between the two variables, the descriptive statistics for the difference between the two variables is shown under "Paired Differences". Since the significance value is .001 which is significantly less than .05, it is concluded that the difference is of high statistical significance. There is a very significant difference between pre- and post-test scores for technology learning experiences characteristics (T = -3.590, DF is 56) that can be attributed to the impact of the intervention mechanisms in the design of the learning experiences model as opposed to the traditional learning model.

Table 6.11 Paired Sample T-Tests for Learning Experiences

Paired Samples Test

		Paired Differences			
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference
					Lower
Pair 1	LEC-PRE - LEC-POST	-.33615	.70694	.09364	-.52373

Table 6.12 Paired Sample T-Tests for Learning Experiences (T-differences)

Paired Samples Test

		Paired Differences	t	df	Sig. (2-tailed)
		95% Confidence Interval of the Difference			
		Upper			
Pair 1	LEC-PRE - LEC-POST	-.14858	-3.590	56	.001

Technology Self- Efficacy

Table 6.13 Paired Sample Test for Self-Efficacy

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	SE PRE	3.2222	57	.99469	.13175
	SE POST	3.4795	57	.79935	.10588

The first research question was in part about examining whether using the RWC learning model will have a positive impact on students' self-efficacy in computer-based subjects. From the paired samples statistics table, the post-test mean scores are higher than the pre-test for students' self-efficacy in technology. Since this is just on face value, we still do not know if this difference is statistically significant. Next, the correlation between the two variables is examined. Since the groups are paired / the same and the correlation coefficient is slightly above .4 but below .7 in the positive direction, we assume that there is a low moderate

correlation between the first and second measurement. If there was a stronger positive correlation, this should imply that the same people who did well on the pre-test also did well on the post-test.

Table 6.14 Paired Sample Correlations for Self- Efficacy

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	SE PRE & SE POST	57	.562	.000

The Paired Samples T Test results are then examined. As this test is based on the difference between the two variables, the descriptive statistics for the difference between the two variables is shown under "Paired Differences". Since the significance value is .027 which is less than .05, it is concluded that the difference is of statistical significance. There is a relatively large difference between pre- and post-test scores for technology self-efficacy (T = -2.267, DF is 56) that can be attributed to the intervention mechanisms in the design of the learning experiences characteristics.

Table 6.15 a & b Paired Samples T -Test for Self-efficacy

Paired Samples Test

		Paired Differences			
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference
					Lower
Pair 1	SE PRE – SE POST	-.25731	.85685	.11349	-.48466

Paired Samples Test

		Paired Differences	t	df	Sig. (2-tailed)
		95% Confidence Interval of the Difference			
		Upper			
Pair 1	SEA PRE – SEA POST	-.02996	-2.267	56	.027

Technology Outcome Expectations

Table 6.16 Paired Sample Test for Outcome Expectations

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	OE PRE	3.6550	57	.74726	.09898
	OE POST	3.7368	57	.64546	.08549

From the paired samples statistics table, the post-test mean scores are higher than the pre-test for technology outcome expectations. Since this is just on face value, we still do not know if this difference is statistically significant. Next, the correlation between the two variables is examined. Since the groups are paired / the same and the correlation coefficient is above .4 but below .7 in the positive direction, we assume that there is a moderate correlation between the first and second measurement. If there was a stronger positive correlation, this should imply that the same people who did well on the pre-test also did well on the post-test.

Table 6.17 Paired Sample Correlations for Outcome Expectations

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	OE PRE & OEA POST	57	.689	.000

The Paired Samples T Test results are once again examined. As this test is based on the difference between the two variables, the descriptive statistics for the difference between the two variables is shown under "Paired Differences". Since the significance value is .272 which is more than .05, it is concluded that the difference is of no statistical significance. There is a difference between pre- and post-test scores for technology outcome expectations (T = -1.109, DF is 56) that can be attributed to the intervention mechanisms in the design of the learning experiences characteristics.

Table 6.18 a & b Paired Samples T -Test for Outcome Expectations

Paired Samples Test

		Paired Differences			
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference
					Lower
Pair 1	OE PRE – OE POST	-.08187	.55735	.07382	-.22976

Paired Samples Test

		Paired Differences	t	df	Sig. (2-tailed)
		95% Confidence Interval of the Difference			
		Upper			
Pair 1	OE PRE – OE POST	.06601	-1.109	56	.272

Technology Interest

Table 6.19 Paired Sample Test for Technology Interest

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	ITI PRE	2.8363	57	.84544	.11198
	ITI POST	3.0906	57	.87405	.11577

The first research question was also about examining whether using the RWC learning model will have a positive impact on students' interest in computer-based subjects. From the paired samples statistics table, the post-test mean scores are higher than the pre-test for students' interest in technology. Since this is just on face value, we still do not know if this difference is statistically significant. Next, the correlation between the two variables is examined. Since the groups are paired / the same and the correlation coefficient is above .4 but below .7 in the positive direction, we assume that there is a moderate correlation between

the first and second measurement. If there was a stronger positive correlation, this should imply that the same people who did well on the pre-test also did well on the post-test.

Table 6.20 Paired Sample Correlations for Technology Interest

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	ITI PRE & ITI POST	57	.653	.000

The Paired Samples T Test results are then examined. As this test is based on the difference between the two variables, the descriptive statistics for the difference between the two variables is shown under "Paired Differences". Since the significance value is .01 which is less than .05, it is concluded that the difference is of statistical significance. There is a relatively large difference between pre- and post-test scores for technology interest (T = -2.679, DF is 56) that can be attributed to the intervention mechanisms in the design of the learning experiences characteristics.

Table 6.21 a & b Paired Samples T -Test for Technology Interest

Paired Samples Test

		Paired Differences			
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference
					Lower
Pair 1	ITI PRE – ITI POST	-.25439	.71693	.09496	-.44461

Paired Samples Test

		Paired Differences	t	df	Sig. (2-tailed)
		95% Confidence Interval of the Difference			
		Upper			
Pair 1	ITI PRE – ITI POST	-.06416	-2.679	56	.010

6.4.2 The Non-Parametric Approach: Wilcoxon Signed Ranks Test

A Wilcoxon Signed-Rank test was run to determine if there were differences in technology self-efficacy, outcome expectations and interest between the paired sample before and after RWC interventions. There was a statistically significant increase in self-efficacy and interest as a result of RWC interventions. For technology self-efficacy, (*positive ranks 26 versus 15 negative ranks*), $z = -2.044$, $p < .05$. For technology interest, (*positive ranks 27 versus 14 negative ranks*), $z = -2.383$, $p < .05$. Outcome expectations results were not statistically significant since $p>.05$.

Table 6.22 a & b Wilcoxon Signed-Rank Test Results

Ranks

		N	Mean Rank	Sum of Ranks
LEC POST – LEC PRE	Negative Ranks	13[a]	23.08	300.00
	Positive Ranks	39[b]	27.64	1078.00
	Ties	5[c]		
	Total	57		
SE POST – SEA PRE	Negative Ranks	15[d]	18.27	274.00
	Positive Ranks	26[e]	22.58	587.00
	Ties	16[f]		
	Total	57		
OE POST – OE PRE	Negative Ranks	16[g]	26.00	416.00
	Positive Ranks	28[h]	20.50	574.00
	Ties	13[i]		
	Total	57		
ITI POST- ITI PRE	Negative Ranks	14[j]	17.75	248.50
	Positive Ranks	27[k]	22.69	612.50
	Ties	16[l]		
	Total	57		

Test Statistics

	LEC POST – LEC PRE	SE POST – SEA PRE	OE POST – OE PRE	ITI POST- ITI PRE
Z	-3.552[b]	-2.044[b]	-.928[b]	-2.383[b]
Asymp. Sig. (2-tailed)	.000	.041	.354	.017

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

6.5. Examining the Impact of RWC on Reducing Gender Gap (H6)

6.5.1 Test of Normal Distribution for Gender versus Self-Efficacy

Self-efficacy scores were normally distributed for both males and females, as assessed by Shapiro-Wilk's test ($p > .05$) and also by using visual inspection of Normal Q-Q Plots.

Table 6.23 Shapiro-Wilk and Q-Q Plot Self-efficacy Pre-Test

Tests of Normality

	GENDER	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
SE PRE	MALE	.208	24	.009	.941	24	**.175**
	FEMALE	.136	33	.124	.946	33	**.101**

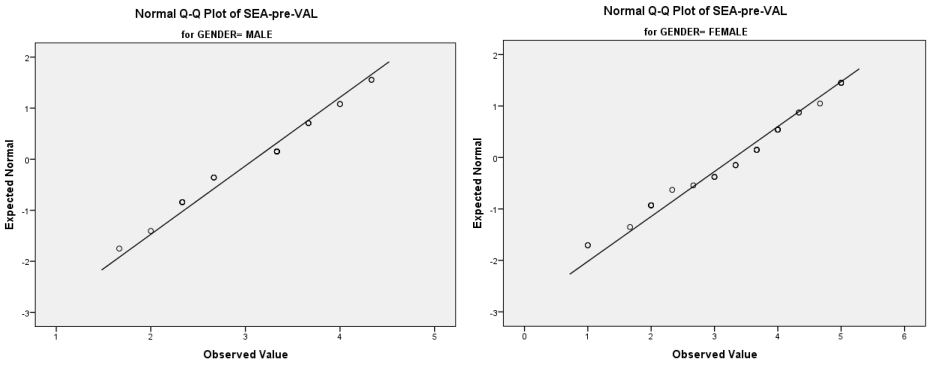
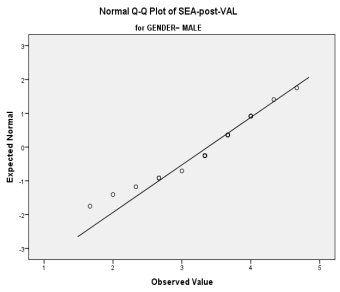
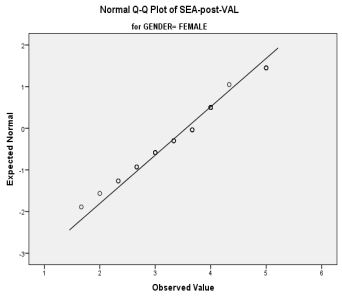


Table 6.24 Shapiro-Wilk and Q-Q Plot Self-efficacy Post-Test

Tests of Normality

	GENDER	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
SE POST	MALE	.227	24	.003	.939	24	**.158**
	FEMALE	.152	33	.052	.949	33	**.127**





6.5.2 The Chi Square Test Approach

Cross-tab Pre-Test/Post Test for Gender and Self-efficacy

To use the non-parametric Chi Square method, the crosstabulation calculation was conducted where observed and expected frequencies for each cell of our 2 X 2 factorial design before (pre-test) and after (post-test) RWC intervention are found in the gender*self-efficacy Crosstabulation table, as shown below. Chi Square assumptions were verified. All expected cell frequencies were greater than five in both tests and normal distribution was tested for the potential association of our two dichotomous variables by using both Shapiro-Wilk and Q-Q plot tests in section 6.5.1.

A Chi-square test for association was conducted between gender and self-efficacy at two levels (low and high). There was no statistically significant association between gender and the two levels of self-efficacy for pre-test and post-test alike, $\chi^2(1) = .788$ and .001 , $p = .375$ and $.972 < .05$ respectively. This was also confirmed by Fisher's one sided

and two-sided exact tests since *p* was significantly > .05 as in the SPSS results below.

Phi (φ) and Cramer's V are both measures of the strength of association of a nominal by nominal relationship where Phi is only adequate when we have two dichotomous variables. As expected, Phi and Cramer's V will provide the same answer when for a 2 x 2 crosstabulation, although Phi is more often reported in such scenarios. Since *p>.05* for the pre-test and post-test in this case, the value of Phi and Cramer's V are not statistically significant.

However, results demonstrate that while we can't reject the null hypothesis for an independent association between gender and self-efficacy, the values of Chi Square and Phi were significantly higher in the post-test results versus the pre-test results. This may be considered a good indicator of the impact of RWC intervention mechanisms on removing the dependency of self-efficacy on gender.

The first set of bar charts compared the impact of RWC interventions on self-efficacy as categorized by gender. From the comparison table and charts, it is quite obvious that RWC interventions has improved self-efficacy for both genders alike as opposed to traditional models that tend to have a much bigger impact on male students than female students. The second set of comparison charts addressed the low and high self-efficacy default groups categorized by gender and the impact of RWC interventions on each group. Clearly, female students with higher self-efficacy improved more than female students with lower self-efficacy while male students with lower self-efficacy benefited more than male-students with higher self-efficacy.

Table 6.25 Chi Square Count Comparison between Pre and Post Test

			TECHNOLOGY SELF-EFFICACY			
			LOW		HIGH	
			Pre	Post	Pre	Post
GENDER	MALE	Count	***10***	***5***	***14***	***19***
		Expected Count	8.4	5.1	15.6	18.9
		% within GENDER	41.7%	20.8%	58.3%	79.2%
	FEMALE	Count	***10***	***7***	***23***	***26***
		Expected Count	11.6	6.9	21.4	26.1
		% within GENDER	30.3%	21.2%	69.7%	78.8%

Table 6.26 a & b Chi Square Correlation Comparison between Pre and Post Test

Chi-Square Tests

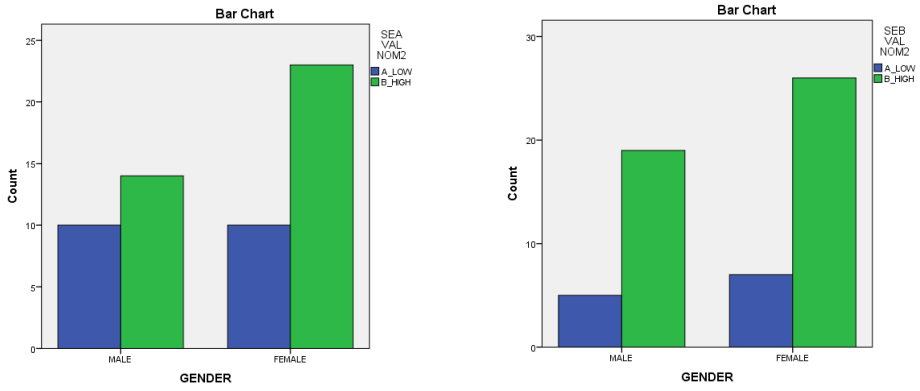
	Value		df		Asymp. Sig. (2-sided)		Exact Sig. (2-sided)		Exact Sig. (1-sided)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Pearson Chi-Square	.788[a]	.001[a]	1	1		.972				
Continuity Correction[b]	.368	.000	1	1	.544	1.000				
Likelihood Ratio	.784	.001	1	1	.376	.972				
Fisher's Exact Test							.411	1.000	.271	.619

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.42.

b. Computed only for a 2x2 table

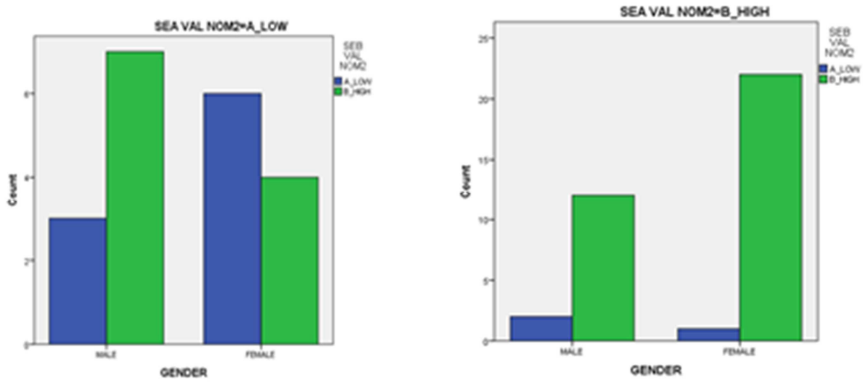
Symmetric Measures

		Value		Approx. Sig.	
		Pre	Post	Pre	Post
Nominal by Nominal	Phi	.118	-.005	.375	.972
	Cramer's V	.118	.005	.375	.972



Before **After**

Graph 6.1 Differences in Self-efficacy between Genders before and after RWC Treatment



Low SE Default **High SE Default**

Grpah 6.2 Impact of RWC on Both Genders with Low & High Default Levels of Self-efficacy

6.5.3 The Independent Sample T-Test Approach

Pre-Test

Inspection of Q-Q Plots revealed that pre-test self-efficacy was normally distributed for both female and male students. There was no homogeneity of variance, however, as assessed by Levene's Test for Equality of Variances (corresponding P< .05). As a result, equal variances were not assumed and the related independent t-test was run on the data as well as 95% confidence intervals (CI) for the mean difference to compare pre-test self-efficacy in male

students and female students. There was no significant difference in the Self-efficacy for male students (M=3.08, SD=.75) and female students (M= 3.31, SD=1.12); t (55) = - .86, p = .4.

Post-Test

On the other hand, inspection of Q-Q Plots for post-test self-efficacy, while has also revealed normal distribution for both female and male students, it was concluded that there was homogeneity of variance as assessed by Levene's Test for Equality of Variances (corresponding P > .05). As a result, equal variances were assumed and the related independent t-test was run on the data as well as 95% confidence intervals (CI) for the mean difference to compare post-test self-efficacy in male students and female students. While female students IT self-efficacy scores continued to be higher than male students, the difference was not statistically significant in the post-test Self-efficacy for male students (M=3.4, SD=.71) and female students (M= 3.60, SD=.86); t (55) = - .84, p = .4.

Table 6.27 Independent Sample Mean Comparison between Pre and Post Test

	GENDER	N	Mean	Std. Deviation
SEA PRE	MALE	24	3.0972	.74522
	FEMALE	33	3.3131	1.14546
SEA POST	MALE	24	3.3750	.71094
	FEMALE	33	3.5556	.86066

Table 6.28 Independent Sample T-Test Comparison between Pre and Post Test

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference
SEA PRE	Equal variances assumed	4.143	**.047**	-.807	55	.423	-.21591
	Equal variances not assumed			**-.861**	**54.434**	**.393**	**-.21591**
SEA POST	Equal variances assumed	1.822	**.183**	**-.840**	**55**	**.405**	**-.18056**
	Equal variances not assumed			-.866	54.036	.391	-.18056

6.5.4 The Mann-Whitney Test Approach

The ranks table 6.29a provides information regarding the output of the Mann-Whitney U test and shows mean rank and sum of ranks for the two groups tested ('male' and 'female' treatment groups). This table is very useful because it indicates which group can be considered as having the higher self-efficacy, overall; namely, the group with the highest mean rank. In this case, the female group had the highest self-efficacy in pre-test and post-test alike.

Table 6.29b shows us the actual significance value of the test, specifically, the test statistic, *U* value, as well as the asymptotic significance (2-tailed) *p*-value. From this data, it can be concluded that self-efficacy in the treatment group was not statistically significantly higher for female students than the pre-test group ($U = 337$ & 342, $p = .337$ & $.377$).

Table 6.29 a & b Mann-Whitney Test

Ranks

	GENDER	N	Mean Rank	Sum of Ranks
SEA-pre-VAL	MALE	24	26.54	637.00
	FEMALE	33	30.79	1016.00
SEA-post-VAL	MALE	24	26.75	642.00
	FEMALE	33	30.64	1011.00

	SE PRE	SE POST
Mann-Whitney U	337.000	342.000
Wilcoxon W	637.000	642.000
Z	-.960	-.884
Asymp. Sig. (2-tailed)	.337	.377

6.6 Testing Other Hypothesis

Table 6.30 Testing Other Hypothesis Road Map

Research Question Component	Hypothesis #	Hypothesis Narrative
Does using the RWC learning model have a positive impact on students' self-efficacy in computer-based subjects?	**Hypothesis (H1)**	There will be a positive relation between learning experiences characteristics in RWC and technology self-efficacy.
Do re-designing "learning experiences" in SCCT using the RWC model ingredients make a significant difference in its impact on students' technology self-efficacy?	**Hypothesis (H1)** & **Hypothesis (H8)**	
Does using the RWC learning model have a positive impact on students' interest in computer-based subjects?	**Hypothesis (H2)**	There will be a positive relation between learning experience characteristics and technology outcome expectations.
Does the RWC learning model fit the SCCT framework?	**Hypothesis (H3)**	There will be a positive relation between technology self-efficacy and technology career interest.
Does the RWC learning model fit the SCCT framework?	**Hypothesis (H4)**	There will be a positive relation between technology outcome expectations and technology career interest
Does the RWC learning model fit the SCCT framework?	**Hypothesis (H5)**	There will be a positive relation between technology self-efficacy and technology outcome expectations.
Which ingredient of RWC-based ""learning experiences" is the most influential?	**Hypothesis (H7)**	Ingredient of RWC-based ""learning experiences" have differences in their impact on self-efficacy.
How does the impact of RWC model compare to traditional SCCT sources of self-efficacy?	**Hypothesis (H8)**	RWC ingredients have greater impact on self-efficacy than the four original SCCT sources.

6.6.1 Results Pertaining to Research Hypotheses *(H1, H2, H3, H4 and H5)*

Examining Relationships between the Four Constructs using Regression Analysis:

ANOVA regression analysis was carried out to test the five hypotheses *(H1, H2, H3, H4 and H5)* for all four variables involved: learning experiences characteristics, self-efficacy, outcome expectations and technology interest. Column headings in the regression table include the variable entered, the multiple correlations (R), the coefficient of determination (explanation power) (R2), the F value for the variable entered (F), the level of statistical significance for the variable entered (p), Spearman correlation coefficient (R) and its corresponding level of statistical significance for the variable entered.

Correlations for the measured constructs were supportive to all our enhanced SCCT hypotheses. Self-efficacy was positively and significantly related to technology interests, learning experiences characteristics and outcome expectations; coefficients ranged from .441 ($p < .01$), to .468 ($p < .01$), to .580 ($p < .01$), respectively. Outcome expectations also related positively and significantly to learning experiences characteristics and interests; coefficients ranged from .591 ($p < .01$) to .611 ($p < .01$), respectively. In all cases, the largest correlations between any two given constructs occurred between outcome expectations and interest. The correlation matrix is contained in Table 6.31.

Regressions were performed using learning experiences characteristics to predict self-efficacy and outcome expectations **(H1, H2).** Learning experiences characteristics accounted for a significant amount of variance in self-efficacy ($R2 = .219$, $F = 15.5$, $p < .01$) as well as variance in outcome expectations ($R2 = .349$, $F = 29.5$, $p < .01$). Also, regressions were performed using self-efficacy to predict interest in technology and outcome expectations **(H3, H5)**. Self-efficacy accounted for a significant amount of

variance in interest in technology (R2 = .194, F = 13.6, p < .01) as well as variance in outcome expectations (R2 = .336, F = 27.8, p < .01). Outcome expectations accounted for a significant amount of variance in interest in technology (R2 = .373, F = 32.8, p < .01) **(H4)**. As shown in Table 6.31, F-test values for all hypotheses were all statistically significant p < .01 and were greater than the critical value *(df1=1, df2=55, F critical 4.02).*

The research question was: Does the RWC learning model fit the SCCT framework? As a result of these tests, all five hypotheses *(H1, H2, H3, H4 and H5)* were substantiated since the null hypotheses were rejected based on R and F results. This is an obvious positive answer to this research question.

Table 6.31 Regression Testing to Examine Relationships among the Four Constructs

SPSS Out Examined Constructs	Hypothesis	Pearson Correlation *r*	Power of Explanation r^2	F- Test	*P – Value* (ANOVA)	Spearman R (p < .05)	*Test Result*
LEC X SE	***(H1)***	.468	.219 **(21.9%)**	15.5	< .001	.389	Reject Null
LEC X OE	***(H2)***	.591	.349 **(34.9%)**	29.5	< .001	.581	Reject Null
SE X ITI	***(H3)***	.441	.194 **(19.4%)**	13.26	.001	.337	Reject Null
OE X ITI	***(H4)***	.611	.373 **(37.3%)**	32.8	< .001	.541	Reject Null
SE X OE	***(H5)***	.580	.336 **(33.6%)**	27.8	< .001	.498	Reject Null

**For df1=1, df2=55, F critical =4.02*

6.6.2 Exploring which Ingredient of RWC-Based "Learning Experiences" is Most Influential (H7)

ANOVA regression analysis was performed to test the multi-test hypothesis *(H7)* for all four variables involved: social integration, sense of ownership, sense of self-importance and self-efficacy. Column headings in the regression table 6.32 include the variable entered, the multiple correlations (R), the coefficient of determination (explanation power) (R2), the F value for the variable entered (F), and the level of statistical significance for the variable entered (p).

Correlations for the measured constructs with self-efficacy were not statistically significant except for social integration ($p < .05$). Self-efficacy was positively but not significantly related to social integration, sense of ownership, sense of self-importance; coefficients ranged from .120 ($p > .05$), to .134 ($p > .05$), to .268 ($p < .05$), respectively. Social integration related positively and significantly to sense of ownership and sense of self-importance; coefficients ranged from .320 ($p < .05$) to .266 ($p < .05$), respectively. In all cases, the largest correlations between any two given constructs occurred between social integration and self-efficacy. The correlation matrix is contained in Table 6.33.

Regressions were performed using social integration, sense of ownership, sense of self-importance to predict self-efficacy (H7). Social integration accounted for more significant amount of variance in self-efficacy ($R2 = .072$, $F = 4.258$, $p < .05$). However, regressions that used sense of ownership ($R2 = .018$, $F = 1.00$, $p > .05$) and sense of self-importance ($R2 = .014$, $F = .804$, $p > .05$) to predict self-efficacy were not statistically significant and did not account for a significant amount of variance in self-efficacy. The combined effect of social integration, sense of ownership and sense of self-importance accounted for significant amount of variance in self-efficacy ($R2 = .219$ (21.9%), $F =$

15.466) and it is not statistically significant ($p < .001$). As shown in Table 6.32, only social integration F-test value was statistically significant $p < .05$ and was greater than the critical value *(df1=1, df2=55, F critical 4.02).*

Table 6.32 Testing the Impact of RWC-Components on Self-efficacy

SPSS Out Examined Constructs	Hypothesis	Pearson Correlation *r*	Power of Explanation r^2	F- Test	*P – Value* (ANOVA)
Social Integration X SE	***(H7)***	.268	.072 (7.2%)	4.258	.044
Sense of Ownership X SE	***(H7)***	.134	.018 (1.8%)	1.001	.321
Sense of self-importance X SE	***(H7)***	.120	.014 (1.4%)	.804	.374
RWC Combined X SE	***(H7)***	.468	**.219 (21.9%)**	**15.466**	**. < .001**

Stepwise multiple regression analyses were used to determine the degree of variation in self-efficacy among students' accounted for by the combination of the social integration, sense of ownership and sense of self-importance variables and by each variable individually as seen in Tables 6.32 and 6.33.

Table 6.33 Step-Wise Regression Analysis

Step-wise Regression : Excluded Variables

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
						Tolerance
1	Sense of Ownership	-.102[b]	-.742	.461	-.100	.898
	Sense of Self-Importance	-.047[b]	-.343	.733	-.047	.929

Table 6.34 Pearson Correlations of Ingredients of RWC-Based "Learning Experiences"

Correlations

		Social Integration	Sense of Ownership	Sense of Self-Importance	SELF-EFFICACY POST
Social Integration	Pearson Correlation	1			
	Sig. (2-tailed)				
Sense of Ownership	Pearson Correlation	**.320***	1		
	Sig. (2-tailed)	.015			
Sense of Self-Importance	Pearson Correlation	**.266***	**.240**	1	
	Sig. (2-tailed)	.045	.072		
SELF-EFFICACY POST	Pearson Correlation	**.268***	**-.006**	**.028**	1*
	Sig. (2-tailed)	.044	.964	.836	

6.6.3 How Does The Impact of RWC Model Compare to Traditional SCCT Sources of Self-Efficacy? (H8)

ANOVA regression analysis was performed to test the hypothesis *(H8)* for the combined impact of the four sources of self-efficacy in SCCT (*accumulative accomplishments, vicarious learning, social persuasion and emotional arousal)* on self-efficacy. Column headings in the regression table 6.35 include the variables entered, the multiple correlations (R), the coefficient of determination (explanation power) (R2), the F value for the variable entered (F), and the level of statistical significance for the variable entered (p).

Regressions were performed twice using traditional SCCT sources versus RWC sources to predict self-efficacy (H8). Traditional SCCT sources accounted for significant amount of variance in self-efficacy ($R2 = .11$, $F = 6.798$, $p < .05$). Yet, regression analysis also resulted in even better outcomes with RWC sources which were more statistically significant ($R2 = .219$, $F = 15.466$, $p < .001$).

In answering the research question pertaining to comparing the impact of RWC Model to traditional SCCT Sources on self-Efficacy, we can reject H8 null hypothesis and conclude that RWC sources have outperformed traditional SCCT sources in improving technology self-efficacy for adolescents.

Table 6.35 ANOVA Comparison between Traditional and RWC Sources of Self-Efficacy

SPSS Out Examined Constructs	Hypothesis	Pearson Correlation *r*	Power of Explanation r^2	F- Test	*P – Value* (ANOVA)
Four Traditional Sources of Self-Efficacy	***(H8)***	.332	**.110 (11%)**	**6.798**	**.012**
RWC Learning Experiences	***(H8)***	.468	**.219 (21.9%)**	**15.466**	**< .001**

6.7 Summary of Research Questions and Hypotheses Tests

Based on the tests and statistical analysis in Chapter 6, most hypotheses are found to be supported with statistical significance and most research questions are found to be significantly positive. Table 6.36 summarizes the Chapter 6 results of the hypotheses and research questions tests.

Table 6.36 Research Questions and Hypotheses Tests Results

Research Question Component	Hypothesis #	Hypothesis Narrative	Result
Q1-A Does using the RWC learning model have a positive impact on students' self-efficacy in computer-based subjects?	**(H1)**	There will be a positive relation between learning experiences characteristics in RWC and technology self-efficacy.	Supported
Q2 Do re-designing "learning experiences" in SCCT using the RWC model ingredients make a significant difference in its impact on students' technology self-efficacy?	**(H1)** & ***(H8)***	*Narrative provided above and below.*	Supported
Q1-B Does using the RWC learning model have a positive impact on students' interest in computer-based subjects?	**(H2)/*(H1)*** ***(H3)/(H4)***	There will be a positive relation between learning experience characteristics and technology outcome expectations.	Supported
Q3 Does the RWC learning model fit the SCCT framework?	**(H3)**	There will be a positive relation between technology self-efficacy and technology career interest.	Supported
	(H4)	There will be a positive relation between technology outcome expectations and technology career interest	Supported
	(H5)	There will be a positive relation between technology self-efficacy and technology outcome expectations.	Supported
Q4 Does using the RWC model reduce the gender gap between boys and girls in their computer-based self-efficacy?	**(H6)**	The positive relationship between learning experiences and self-efficacy will not vary significantly between male and female students**.**	Partially supported due to statistical significance
Q5 Which ingredient of RWC-based ""learning experiences" is the most influential?	**(H7)**	Ingredient of RWC-based ""learning experiences" have differences in their impact on self-efficacy.	Supported *(Social Integration was the factor with most impact)*
Q6 How does the impact of RWC model compare to traditional SCCT sources of self-efficacy?	**(H8)**	RWC ingredients have greater impact on self-efficacy than the four original SCCT sources.	Supported

CHAPTER SEVEN

CONCLUSIONS, DISCUSSION AND FUTURE WORK

7.1 Overview of the Study

Chapter 7 starts with a brief overview of the study. The importance, objectives, and intended contributions to STEM-based computer technology education are restated. Key findings and conclusions derived as a result of the quantitative analyses in Chapter 5 and Chapter 6 are illustrated. The findings are discussed as they relate to the social cognitive career theory (SCCT) and related educational psychology theories, future research, and best practices. Chapter 7 ends with a summary of this study.

An assessment of the literature demonstrated that there are serious gaps in designing motivational learning experiences for upper middle school, high school, freshmen and sophomore college students especially as they relate to computer technology education in STEM areas. Such gaps become more severe with female adolescents as switching female students' interest to computer technology requires extra efforts. Social cognitive career theory (SCCT) researchers frequently associated four external sources of self-efficacy to boosting students' interest (i.e.: accumulative accomplishments, vicarious learning, social persuasion and emotional arousal) without consideration for social integration or personal relevance. An extensive literature review on teaching strategies and self-efficacy showed that the issue was studied primarily by examining experiential learning and teacher-owned factors that contribute to student enrollment rates. In this study, the focus was on learning experiences dimensions that had more to do with students-owned constructs than external factors or demographics.

Moreover, this study shifted the research focus in SCCT to examine the design of "learning experiences characteristics" to boost self-efficacy and interest in computer technology among adolescents as opposed to studying the impact of self-efficacy on other constructs assuming that the four traditional sources of self-efficacy are sufficient. The study was carried out in the context of an assessment for an existing learning model (i.e., Real World Connections Program at NJIT or RWC) that has created a unique recipe to boost adolescent's self-efficacy and interest in STEM-related computer technology education. While the study aimed at assessing the effectiveness of the RWC model in the light of the SCCT theory, the model, on the other hand, offered an enhanced approach to improve SCCT self-efficacy sources. Subsequently, the hypotheses were formulated to test the exchangeable impact of SCCT and RWC on one another.

7.2 Major Findings and Conclusions

In Chapter 6 of this study, numerous statistical findings were reported after investigating relationships among the study variables. The conclusions drawn from the statistical analyses and considered most important for subsequent discussion are presented below.

7.2.1 First Major Finding

The quality of the instruments developed through four rounds of refinements for this study was verified by the outcomes from the sample used despite sample size limitations as these instruments were proven to be both valid and reliable. These instruments were originally validated explicitly in Chapter 5 using multiple methods. Then they were further substantiated implicitly through the consistency of the results of our statistical tests throughout Chapter 6 which also supported most of the hypotheses of our study.

Conclusions:

1- The study instruments can be confidently replicated for future research and theory evolution, once few refinements are applied. Technology self-efficacy, technology outcome expectations and technology interest constructs measures need little or no refinement while learning experiences characteristics construct needs extra refinement.

2- Learning experiences characteristics has at least three dimensions. These dimensions are social integration, sense of ownership and sense of self-importance. However, social integration was the dimension with highest degree of validity and power of explanation.

7.2.2 Second Major Finding

The hypothesized relationships between the independent variables *(learning experiences characteristics, technology self-efficacy, and technology outcome expectations)* and technology interest were substantiated.

Conclusions:

1- Using RWC learning model has a positive impact on students' self-efficacy in computer technology- based subjects.

2- Re-designing "learning experiences" in SCCT by using RWC model ingredients make a significant difference in its impact on students' computer technology self-efficacy.

3- Using the RWC learning model has a positive impact on students' interest in computer-based subjects.

4- RWC learning model matches the expectations of the SCCT framework. On the one hand, it enhances self-efficacy sources which increase self-efficacy and outcome expectations alike. On the other hand, it maintains the impact of self-efficacy and outcome expectations on interest. This ensures the indirect positive correlation of the RWC model with technology interest.

7.2.3 Third Major Finding

There are limited differences among student groups classified by gender, on the measures of the self-efficacy variable included in the study.

Conclusions:

Using the RWC model has a limited impact on reducing the gender gap between boys and girls in their computer-based self-efficacy

7.2.4 Fourth Major Finding

The RWC variables utilized in the study appear to be more powerful predictors of high school and early college student's interest in computer-based technology than variables derived from SCCT traditional sources of self-efficacy.

Conclusions:

1. Variables included in SCCT traditional model to predict and explain students' interest in computer-based technology are not as potent predictors as some of the RWC-based variables used in this study.

2. Future studies of adolescents interest in computer-based technology associated with STEM areas should consider the use of RWC variables to explain or predict student interest in computer-based technology.

7.2.5 Fifth Major Finding

Social integration was the most powerful predictor of high school and early college student's self-efficacy in computer-based technology as opposed to the limited power of explanation posited by other RWC interventions such as sense of ownership and sense of self-importance.

7.3 Discussion of "Real World Connections (RWC)" Program Evaluation Results

As stated earlier, the main purpose of this study was to evaluate an existing learning model (RWC) within the context of the Social Cognitive Career Theory (SCCT) and explore the potentials of this model to enhance self-efficacy sources as the collective impact of these sources is the key generator of the chain of effects across the entire SCCT framework toward boosting and directing interests, intentions and career choices.

In our study, RWC model was plugged into the SCCT framework as alternative recipe for traditional self-efficacy sources. This approach allowed us to explore the effectiveness of RWC sources on self-efficacy and outcome expectations alike and subsequently their indirect influence on interest in computer technology areas related to STEM. Additionally, this approach facilitated an examination of how SCCT framework itself will be impacted after incorporating RWC sources of self-efficacy into its learning experiences construct.

7.3.1 A Zoom-In into Results

Generally speaking, this study produced results which corroborate the findings of a great deal of the previous work in this field. Both descriptive and inferential results in chapter 6 show that post-test student' scores for technology self-efficacy, outcome expectations and interest were significantly higher than corresponding pre-test scores for the same group as a result of using Real World Connections program interventions versus traditional teaching methods.

Correlation results in Table 6.2 have shown that outcome expectations correlated higher than other constructs with RWC learning experiences characteristics. This can be attributed partially to students' perception of RWC model potential outcomes as they

relate to students' expected academic and professional careers. Additionally, RWC program is offered under a university roof and it heavily engages university faculty, industry professionals and advanced university peers which gives the impression that its interventions are driven by resources that support students' career choices and interests. The group was also composed of three sub-groups that were not homogeneous in their demographics, age groups or prior experience with the RWC model. This could be another influential factor as the high school group, while it was the youngest, was the most exposed to similar prior interventions.

One unanticipated finding was that outcome expectations also correlated higher than self-efficacy with technology interest. This finding, however, can be explained by an almost identical correlation between self-efficacy and outcome expectations. Consequently, outcome expectations power of explanation of variance in interest can be understood by realizing the collective impact of learning experiences and self-efficacy on interest.

The current study found that RWC sources of self-efficacy had more positive impact on self-efficacy than SCCT four traditional sources alone. However, some traditional sources measures lack sufficiency in terms of valid measures. Moreover, the two-hour experiment was relatively very short as opposed to a full scale multiple- month RWC program. The time factor may have had a significant impact on the effectiveness of some RWC intervention mechanisms that require sufficient amount of time to produce tangible results such as sense of ownership, sense of self-importance, emotional relevance and social bonding.

On the question of influential RWC ingredients, this study found that social integration has explained much more variance than sense of ownership and self-importance individually or combined as in table 6.32, 6.33 and 6.34. While it was highly predicted that the social factors are dominant in RWC interventions breakdown, sense of ownership was expected to score much higher. This can be largely attributed to the limited number of validated questionnaire items that measure sense of ownership and also to the short experimental duration which makes such realizations not as obvious.

It is somewhat surprising that this study found much higher correlation between social integration and both sense of ownership and sense of self-importance than self-efficacy. However, the ANOVA showed that these results were not statistically significant. It is important to note that the grouping of "Learning experiences characteristics" variables into three sub-constructs was a result of exploratory factor analysis which did not match the presumed dimensions of this construct.

Another important finding was that the correlation between the learning experiences characteristics construct and self-efficacy was much better in the final study as opposed to pilot studies as seen in Tables 6.2 and 6.3. This indicates that the refined instruments developed for the final study mirrored RWC interventions more representatively.

On the question of examining the impact of the RWC model on reducing the gender gap, the study found that RWC interventions have improved self-efficacy for both genders alike as opposed to traditional models that tend to have a much bigger impact on male students than female students. The most interesting finding was that female students with higher self-efficacy improved more than female students with lower self-efficacy

while male students with lower self-efficacy benefited more than male students with higher self-efficacy.

Contrary to expectations, this study did not find a significant difference between male and female students in self-efficacy. The reason for this is not too clear but it may have something to do with high degree of self-efficacy among a good percentage of female students in pre-test scores. There are several possible explanations for this result. The possible interference of other demographic characteristics or person inputs cannot be ruled out. A possible explanation for some of our results may be the lack of adequate time due to the shortened duration of the experience in the experimental design which can significantly impact RWC social interventions that are most influential in regard to female students.

7.3.2 Experiment Challenges

The final study was able to overcome most of the threats to internal and external validity alike. Since one of the key challenges in our pilot studies was subjects' poor ability in recalling their initial attitude after they have been exposed to a treatment due to history and maturation effects, the design of the final experiment provided a time boxed treatment that concludes the entire experience within a maximum of two hours versus several months. This design did not only overcome memory effects but also increased the size of participation as it has ensured participants availability within a short duration and excluded any external factors that could have impacted the effectiveness of the experiment in less-controlled environment settings.

However, the side effect of such a highly controlled experiment is that short durations do not allow strong social bonding to form, or senses of ownership and self-

importance to mature which limits the anticipated impact of RWC interventions to levels below what is usually seen in regular program settings. The influence of this side effect was obvious in our test results in terms of low statistical significance of some RWC interventions.

7.3.3 Issues with Experimental Design

The first step of our experimental design was to identify the independent, dependent, and nuisance variables and determine the way in which the statistical aspects of our experiment are to be carried out. The primary goal was to test the applicability of the Social Cognitive Career Theory framework by establishing a causal connection between learning experiences characteristics and each of self-efficacy and outcome expectations directly and between learning experiences characteristics and technology interest via self-efficacy and outcome expectations. The second goal was to extract the maximum amount of information with the minimum cost of resources.

Through random assignment, a diverse sample of participants across three different groups that are within the same age group and the limited computer technology exposure in the targeted areas but different in backgrounds was used, demographics and affiliations where at the time of assignment they were probabilistically similar on the average. This was ensured in part by selecting the highly diverse high school summer group where students come from all geographical areas in the state of New Jersey and also by inviting non-computer science freshmen students across multiple disciplines. The weakness in this sample was the fact that some of the summer students had prior exposure to the RWC model nut not in the treatment areas that were tested.

In this experiment the one-group pretest-posttest design with one treatment level was used. The dependent variables (self-efficacy, outcome expectations and technology interest) were measured before and after the RWC treatment level is presented. The design enabled us to compute means differences in which the pretest and posttest means are measured with the same precision. Each block in the design contained one participant who is observed two times provided that the construct on which participants are matched is correlated with the dependent variable.

One problem with our one-group pretest-posttest design was that while a pretest may have familiarized the subjects with the topic increasing attention, it may have been also a factor in diminishing their sensitivity to the topic resulting in reducing the effectiveness of the treatment. This fact can explain why few subjects did not score similar to their peers in terms of self-efficacy after the treatment was introduced.

Another problem is associated with the relatively high pre-test scores for a good percentage of the participants due to the fact that we were drawing this sample from either a group with high appreciation to RWC program or a group that is studying in a STEM-based school with high emphasis on computer technology. As a result, statistical regression could become a threat to the internal validity of our experiment as the mean-pretest scores are unusually high because it operates to increase the scores of the subjects on the posttest if the mean-pretest score is unusually low and vice versa.

Finally, since one-group posttest-only design is at its best in controlled settings where the time interval between the pretest and posttest is relatively short, the internal validity of our experimental design can be upgraded by incorporating other pretest levels such as a level with traditional sources of self-efficacy alone. This proposed approach for

future work is the one-group double pretest-posttest design.

7.4 Implications for Future Work

7.4.1 Implications for Theory

This study produced results which corroborate the findings of a great deal of the previous work in the fields of constructivism, social cognitive learning and career development theories. The findings of the current study are consistent with those of Hackett, Lent and Brown (1987, 1994) who found that the role of self-efficacy and outcome expectations is crucial in influencing interest and career choices and emphasized on the triadic reciprocal correlations between personal attributes, external factors and overt behavior as illustrated in Chapter 2 of this study.

The importance of this study to theory is multi-fold. On the one hand, this study contributes to the existing Social Cognitive Career Theory (SCCT) in regard of the constructs of self-efficacy, outcome expectations and interest by investigating the role the redefined "learning experiences characteristics" variable plays with each construct based on incorporating Real World Connections Program interventions versus traditional sources of self-efficacy proposed by Bandura (1977, 1994) two decades ago.

On the other hand, because computer technology-based self-efficacy, outcome expectations and interest in adolescents' STEM-related education is relatively a new research area in the literature, this research contributes to a basic understanding of technology-based/ STEM-driven Social Cognitive Career Theory. The study has also developed highly validated instruments that can be reused in future theoretical research for pre-college and college settings alike.

Additionally, the combination of findings provides some support for the conceptual premise and best practices observations that social integration and personal relevance will reduce the gender gap in technology self-efficacy regarding STEM education. Finally, study findings have important implications for developing new theoretical models for the sources of self-efficacy, rather than continuing to limit research efforts to the four traditional sources *(i.e., Accumulative accomplishments, vicarious learning, social persuasion and emotional arousal).*

It is also implied that bridging SCCT gaps or providing intervention mechanisms is equivalent to providing contextual supports to help increase coping efficacy, resilience and ability to overcome barriers. While the SCCT theory in its latest versions sits at the top of career development theories as the most comprehensive, reflective and integrative theory around, the theory still has some gaps that need to be addressed and bridged. Future studies on the current topic are therefore recommended.

Implications for the RWC model on various learning and career development theories reviewed in Chapter 2 are discussed in the following sections.

The Connections of this Research to Information Systems Theory

Information systems integrate information technology solutions and business processes to match the information needs of businesses and other enterprises. This study presents a multidisciplinary research that links information systems theory to other disciplines. The purpose of this research was to evaluate and evolve a holistic instructional system where high motivation in knowledge development and information processing is a key metric in designing effective instruction and successful learning environment. This system is a type of instructional systems design (ISD) which is defined as the “practice of creating

instructional experiences which make the acquisition of knowledge and skills more efficient, effective and appealing".

This instructional system acts as a learning organization in the education domain by using an adaptive collaboration system with high degree of social intelligence. In this system, there is high synergy between the learning organizations and information technology.

The newly proposed enhanced SCCT framework is an integration of key ingredients of several information systems theories including system theory, TAM, "Unified Theory of Acceptance and Use of Technology" and "connectivism" as reviewed in Chapter 2 of this study and Table 7.1.

On the other hand, a revised Real World Connections Program's (RWC) learning system will be proposed as a practical implication of this dissertation. This system will use a computer-based information system in educational environments to enable peer mentorship, boost social bonding, and facilitate student, learning, data and communication management. The new instructional system will represent a social entrepreneurship organization where the social value represents the return on investment in time and resources. This organization will build a technology-driven pipeline from middle school to industry.

Additionally, the emphasis in this research was on improving self-efficacy in technology-driven STEM fields which is part of human resources management in the field of management information systems.

Table 7.1 Study Connections to and Overlap with Information Systems Theory

Study Area	Information Systems Theory	Link between study and IS research
Instructional Design Process (ARCS model)	System Development Life Cycle (SDLC)	Development phases similarity (analysis, design, development, implementation, evaluation, and management). See Reiser (2001) and Figure 2.2.
Self-Efficacy	Technology Acceptance Model (TAM)	Perceived ease of use, perceived usefulness and users' belief in positive outcomes are not sufficient as determinants of technology usage by users without incorporating users' belief in their own capabilities to use technology (Igbaris and Iivari, 1995).
Social Cognitive Career Theory (SCCT)	Technology Acceptance Model (TAM 2)	Re-introducing an extended version of the TAM model as a career development model in IT-related fields (Section 2.3.1).
Social Cognitive Career Theory (SCCT)	Unified Theory of Acceptance and Use of Technology (UTAUT)	Performance expectancy, effort expectancy, social influence, and facilitating conditions are UTAUT constructs where at least three of these four factors are strongly correlated one way or another with the self-efficacy theory and SCCT (Section 2.3.2)..
Designing Learning Environments (Instructional Design)	Design of Interactive Systems	From a global perspective, Users in these systems are students who are receiving the interactive instruction.
Social Learning Theory	Cooperative learning	Studying the impact of cooperative learning and team work in the Information Systems teaching environment including cultural bidirectional influences on IS teaching.
Motivational Theories, Self-efficacy, Outcome Expectations and Interest constructs	Human Resources Management and Project Management in an Information System	Organizational effectiveness through human resources empowerment and effective HR management.
Redefining the Social Cognitive Career Theory (SCCT)	Business Process Re-engineering	Re-defining the inputs of the "learning experiences" process to produce better self-efficacy, outcome expectations and interest.

7.4.2 Implications for Future Research

The study findings emphasize the significance of revising traditional sources of self-efficacy especially as it relates to instructional design of environments involving computer technology education for adolescents, especially female students. Previous research on learning experiences design indicates that it is a strong predictor of subsequent self-efficacy and outcome expectations which in turn predict the degree of student's interest in a subject (Bandura, 1977, 1994; Lent, Hackett, et al., 2000; Lent et

al. (2003); Byars & Hackett, 1998). While empirical evidence was in support of the predictability power of self-efficacy for science- and math- related interests (Lopez et al, 1997), much more research is needed to examine its influence on women's interest in technology related fields.

By studying learning experiences characteristics (or sources of self-efficacy) more thoroughly, researchers can gain information about student's interest that might be used to guide instructional design of new effective technology-focused learning environments. By studying the uniqueness of adolescent women in regard to technology education, educators will have a chance to make an impact on increasing women participation in technology related fields.

Also, by realizing that the differences in learning theories, instructional design theories and career development theories are in the most part complementary to each other rather than contradictory, researchers will explore new ways to build more holistic approaches to embrace the integration of all these theories in a unified framework.

It is interesting to note that the Real World Connections program (RWC) usually attracts a good percentage of talented students with strong parental support. These types of students are anticipated to have already built some degree of confidence, coping efficacy, barriers perception and resilience in prior learning experiences. Future research should focus on a broader population of students across diverse demographics to enhance the degree of replication of the study.

Another important finding was that the RWC interventions have improved self-efficacy for both genders alike as opposed to traditional models that tend to have a much bigger impact on male students than female students. These results provide further

support for the hypothesis that using the revised sources of self-efficacy will reduce the gender gap. One of the issues that emerge from these findings is that female students with higher self-efficacy improved more than female students with lower self-efficacy while male students with lower self-efficacy benefited more than male-students with higher self-efficacy. Further studies, which take these demographics and person-factors (such as "contextual affordances") into account, will need to be undertaken.

While our main goal in this study was to study the impact of an RWC-empowered learning experiences design on technology interest via self-efficacy and outcome expectations, further research should be done to investigate the impact of the incorporation of all other SCCT constructs such as additional person inputs, background contextual affordances, intentions and career decisions as well. This may provide a more accurate picture of the intervening and moderating influences in the study and probably offer additional explanation for some of our unexpected results.

7.4.3 Implications for the Education Practice

Beyond the need to conduct future studies with revised "Learning Experiences" instruments, increase the sample size and improve our sampling strategies, there is abundant room for further progress in improving the current intervention mechanisms in the Real World Connections model in the light of our findings as follows:

- Findings from this study highlight the importance of designing more innovative learning experiences for female adolescents in computer technology areas. Statistical results related to gender's impact on self-efficacy suggest that such interventions should also address individual differences between female students including parental support, prior experiences, cultural backgrounds and contextual

affordances.

- Since the program interventions had a higher correlation with outcome expectations than self-efficacy for both genders, developing strategies to increase technology self-efficacy become imperative. Our extensive literature review suggests that we should study the impact of perceived barriers, supports, coping efficacy and barrier attribution on self-efficacy. (Albert and Luzzo, 1999; Lindley, 2005; Smith, 2004). Such variables must also be incorporated in additional research questions to be asked in future studies. We should also utilize the fact that not only women who chose investigative or conventional careers had much higher perceptions of career barriers as opposed to women who chose social careers but also they have strong persistence in those fields despite the perceptions of considerable barriers they have to overcome (Lindley, 2005; Smith, 2004).
- Several questions remain unanswered at present including the low correlation of sense of ownership and sense of self-importance with self-efficacy while they correlated higher with social integration. Since these particular constructs usually exist at high levels in the RWC program, this suggests that the design of the experiment should allow more time for such interventions to be realized. However, the significance of social integration should also be utilized as the most capable factor in explaining variance in self-efficacy for male and female students alike. The utilization of social integration implies the following actions that need to be taken:
    - Maintain social persuasion and vicarious learning as significant social elements among traditional self-efficacy sources. This implies the highly encouraged involvement of industry, university and community people as

mentors and endorsers of students work. It also implies the significance of role modeling in students' lives from peers to champions in real world organizations as well as using the dramatization technique through stories, movies, theater and other creative means of illustration to incorporate strong emotions toward values with our intervention mechanisms.

- Put more emphasis on team work and cross-functional/cross-discipline collaboration work across Real World teams, program task-forces and program community of participants.
- Enhance social bonding activities since the ability to make friends and build value-added social connections in the program has always played an instrumental role in RWC students' satisfaction, retention, motivation and dramatic shifts in career choices.

- Since RWC has been proven statistically to be an effective learning model in increasing students' interest in technology–related fields, there are numerous practical implications with broader impact for education which focus on practices related to instructors, school system administrations and community.

One implication is that designing learning environments should be socially-driven where students can achieve self-efficacy through collective efficacy, social bonding, social support and learning by doing and by watching inspiring examples. For instance, doing technology development in a realistic social context means that students will solve real-world problem within social dimensions and use technology as part of the solution. For example, a food pantry *(contextual learning)* needs to distribute donated meals fairly *(social motivation).* The solution might include

database design and website development. Effective learning by doing requires a team of students to work collaboratively *(collective efficacy)* and independently *(sense of ownership and self-importance)* to develop some understanding of all the component activities *(knowledge defragmentation),* and to do computer software development in this larger context while being supported by mentors from university, industry and community *(social persuasion and vicarious learning).* Projects include all participants (the project team, client and end users), as well as the organizations to which the participants belong. (A Real World Connections "virtual company" simulates a computer technology company or department). Real-world problem solving increases the interest students in technology, especially female students and others who prefer problems with social dimensions. Learning in a context that includes technology professionals and managers, and sometimes STEM professionals, helps students develop a professional network and get recommendations from professionals and managers.

Another broader implication from the success of the RWC model is the importance of providing supportive scaffolding for student project-based learning environments. Scaffolding includes instruction, coaching and other inputs that facilitate learning and doing in projects, as well as a learning setting that is supportive and information-rich for students. Real World Connections provides project-related scaffolding:

- Workshops covering project-related concepts, methods and tools,
- A project manager for each project (a *Real World Connections* student),
- A coach and a SME for each project.

Table 7.2 provides some practical implications of this study for multiple stakeholders.

Table 7.2 Practical Implications Categorized by Stakeholder

Stakeholder	Finding	Practical Implication
Technology Instructors	Social integration was the most powerful predictor of high school and early college student's self-efficacy in computer-based technology.	When delivering technology courses to increase participation of women, courses should incorporate emotional relevance, social bonding and multidisciplinary aspects that link technology to people.
School Administrators	The hypothesized relationships between the independent variables (learning experiences characteristics, technology self-efficacy, and technology outcome expectations) and technology interest were substantiated.	Schools should incorporate RWC interventions into regular classroom with STEM and Technology focus, create after-school programs or start new schools that utilize such interventions .
Industry Executives	Social integration was the most powerful predictor of high school and early college student's self-efficacy in computer-based technology.	The role of industry role modeling and industry support is crucial. On the one hand, it provides opportunity to students. On the other hand, it brings needed HR that match industry needs.
Education Researchers	The quality of the instruments developed through four rounds of refinements for this study was validated and verified.	Utilize this study measures for technology self-efficacy, technology outcome expectations and technology interest with confidence in future studies.
	Re-designing "learning experiences" in SCCT by using RWC model ingredients make a significant difference in its impact on students' computer technology self-efficacy.	Explore SCCT implications in the light of revised sources of self-efficacy beliefs including but not limited to the four sources identified in 1977.
	There are limited differences among student groups classified by gender, on the measures of the self-efficacy variable included in the study.	-In future research to test RWC-like models, more time should be allowed to let time-driven interventions mature. -In future research, women with prior interest in technology should not be part of the pre-test group.

7.5 Limitations of the Study

There were several limitations within this study. It was difficult to run the experiment online since parents' approval is required for IRB approval which made the sample size option logistically infeasible and limited participation volume. The students' age was also a challenge in survey design and instrument wording since students may not be familiar with some terminologies or concepts used in the survey.

In the first two pilot studies, students were asked to report their strength of interest before and after their RWC program experience, which was a threat to the validity of their responses since had to deal with their long-term memory and recall their feelings prior to the program experience after completing it. Obviously, a vast majority of students have limited ability to recall their previous feelings or perceptions long after they have been exposed to a new treatment or experience. A solution to this problem was to create a short term experience that minimizes the impacts of history, maturation and mortality factors on internal validity.

The final study was able to overcome many of the earlier threats to internal and external validity alike. Since one of the key challenges in our pilot studies was subjects' poor ability in recalling their initial attitude after they have been exposed to a treatment due to history and maturation effects, the design of the final experiment provided a time boxed treatment that concludes the entire experience within a maximum of two hours versus several months. This design did not only overcome memory effects but also increased the size of participation as it has ensured participants availability within a short duration and excluded any external factors that could have impacted the effectiveness of the experiment in less-controlled environment settings.

Other strengths of the final experimental design include: a matching design to the targeted age group which eliminates the impact of irrelevant populations beyond the scope of this dissertation; inviting multiple diverse groups of students that meet the broad characteristics of the same population at different times which increases cluster-based randomization and supports the generalizability of the study in terms of external validity; using a different sub-topic with each group while maintaining the computing scope and the similarity of the computing application which rules out that the intervention impact was due to the level of complexity or difficulty of the topic introduced; teaching a different skill within the same scope in the post-test intervention to reduce the interaction effect with the pre-test method; using different people at similar training levels to administer the experiment while maintaining the overall supervision to balance between eliminating experimenter biases and standardization to ensure the most consistent measurement of perceived attitudes.

However, there are several side effects of such a highly controlled experiment including short durations which do not allow strong social bonding to form, or senses of ownership and self-importance to mature which limits the anticipated impact of RWC interventions to levels below what is usually seen in regular program settings. The influence of this side effect was obvious in our test results in terms of low statistical significance of some RWC interventions.

A notable limitation is the absence of a control group within the study which is the case with any pretest-posttest experimental design. This limitation impacts the ability of this study be generalized to the population of interest which is a threat to external validity. On the other hand, it makes it difficult to determine if improvements were based

solely on the new treatment which is a threat to internal validity. In other words, A pre-test/ post-test design with one group is not as effective in predicting causal effects as a pre-test, post-test design that based on both a control group and an experimental group and. Basing the treatment on only one group, may suggest that other confounding variables have interacted between the pre-test and the post-test that influenced post-test outcomes.

Another problem with our one-group pretest-posttest design was that while a pre-test may have familiarized the subjects with the topic increasing attention, it may have been also a factor in diminishing their sensitivity to the topic resulting in reducing the effectiveness of the treatment. For example, students exposed to alternate forms of the test may perceive things better than those exposed to the test for the first time especially students who had long-term experience in the large scale RWC program and they may also discuss the test/instrument between pre and post times which may be reflected in their responses from a social perspective.

Also, a problem is associated with the relatively high pre-test scores for a good percentage of the participants due to the fact that we were drawing this sample from either a group with high appreciation to RWC program or a group that is studying in a STEM-based school with high emphasis on computer technology. As a result, statistical regression could become a threat to the internal validity of our experiment as the mean-pretest scores are unusually high because it operates to increase the scores of the subjects on the posttest if the mean-pretest score is unusually low and vice versa.

Particular characteristics of a certain group such as the high school or freshmen college group may generate an interaction of selection and treatment which may affect

reaction to the treatment versus other groups. – Perceptions reported on the posttest survey may be different as a result of the fact that the participants know that they are being studied due to reactive arrangements. This fact may explain why few subjects did not score similar to their peers in terms of self-efficacy after the treatment was introduced.

Since one-group pre-test/posttest design is at its best in controlled settings where the time interval between the pretest and posttest is relatively short, the internal validity of our experimental design can be enhanced by incorporating other pretest levels such as a level with traditional sources of self-efficacy alone. This proposed approach for future work is the one-group double pretest-posttest design.

It is also suggested that future research may carry out a follow-up experiment with a larger sample size which will enable us to breakdown the group into multiple groups, including a control group that receives both pre/post surveys but does not participate in the treatment X. This takes this experiment to a new level of true design called Pretest-Posttest Control Group Design.

Another suggestion would be conducting a series of pretest/posttest experiments at regular intervals which will allow repeated measures. All these suggestions can improve subject assignment randomization in experimental design, to properly minimize the influence of confounding variables. Through incorporating multiple rounds of pretests and posttests, many of the problems present in the one-group pretest-posttest design can be avoided since one-group pretest-posttest design has only one pretest and one posttest.

Additionally, there was very limited research available in identifying sources of self-efficacy beyond the four sources identified by Bandura more for more than quarter a

century. Moreover, there has been limited research examining the development of self-efficacy beliefs in middle school and high school students' career decisions. Another limitation is that the Real World Connection Program is relatively a very new model.

7.6 Summary of Contributions

This study has proposed and tested an enhanced framework for the Social Cognitive Career Theory (SCCT) with emphasis on factors that influence self-efficacy in computer technology education for adolescents, especially female students. The study achieved the following accomplishments:

- A comprehensive literature review was carried out including analysis, synthesis and integration of numerous learning theories, instructional design theories and career development theories. This review linked these theories to each other and the multiple dimensions of the Social Cognitive Career Theory (SCCT) using originally developed tables, visual models and frameworks.
- An evolutionary re-design and representation of the Social Cognitive Career Theory (SCCT) in multiple iterations with the incorporation of theoretical and empirical findings of research and experimentation until a final framework was proposed.
- A thorough investigation and identification of the Social Cognitive Career Theory (SCCT) sources of self-efficacy gaps as a result of an extensive literature review, an object-oriented methodology leading to a holistic taxonomy of all potential relevant variables and best practices extracted from the existing Real World Connections Program (RWC) learning model. This contribution included providing extensive analysis of numerous learning experience characteristics (self-efficacy sources) that

were overlooked by SCCT researchers over two decades and incorporating them as part of a revised RWC-based treatment.

- Adopting an iterative approach using an evolutionary instrumentation prototype to carry out multiple studies with four major experimental steps. Including using a taxonomical approach to develop a general framework that aims at revising the "learning experiences characteristics" factor in a comprehensive fashion, proposing a revised research model based on the theoretical findings in the taxonomy strategy, formulating hypotheses based on the revised research model and creating a multi-step approach to build valid instruments that can be used to finalize the model and test the hypotheses alike. This was followed up by proposing a final research model based on the four-step approach in terms of defining the key factors (latent constructs).
- A multi-phase experiment with extensive statistical analysis was designed to study the impact of the revised "learning experiences characteristics" on self-efficacy, outcome expectations and technology interest based on research hypotheses and questions. The data collection process was evolutionary in nature. It was conducted in two phases of quantitative internal pilot studies, one phase of qualitative study (Q-sort) and one final dissertation study.
- A theoretical foundation, new directions and guidelines for future research in the Social Cognitive Career Theory (SCCT), instructional design strategies and career development in general were provided based on theoretical and empirical findings throughout this dissertation.

7.7 Chapter Summary

Chapter 7 presented an overview of the dissertation, the dissertation's major findings, conclusions and discussion. The discussion encompassed future implications for theory, research, and education practice.

APPENDIX A
IRB APPROVED CONSENT FORM

This section includes the IRB-approved consent form that was required to review and sign by all participants in the survey.

NEW JERSEY INSTITUTE OF TECHNOLOGY
323 MARTIN LUTHER KING BLVD.
NEWARK, NJ 07102

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

TITLE OF STUDY:

Increasing Participation Of Women In Computing And Technology: Reconceptualizing Social Cognitive Career Theory For Pre-College and College Learning Environments

RESEARCH STUDY:

I,_____, have been asked to participate in a research study under the direction of Senior university lecturer Osama Eljabiri. Other professional persons who work with them as study staff may assist to act for them.

PURPOSE:

The purpose of this study is to create a theory of women's career interest and development in the context of the information technology field as part of the STEM, specifically targeted to female students in pre-college and college-level schools in the US.

DURATION:

My participation in this study will last for about one hour for answering a questionnaire.

PROCEDURES:

You will be asked to complete a questionnaire to provide feedback on your Real World Connections experiences.

PARTICIPANTS:

I will be one of about 200 participants in this study.

EXCLUSIONS:

I will inform the researcher if I am not a middle school, high school or college student who has been in real world connections programs in the past four years.

RISKS/DISCOMFORTS:

There may be risks and discomforts that are not yet known.
I fully recognize that there are risks that I may be exposed to by volunteering in this study which are inherent in participating in any study; I understand that I am not covered by NJIT's insurance policy for any injury or loss I might sustain in the course of participating in the study.

CONFIDENTIALITY:

I understand confidential is not the same as anonymous. Confidential means that my name will not be disclosed if there exists a documented linkage between my identity and my responses as recorded in the research records. Every effort will be made to maintain the confidentiality of my study records. If the findings from the study are published, I will not be identified by name. My identity will remain confidential unless disclosure is required by law.

PAYMENT FOR PARTICIPATION:

I have been told that my name will be entered in a raffle for a $50 cash prize as a result of my participation in this study. The raffle will take place within one week after survey

NJIT

Approved by the NJIT IRB on 9/24/12.
Modifications may not be made to this consent form without NJIT IRB approval.

APPENDIX 2
INSTRUMENTATION

This section describes the instruments used to measure the study constructs. The first part is the literature-based survey scale. The second part is the Q-sorting method. The third part is the actual questionnaire used in the final study after several refinements of the scale.

Literature- Driven Instruments

Learning Experiences Characteristics

- The program allows me to be part of a real world project for real clients.(Williams and Lawson, 2001)
- The programs allows me to have many hands-on activities.(Williams and Lawson, 2001)
- I feel the program was interested in supporting my personal interest.
- The program allows me to choose or propose projects they are interested in.
- The program allows me to choose people in my team based on common interests.(Williams and Lawson, 2001)
- The program allows me to choose project tasks and roles I am interested in.
- I feel that students are not forced to participate in activities they are not interested in.
- The program let me feel the sense of freedom and independency.
- The program allows me to have a say in what I learn.(Williams and Lawson, 2001)
- The program gives me room to suggest new ideas in solving real world problems.
- My interest in the program does not depend on fear of losing grades or other consequences from school or parents.
- I don't feel that this program has any school or parent pressure.
- Program atmosphere let me feel relaxed and happy while I am in it.
- I enjoy learning while I am part of this program.
- The program allows me to work on my own space. (Williams and Lawson, 2001)
- The program allows students to vote to elect team and program leaders.
- The program allows students to vote to select program activities.
- I feel that the success of my project is part of my personal success and vice versa.
- I feel that I have real contributions to the success of a real world project.
- The program gave me personal and easy access to professor, project client and mentors.
- I feel program leaders strongly care about my personal needs and success.
- In the program, I feel that I am allowed to take important real world roles.
- In the program, I feel that I can make serious decisions about real world situations.
- In the program, I feel I can do big things in this program that I can't do anywhere else.
- In the program, I am allowed to improve my project continuously in several iterations based on peer, client, mentor and professor ongoing feedback.
- I work on exciting projects that keep me engaged.
- Challenges, presentations and feedback from judges encourages me to put up work so others can see it. (Williams and Lawson, 2001)
- Despite the differences between projects, I felt that computer technology is always used in projects.

- The way computer technology is taught in the program makes it easier to understand.
- The way computer technology is taught in the program makes it a lot of fun.
- Industry guest speakers helped me have a better feeling about computer technology.
- Tours and visits to industry sites helped me have a better feeling about computer technology.
- I feel the way computer technology is used in the program helps me understand its relevance to solving real world problems.
- Computer technology is introduced in the program in a way that links it to other subjects I like.
- I like that computer technology is introduced in a way strongly related to humans.
- The program has strong emphasis on solving problems related to community and people needs.
- My peer in the program told me I was good in one or more computer skills. (Anderson and Betz, 2001)
- I had strong endorsement from my industry sponsor for my computer skills.
- I had strong endorsement from program college professor for my computer skills.
- I had strong endorsement from program college students' mentors for my computer skills.
- My family encouraged me while in the program to be proud of my computer skills. (Anderson and Betz, 2001)
- My family encouraged me while in the program to develop my computer skills. (Anderson and Betz, 2001)
- I feel that the program gives tremendous recognition for personal accomplishments.
- The program has role models in computer skills that I look up to.
- I have friends in the program in my age that have excellent computer skills. (Anderson and Betz, 2001)
- I feel that students in the program help and support each other.
- The program allows me to share thoughts with the class.
- I feel that the program is highly social.
- I am motivated by the high energy I see in the program.
- Program activities help me make many friends.
- I feel that the program helps make long lasting friendships and connections.
- Program online groups and communication enable me to enhance my social life.
- The program allows me to evolve my computer skills gradually from scratch. (Anderson and Betz, 2001)

Technology Self-Efficacy

- I feel I understand computer work I am doing. (Williams and Lawson, 2001)
- I feel I can get better at computer skills. (Williams and Lawson, 2001)
- I feel am good at computer skills. It is easy for me. (Williams and Lawson, 2001)

- I feel confident making selections from an on screen menu. (Barbeite and Weiss, 2004)
- I feel confident using the computer to write a letter or essay. (Barbeite and Weiss, 2004)
- I feel confident escaping or exiting from a program or software. (Barbeite and Weiss, 2004)
- I feel confident calling up a data file to view on a computer screen. (Barbeite and Weiss, 2004)
- I feel confident finding most kind of information on the internet. (Ioannoa et al., 2005)
- I feel confident troubleshooting computer problems. (Barbeite and Weiss, 2004)
- I feel confident if I saw a new type of computer program I can figure it out. (Ioannoa et al., 2005)
- I feel confident understanding terms/words relating to computer hardware. (Barbeite and Weiss, 2004)
- I feel confident explaining why a program (software) will or will not run on a given computer. (Barbeite and Weiss, 2004)
- I feel confident that I can learn very difficult skills on a computer. (Ioannoa et al., 2005)
- I feel confident I can learn lots of information when I do a lot of research on the computer. (Ioannoa et al., 2005)
- I feel confident writing simple programs for the computer. (Barbeite and Weiss, 2004)
- I feel confident to apply character (letter) effects such as bolding, italicizing, or subscripting in a word processing document.(Downey and McMurtry, 2007)
- I feel confident to write a simple formula in a speared sheet to perform math calculations. (Downey and McMurtry, 2007)
- I feel confident to use a graphic presentation program (e.g., power point) to convey information to others. (Downey and McMurtry, 2007)
- I feel confident to create and work with database tables in a database application. (Downey and McMurtry, 2007)
- I feel confident to reply to individual and multiple recipients of an email. (Downey and McMurtry, 2007)
- I feel confident to design a simple web page using HTML. (Downey and McMurtry, 2007)
- I feel confident to use a router to connect multiple computers.
- I feel confident to use a photo editor to make changes in a digital photo.

Outcome expectations

- I'll need computer technology for my future work. (Smith, 2002)
- I study computer technology because I know how useful it is. (Smith, 2002)
- Knowing computer technology will help me earn a living. (Smith, 2002)
- Computer technology is worthwhile and necessary subject. (Smith, 2002)
- I'll need a firm mastery of computer technology for future work. (Smith, 2002)

- I will use computer technology in many ways as an adult. (Smith, 2002)
- Using computer technology effectively will make me more productive. (Niederhauser and Perkmen, 2010)
- Using computer technology effectively will make my work more exciting. (Niederhauser and Perkmen, 2010)
- Using computer technology effectively will make my work more satisfying. (Niederhauser and Perkmen, 2010)
- Using computer technology effectively will increase my status among my peers. (Niederhauser and Perkmen, 2010)
- Using computer technology effectively will increase others respect of my capabilities. (Niederhauser and Perkmen, 2010)

Technology Interest

- In general, I find working on computer-related projects interesting. (Roeser et al, 1993)
- Compared to most of my other activities, I like doing computer-related activities. (Roeser et al, 1993)
- I use my computer often to help me in assignments and projects.
- I like reading computer magazines and books. (Nurulazam et al, 2010)
- I like to attend workshops or classes related to computer software or hardware often.(Wigfield and Cambria, 2010)
- I like to participate with teams concerned with computer software or hardware often. (Wigfield and Cambria, 2010)
- I know a lot about computers. (Wigfield and Cambria, 2010)
- Computer technology is important to me. (Wigfield and Cambria, 2010)
- I am interested in spreadsheets programs such as excel. (Wigfield and Cambria, 2010)
- I am interested in word processing programs. (Wigfield and Cambria, 2010)
- I am interested in graphic programs such as PowerPoint. (Wigfield and Cambria, 2010)
- I am interested in databases. (Wigfield and Cambria, 2010)
- I am interested in computer hardware. (Wigfield and Cambria, 2010)
- I am interested in computer programming. (Wigfield and Cambria, 2010)
- I like to learn advanced skills in word, excel or PowerPoint. (Wigfield and Cambria, 2010)
- I like to learn how to design a website. (Wigfield and Cambria, 2010)
- I like to build or upgrade a computer. (Wigfield and Cambria, 2010)
- I like to learn new programming languages. (Wigfield and Cambria, 2010)
- If I heard a new computer term I would be interested in understanding its meaning and where it came from. (Wigfield and Cambria, 2010)
- I think computer workshops are interesting. (Wigfield and Cambria, 2010)
- I like my computer instructor. (Wigfield and Cambria, 2010)
- I think what we are learning about computer software and hardware is important (Wigfield and Cambria, 2010)

- Being involved with the subject matter of computers affects my mood positively. (Wigfield and Cambria, 2010)
- It is of great personal importance to me to be able to study computer software or hardware. (Wigfield and Cambria, 2010)
- I would like to become a computer specialist or teacher. (Nurulazam et al, 2010)
- I would like to do more computer work at school. (Nurulazam et al, 2010)
- I like watching computer programs on TV. (Nurulazam et al, 2010)
- Practical computer work is exciting. (Nurulazam et al, 2010)

Q-SORT Method Data

		LEC	TI	TOE	TSE	TOTAL
Chris	J1	27	15	13	23	78
Georgenna	J2	33	14	14	17	78
Sam	J3	33	24	0	21	78
Abdel	J4	21	21	15	21	78
Stephanie	J5	25	18	4	31	78

THEORETICAL					
No of Judges	LEC	TSE	TOE	TI	TOTAL
5	33	17	11	17	390
SUB-TOTALS	165	85	55	85	

ACTUAL CATEGORIES

TARGET CAT	LEC	TSE	TOE	TI	TOTAL	TGT %
LEC	142	9	7	6	164	86.6 %
TSE	0	82	1	1	84	97.6 %
TOE	0	1	43	11	55	78.2 %
TI	3	5	5	70	83	84.3 %

TOTAL ITEM PLACEMENT **386** HITS **337** Over all Hit Ratio **87.31%**

ACTUAL ONLY

		LEC	TSE	TOE	TI		
Chris	J1	26	5	2	0	LEC	theory
	J2	0	17	0	0	TSE	theory
	J3	0	1	10	0	TOE	theory
	J4	1	0	1	15	TI	theory
	TOTAL						

ACTUAL ONLY

		LEC	TSE	TOE	TI		
GEORGENNA	J1	32	0	1	0	LEC	theory
	J2	0	17	0	0	TSE	theory
	J3	0	0	11	0	TOE	theory
	J4	1	0	2	14	TI	theory
	TOTAL						

ACTUAL ONLY

		LEC	TSE	TOE	TI		
SAM	J1	31	0	0	1	LEC	theory
	J2	0	15	0	1	TSE	theory
	J3	0	0	0	11	TOE	theory
	J4	1	4	0	11	TI	theory
	TOTAL						

ACTUAL ONLY

		LEC	TSE	TOE	TI		
ABDEL	J1	21	4	3	5	LEC	theory
	J2	0	16	1	0	TSE	theory
	J3	0	0	11	0	TOE	theory
	J4	0	0	0	16	TI	theory
	TOTAL						

ACTUAL ONLY

		LEC	TSE	TOE	TI		
STEPHANIE	J1	32	0	1	0	LEC	theory
	J2	0	17	0	0	TSE	theory
	J3	0	0	11	0	TOE	theory
	J4	0	1	2	14	TI	theory
	TOTAL						

INSTRUCTIONS TO SUBJECTS AND INSTRUMENTATION
(Microsoft Excel Session)

INSTRUCTIONS: As part of an ongoing study of precollege and college students' interest in technology careers, we would be grateful if you could devote 15-30 minutes to completing this survey.

* I am: (Please check one.)
□Male
□Female

* My age is in the following range: (Please check one.)
□11-12 □13-14 □15-16 □17-18 □19-20

* The languages spoken in my home are: (Please check all that apply.)
□English □Spanish □Hindi □Italian □Chinese □Other

* My ethnicity is: (Please check all that apply.)
□African American □Asian □Caucasian □Hispanic □Native American □Other

* I have done the following: (Please check all that apply.)

□ Used Microsoft Office	□ Programmed in Java
□ Programmed in C++	□ Programmed in Visual Basic
□ Done Database Design	□ Done Web development
□ Written HTML	□ Written Java Script
□ Used Photoshop	□ Used AutoCAD

* The level of support that I can expect from my family if I decide to pursue a career in science or technology – on a scale of 1 to 10, where 1 means no support and 10 means a great deal of support is: (Please circle one of the numbers.)
1 2 3 4 5 6 7 8 9 10

* The level of support that I can expect from my friends if I decide to pursue a career in science or technology – on a scale of 1 to 10, where 1 means no support and 10 means a great deal of support is: (Please circle one of the numbers.)
1 2 3 4 5 6 7 8 9 10

Please answer the following questions by circling the answer: I strongly disagree, I disagree, I'm neutral I agree, or I strongly agree – that most closely represents your opinion on the relevant subject. (Please circle one)

1. The Microsoft Excel Session gave students the freedom to choose what they want to learn.

I strongly disagree I disagree I'm neutral I agree I strongly agree

2. The Microsoft Excel Session allowed students to work independently from instructors.

I strongly disagree I disagree I'm neutral I agree I strongly agree

3. The Microsoft Excel Session allowed students to express their innovative ideas.

I strongly disagree I disagree I'm neutral I agree I strongly agree

4. The Microsoft Excel Session allowed students to run their own class.

I strongly disagree I disagree I'm neutral I agree I strongly agree

5. I feel the Microsoft Excel Session allowed students to take on big challenges and claim credit for the outcomes.

I strongly disagree I disagree I'm neutral I agree I strongly agree

6. I feel the Microsoft Excel Session leader(s) cares about our success.

I strongly disagree I disagree I'm neutral I agree I strongly agree

7. In the Microsoft Excel Session, I feel that university faculty is interested in our accomplishments.

I strongly disagree I disagree I'm neutral I agree I strongly agree

8. I feel that students in the Microsoft Excel Session helped and supported each other.

I strongly disagree I disagree I'm neutral I agree I strongly agree

9. The Microsoft Excel Session allowed me to share thoughts with the class.

I strongly disagree I disagree I'm neutral I agree I strongly agree

10. I feel the Microsoft Excel Session helped me make friends.

I strongly disagree I disagree I'm neutral I agree I strongly agree

11. After the Microsoft Excel Session, I feel computer skills are related to other subjects not related to computers.

I strongly disagree I disagree I'm neutral I agree I strongly agree

12. After the Microsoft Excel Session, I feel computer skills can be used to solve community problems.

I strongly disagree I disagree I'm neutral I agree I strongly agree

13. I felt that participating in the Microsoft Excel Session was stressful.

I strongly disagree I disagree I'm neutral I agree I strongly agree

14. I felt the Microsoft Excel Session was fun.

I strongly disagree I disagree I'm neutral I agree I strongly agree

15. I felt the Microsoft Excel Session was engaging.
I strongly disagree I disagree I'm neutral I agree I strongly agree

16. I felt the Microsoft Excel Session encouraged hands-on participation.
I strongly disagree I disagree I'm neutral I agree I strongly agree

17. In the Microsoft Excel Session, I felt I learned new things by doing them.
I strongly disagree I disagree I'm neutral I agree I strongly agree

18. I felt the success stories presented in the Microsoft Excel Session were powerful.
I strongly disagree I disagree I'm neutral I agree I strongly agree

19. I felt inspired by watching some peers in the Microsoft Excel Session completing the same activity successfully.
I strongly disagree I disagree I'm neutral I agree I strongly agree

Please answer the following questions by circling one answer – that most closely represents your opinion on the relevant subject: (Please circle one)

20. After the Microsoft Excel Session, I am able to use an excel spread sheet to manipulate data and create a formatted visual display
I strongly disagree I disagree I'm neutral I agree I strongly agree

21. After the Microsoft Excel Session, I feel confident I can use advanced features in Microsoft Excel.
I strongly disagree I disagree I'm neutral I agree I strongly agree

22. After the Microsoft Excel Session, I feel more confident about my computer skills.
I strongly disagree I disagree I'm neutral I agree I strongly agree

23. After the Microsoft Excel Session, I feel I will need computer technology in my future work.
I strongly disagree I disagree I'm neutral I agree I strongly agree

24. After the Microsoft Excel Session, I will continue to study computer technology because I know how useful it is.
I strongly disagree I disagree I'm neutral I agree I strongly agree

25. After the Microsoft Excel Session, I feel that knowing computer technology will help me earn a living.
I strongly disagree I disagree I'm neutral I agree I strongly agree

26. After the Microsoft Excel Session, I feel that using computer technology effectively will make me more productive.
I strongly disagree I disagree I'm neutral I agree I strongly agree

27. After the Microsoft Excel Session, I feel that using computer technology effectively will make my work more exciting.
I strongly disagree I disagree I'm neutral I agree I strongly agree

28. After the Microsoft Excel Session, I feel that using computer technology effectively will make my work more satisfying.
I strongly disagree I disagree I'm neutral I agree I strongly agree

29. After the Microsoft Excel Session, I feel that using computer technology effectively will increase my status among my peers.
I strongly disagree I disagree I'm neutral I agree I strongly agree

30. After the Microsoft Excel Session, I find working on computer projects interesting.
I strongly disagree I disagree I'm neutral I agree I strongly agree

31. After the Microsoft Excel Session, compared to most of my other activities, I like doing computer-related activities.
I strongly disagree I disagree I'm neutral I agree I strongly agree

32. After the Microsoft Excel Session, I like to attend workshops or classes related to computer software or hardware.
I strongly disagree I disagree I'm neutral I agree I strongly agree

33. After the Microsoft Excel Session, I am interested in learning more about advanced features of Microsoft Excel.
I strongly disagree I disagree I'm neutral I agree I strongly agree

34. After the Microsoft Excel Session, I would like to become a computer teacher or professional.
I strongly disagree I disagree I'm neutral I agree I strongly agree

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