The Persistence of Second and First Class Power Engineering Distance Education Students at BCIT: A Grounded Theory Approach

by

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Ethics Statement

The author, whose name appears on the title page of this work, has obtained, for the research described in this work, either:

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Abstract

This study was designed to investigate persistence of 2nd and 1st class adult power engineering distance education students from a qualitative paradigm. Existing literature did not offer a suitable explanation and understanding of the observed experience. This study seeks to contribute to the literature through an investigation of learner characteristics, internal as well as external and psychological outcomes manifested as satisfaction and stress. In addition career goals as well as anticipation of financial reward was investigated. A pilot study involved three persisters, and a further twenty persisters participated in the main study, conducted in the British Columbia Institute of Technology Power Engineering Department.

Charmaz's version of a grounded theory methodology was employed. Qualitative interviewing through in-depth individual interviews was the method of data collection. A theoretical sampling approach was used to identify participants for the pilot study as well as for main study.

Findings indicated that age seemed to be associated with some factors. One group, in their early twenties and late thirties, made their decisions about pursuing 2nd and 1st class power engineering courses based on the influence of a family member or members that were involved in the power engineering field. A second group of participants, in their early forties to late fifties, often chose to pursue 2n and 1st class power engineering courses because of encouragement at the workplace, or to secure better job opportunities and more quality time with family. Students who persisted in the program had a variety of educational backgrounds, though most did have prior postsecondary education, either in the form of a one or two-year diploma or degree.

The proposed model of persistence of 2nd and 1st class adult power engineering distance education students incorporates learner characteristics, as well as external and internal factors that converge through psychological outcomes to student persistence.

Keywords: Power engineering, students' persistence, distance education, grounded theory

Dedication

In memory of my mother Vilma-Seka Jendruh (1933 – 1993) and all the other women who, for many different reasons, never had the opportunity to realize their potential.

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My doctoral committee inspired and supported me throughout this journey. I am deeply grateful to Dr. Kevin O'Neill and Dr. Cheryl Amundsen for well over five years of their support, patience, and words of encouragement. It is truly an honor to have been guided by such reputable scholars in the field of Education and Educational Technology. These two unselfish people not only guided me through the research effort but enthusiastically shared my interest in the topic of power engineering students' persistence. They pushed me to higher planes of thinking by asking questions and offering thoughtful suggestions.

I am truly blessed to have had such a diverse, knowledgeable, and supportive committee who made me to look at the project through many different lenses.

To my family, friends, colleagues and BCIT community, who provided encouragement, technical assistance and financial support along the way, I cannot express enough gratitude for all your help.

To the present and former power engineering students who generously participated in this study, I am grateful to you. Your words have taught me, enriched me, inspired me, and helped me to further understand power engineering's career choice and persistence in that choice. I hope this document honors and affirms the experiences you have shared with me.

Lastly, this accomplishment would not have been possible without the support of my husband, Davor, and son Andrej. I appreciate their patience and willingness to join me on this journey.

Thank you from the bottom of my heart.

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Glossary

Term	Definition
Virtual Labs	Two different entities use the name Virtual Labs. One is virtual simulations, which students can access on their computers from any place they want (their home, library or coffee shop). These involve computer-based simulation of physical phenomena, which may not be fully accurate to physical reality. The other involves computer-based access to physical equipment in a real lab that can be run and operated using a user interface accessible through the Internet.
Virtual Classrooms	Virtual classrooms are a simulation of a face – to - face classrooms using available technology such as Elluminate Live or Black Board Collaborate.

Chapter 1. Introduction

My current position at British Columbia Institute of Technology (BCIT) is Power Engineering Chief Instructor (Department Head). I have been in this position for the last 11 years. The Power Engineering Department at BCIT provides full time face-to-face programs in General and Power and Process for 94 students per year. The Department also offers power engineering courses through distance education for approximately 900 adult students per year. Approximately 95% of the Department's students are male.

My responsibilities as a Chief Instructor and as an educational leader are to support all faculty members in their day-to-day duties, as well as to lead any curriculum or program development in the department. My educational background is in mechanical engineering, with a major in power engineering. I hold a doctoral degree in the area of applied thermodynamics and heat transfer, with a research interest in green technology. Besides Chief Instructor responsibilities, I am also a faculty member, teaching courses such as Thermodynamics, Fluid Mechanics and Heat Transfer offered through full-time face-to-face programs. In the early days, 16 years ago, I was also involved in the development and design of the distance education courses.

During this period, I have been involved in the early adoption of educational technologies such as computer simulations for the face-to face programs and virtual classroom and virtual laboratory technology for the distance education programs. The prevailing view in the Power Engineering Department has been that if we applied available technology, we should be able to enhance students' persistence to complete the programs. We observed that the completion ratio for the full time face-to-face programs was close to 95% and for distance education lower-level courses (4th and 3rd class power engineering courses), it was 75%. However for the distance education higher-level courses (2nd and 1st class power engineering courses) only 11% of the students completed. The low completion ratio for the 2nd and 1st class distance education courses has been an ongoing concern, calling for research to help us understand students' persistence with these courses.

In 2008 an important step was taken with the research of Associate Dean Guy Ellis as part of his Master's Degree at Royal Roads University, under the supervision of Kathy Kinloch, Trevor Williams and myself. The purpose of this research was to develop strategies for improving completion rates in higher-level distance education Power Engineering (2nd and 1st class courses). Ellis's (2008) research took a mixed-method approach, and was the first related specifically to the power engineering student population. Based on his findings, Ellis offered the following recommendations:

- increase student engagement opportunities (it was suggested to increase live interaction between students and instructors)
- conduct instructional analysis of second-class PE courses, and
- establish a provincial forum to promote collaboration among PE stakeholder organizations.

In the following years, the Power Engineering Department faculties and I did our best to implement these recommendations as we continued to observe students' persistence in the 2nd and 1st class power engineering distance education courses. Developing the form and shape of the current 2nd and 1st class distance education courses involved the expertise, enthusiasm, pioneering and hard work of 9 instructors in the Power Engineering Department. Despite all our effort and knowledge, we did not observe a significant change in students' persistence in these courses and the completion ratio for 2nd and 1st class power engineering distance education courses remains at the level of 11%. It was therefore evident that we needed to take a different direction that would not simply involve the implementation of a different educational technology. It was also clear to me that the approach had to be directed to developing a new understanding of the problem, and would need to include listening to and observing these students and understanding the circumstances under which they could continue their studies. More research was clearly needed that would offer a better understanding of the student's persistence process, and offer different approaches to enhance the students' ability to complete their studies.

This brief background should make clear that my long-term involvement in engineering, and in Power Engineering education, is the driving force for this study. My background and my desire to improve engineering education prompts me to find the most effective way of enhancing students' persistency in power engineering distance education courses. A properly educated power engineer is a safe engineer, and as a regulated profession, we are committed to and obligated by the British Columbia Safety Authority (BCSA), or any Canadian boiler safety authority for that matter, to provide proper education for our future 2nd and 1st class power engineers.

The following section describes the field of power engineering and its regulatory environment, in order to help the reader appreciate the process which students must complete in order to obtain the qualifications at issue in this thesis.

Power Engineering Regulation and Certification in Canada

Power engineers are professionals who are responsible for designing, building, operating and maintaining the infrastructure that provides steam for heating, industrial processes and electricity across Canada. Power Engineering is a profession in which knowledge of applied sciences is gained through both formal study and practical interactions. That knowledge and experience is then applied to economically and eco-friendly operation, maintenance and management of pressure equipment such as steam boilers and turbines.

Four levels of professional certification for power engineers are provided under British Columbia and Canadian legislation, advancing from the 4th class to the 1st class certificate. These levels are defined in the Power Engineers, Boiler, Pressure Vessel and Refrigeration Safety Regulation Act (B.C. Reg. 104/2004).

In every Canadian province and territory, only certified power engineers are permitted to operate industrial plants that use equipment such as boilers or refrigeration units. Power engineers offer their skills to a wide variety of potential employers in the pulp and paper industry, chemical manufacturing, food processing, electrical generation, breweries, petroleum refineries, recreational facilities, and institutions such as schools, hospitals and shopping malls.

The British Columbia Safety Authority (BCSA) requires, for the 4th and 3rd class certifications, completion of accredited educational programs, either face-to-face or by distance education. BCSA does not require, but recommends completion of accredited programs for higher levels of certification, both 2nd and 1st class power engineering. BSCA considers completion of these programs as the equivalent to 6 months of practical experience (steam or firing time). The 2nd and 1st levels of power engineering courses across British Columbia and Canada are currently available only through self-paced distance education programs, due to the small number of students who take these courses compared to the 4th and 3rd class courses, as well as the wide geographic distribution of the students. Due to high wages and high demand for power engineers, as well as work experience requirements, all of the students enrolled in higher level second and first power engineering courses are employed full time (Ellis, 2008).

BCIT's Power Engineering students taking distance education courses receive access to learning materials and assessment tools through the Desire to Learn (D2L) learning platform, interactive lectures using the BlackBoard Collaborate virtual classroom platform, a virtual laboratory developed by the Power Engineering Department, and instructor support through e-mail, telephone, or in person at BCIT's Burnaby campus.

While BCIT provides educational programs for power engineers, the completion of a certain level of Power Engineering certification requires students to pass a government-administered examination. The prerequisites to be eligible to write the government exams for the 2nd class Power Engineering certification are current 3rd class Power Engineering certification and 30-60 months' experience as a chief, shift, or assistant shift engineer in an appropriately sized operation (Safety Standards Act: Power Engineers, Boiler, Pressure Vessel and Refrigeration Safety Regulation [Safety Standards Act], 2007). For the first class certification, the requirements are as follows:

- An applicant for a first class power engineer's certificate of qualification must hold a second class power engineer's certificate of qualification or a second class power engineer's standardized certificate of competency, and have been employed, while in possession of that certificate, for a period of not less than

- (a) 30 months as chief engineer of a second class plant that is a power plant,
- (b) 30 months as an assistant chief engineer of a first class plant that is a power plant,
- (c) 36 months as a safety officer for the purposes of this regulation,
- (d) 30 months as shift engineer of a first class plant that is a power plant, or
- (e) 45 months as an assistant shift engineer of a first class plant that is a power plant.

- If an applicant has successfully completed a first class power engineering course that has been approved by a provincial safety manager, the required periods of employment referred to in subsection (1) are reduced by 12 months.
- If an applicant holds an engineering degree acceptable to a provincial safety manager the required period of employment for the positions and types of plants set out in subsection (1) is 12 months. [am. B.C. Reg. 134/2009, s. 18.]

The procedure for obtaining the 1st class Power Engineering certificate (starting from the 4th class certificate) requires a total of 20 academic exams and 20 interprovincial exams. Together with corresponding work experience, the process will take a minimum of seven years to complete.

Certification at each class level requires successful completion of a different number of courses: 4th class requires two courses, 3rd class requires four courses, 2nd class requires six courses, and 1st class requires eight courses. Enrolled students are either from British Columbia and other provinces within Canada, or from other countries worldwide. Every year, hundreds of students are striving to become 1st and 2nd class power engineers.

As mentioned above, all of the students taking 1st and 2nd class power engineering courses work full-time in the field while enrolled in the distance education programs. The completion ratio for 4th and 3rd class distance education programs is approximately 75%, however for 2nd and 1st class distance education programs, it is only 11% (BCIT Program Advisory Committee for 2013). Why the completion rate for higher levels of certification is so low despite continued strong demand for professionals with these credentials, is a question of major concern both to educational institutions like BCIT and industry stakeholders and it is also a primary impetus for this study.

According to Ellis (2008), ninety percent of 2nd and 1st class power engineering students are adult learners. Adult learners have been variously defined in the literature, but for the purposes of this study, adult learners are considered to be students over the age of twenty-five years (Kasworm, 2002). Research on adult distance education power engineering students affirms that they are an extremely diverse population that is not easily defined beyond age (Ellis, 2008).

The profile of adult learners in general is that they have jobs, families, community involvement, and other external factors that influence their involvement in postsecondary education and their available time and energy for formal studies. For these students, being involved in any educational activities means constantly maneuvering around competing priorities (Hagedorn, 1999). After the first year of study, they are more likely to leave school than traditional students are. Traditional students in their 20s are typically financially dependent on others, do not have children, consider their college career to be their primary responsibility, and are employed only on a part-time basis if at all during the academic year (Samuels et al., 2011). Even though Johnson (2003) showed that student persistence is 20% lower in online courses than in similar courses offered face-to-face, it has been found that if adult learners in general complete the more difficult courses in a program, they are likely to persist and graduate (Kasworm, 1990).

Some research suggests that adult learners are more autonomous and self-directed than traditional students. They tend to be more internally motivated than younger traditional learners are as well. For adult learners, learning is related to changing their social roles; they need to see the benefit of the new knowledge, and the sooner they see it the more prepared they will be to involve themselves in the learning process (Knowles, Holton, & Swanson, 1998; Merriam & Caffarella, 1999).

Rationale for the Study

While students in BCIT's 1st and 2nd lass Power Engineering programs are adult learners who share many of adult learner characteristics, and have strong career and financial incentives to persist, their completion rate is nonetheless very low. The aim of this research work is to examine persistence as a set of activities, creating shared success stories and ultimately creating a personal relationship among students, their personal experience and their feelings about program completion and the program providers. The hope is that by better understanding the process of persistence in the higher level power engineering courses, and developing an appropriate theory of persistence, educators working in Power Engineering programs at BCIT and elsewhere will be able to better support this process and increase the programs' completion rate. Further, since Power Engineering is a subfield of engineering, better understanding adult Power Engineering distance education students' persistence may also allow scholars to better understand persistence among adult distance education students in engineering more generally.

Previous studies have delved into the reasons why traditional undergraduate students leave academic programs. These include factors mostly under the control of the student, "individual factors" such as academic performance, financial pressures, and motivation to learn (Cabrera, Nora, & Castaneda, 1992). Other qualitative studies have investigated factors mostly under the control of learning institutions, such as advising and faculty support (e.g. Sutton & Sankar, 2011).

Significant research has been done in the area of student's persistence in a variety of engineering programs employing face-to-face instructional delivery methods and enrolling traditional undergraduate students. In these studies, it has been found that the most frequent reasons for low persistence are a lack of high school preparation for engineering education, lack of teaching support, and lack of ability to adapt to the educational requirements of engineering programs (Duncan & Zeng, 2005; Godfrey, Aubrey, & King, 2010; Haag, Hubele, Garcia, & McBeath, 2007; Lowery, 2010; Schmidt, Hardinge, & Rokutani, 2012). Low rates of persistence among engineering students in general has been recognized as a significant and growing problem for educational institutions, industry, and legislative bodies (Ellis, 2008).

However, the reasons for these traditional undergraduate students' success may not apply to adult power engineering distance education students (Kasworm, 2003; Sandler, 2000). It is possible that the lack of persistence of adult distance education students is related to their familiarity or lack of familiarity with distance education, to students having competing demands during the period of their studies, to students' lack of family support or lack of workplace support. These possibilities need to be examined in order to gain a better understanding of non-traditional power engineering student persistence in distance education. The number of power engineering jobs requiring higher levels of certification (ie. 2nd and 1st) is increasing, and the numbers of students completing programs are decreasing (Ellis, 2008, Lutchman, 2008), so pressure has been placed on the providers of power engineering education to address the persistence problem.

Recommendations for further research by Ellis (2008) and Lutchman (2008) provide some of the rationale for the present study. Ellis (2008) recommended that the outcomes of his implemented recommendations be observed, and that further study address the enhancement of students' persistence. His recommendations essentially followed Stringer's (2007) action research cycle of looking, thinking, and acting, in order to find the best possible solutions for the observed phenomena. Lutchman's (2008) study was not directly related to 1st and 2nd class power engineering student's persistence, but addressed power engineers and their working conditions at all levels of certification. In his study, he suggested that further research should attempt to understand and respond to the personal needs of power engineers, including the characteristics of their work environment, their responsibilities, and the effort required to perform their duties and obtain required qualifications and certifications.

Most prior research on persistence, including that focused on adult learners, has been quantitative or mixed method in orientation, and has aimed to "help uncover which external factors are the most important influences in terms of drop out and how these factors may vary across age groups" (Cleveland- Innes, 1994, p. 443). Kennedy and Sheckley (1999) pointed out in their extensive review of 129 articles on adult students over the period of 30 years that in terms of interactions between the student and the institution, this relationship, or institutional fit, explains attrition behavior most consistently. They make their argument by pointing to widely accepted models of persistence. However, they also indicate that these models leave over 50% of the variance associated with retention unexplained. Donaldson and Graham (1999) as well as Samuels et al. (2011), in their Model of College Outcomes for Adults, recommended that it is time for qualitative study that will observe the processes in their model in order to understand all aspects of these processes and better understand the components of their model. The present study responds to this call.

Building upon adult learning theory, this study will examine students' external environments and examine what roles family support, work environment support, program services and the learning environment play in the persistence of adult distance education power engineering students. A previously conducted study (Lutchman 2008, Ellis 2008), that included power engineers employed in the oil and gas industry as well as BCIT power engineering distance education students, informed and influenced the research questions for this study. The authors indicated that support in the work environment and among family members may both be crucial for student success (Ellis, 2008), however they did not explore the relationship between persistence and learning environment.

To gain an understanding of student persistence that will be useful in revising Power Engineering programs, admissions processes or student support, I believed it would be important to develop a more comprehensive model of adult student persistence than those that exist in literature (Duncan & Zeng, 2005; Godfrey, Aubrey, & King, 2010; Haag, Hubele, Garcia, & McBeath, 2007; Lowery, 2010; Schmidt, Hardinge, & Rokutani, 2012). I suspected, based on my examination of prior research, that the most important contributions could be made through a grounded-theory study relying on inductive analysis to revise and elaborate models of persistence that focus on traditional students in face-to-face programs.

Study Context

The 2nd and 1st class power engineering programs are delivered solely in the distance education mode at the Power Engineering Department of BCIT. Students who want to take any distance education course can enroll at any time. However, in order for students to be enrolled in the 2nd class power engineering distance education courses they must hold the 3rd class Power Engineering certificate.

Similar to other distance education programs, the volume of student-instructor interaction in BCIT's Power Engineering programs is much less than in the programs delivered in the face-to-face mode and significant gaps exist in our understanding of students' persistence. Distance education courses in Power Engineering at BCIT are monitored by six instructors. Every week, different instructors monitor different distance education courses. Monitoring mostly entails correspondence by e-mail, phone or in person where circumstances allow.

In its current program structure, BCIT offers advanced certifications in Power Engineering using the online platform Desire to Learn (D2L), allowing students to study the required material at their own pace. Students receive marks and feedback for their attempted quizzes. Instructors monitor the progress of students, and when they observe that a student is experiencing difficulty (for instance not passing the self-quizzes or not accessing course material for a few weeks), an online virtual tutorial is arranged. Additionally, an online virtual tutorial is offered every Tuesday, Wednesday and Thursday between 3:00 pm and 7:30 pm. As previously mentioned, despite these arrangements only a small proportion of students persist in the program (11%).

Research Questions

The main research question for the study is:

- What theories (including existing theories or modifications of them) might explain the persistence of second- and first-class adult distance education power engineering students?

The following open-ended sub-questions will also be considered:

- What is the relationship between students' family and work place support and their persistence?

- What role do student perceptions of the learning environment and learning technology play in persistence?

Research Approach

These questions accord with the general purpose of qualitative research “to gain an understanding of the nature and form of phenomena, to unpack meanings, to develop explanations or to generate ideas, concepts and theories” (Ritchie et al. 2003 p. 82). The expansiveness and open-endedness of these questions therefore lend themselves to a qualitative research approach. Further, qualitative research looks more into ‘what’, ‘why’ and ‘how’ questions than ‘whether’ or ‘how much,’ which again accords with the research questions framed above.

Adopting a qualitative approach under a grounded theory umbrella might help educators to understand how adult power engineers who successfully complete 2nd and 1st class power engineering distance education courses manage to do so. This in turn may help institutions understand how to revise programs so that higher completion rates are realized. There may be opportunities for collaboration between educational institutions and other stakeholders to find additional ways to improve conditions for persistence. Understanding what may promote or hinder the persistence of BCIT's 2nd and 1st class distance education power engineering students should have a positive effect by addressing the current shortage of power engineers, fueled by retirements and the exponential growth of the oil and gas sector (Ellis, 2008).

Twenty students, who at the time of recruitment were at different stages of their 1st and 2nd lass power engineering journeys, were interviewed to understand their perspective on why they were/are persistent in their power engineering program. Under the grounded theory approach (Charmaz, 2006) the researcher aimed to develop a rich and multifaceted picture of BCIT distance power engineering students’ experience.

Theoretical Framework

The major theoretical underpinnings of this study are provided by adult learning theory, research on motivation in postsecondary distance education, and persistency theory. Adult learning theory was first formulated in 1968 by Malcolm Knowles, who is known as the father of andragogy (Cercone, 2008). Andragogy presents a concept of learning that is believed to be markedly different from children's' learning (pedagogy). Knowles' theory contains assumptions which are related to the motivation of adult learning. For example, adults are more likely to feel a need to know the reasons for learning material, their motivation tends to be more internal than external, their experience provides the foundation for learning activities, their learning is problem-centered, and they make decisions about their education, including involvement in the planning and evaluation of their instruction. Furthermore, adult learners ask for respect, particularly with regard to the prior knowledge and experience they bring to the learning experience.

The number of students taking distance education courses all around the globe continues to grow much faster than the postsecondary education enrolment overall (Allen & Seaman, 2008). There are different reasons for this growth, such as students' distance from campus, job and family responsibilities, and even sickness or injury, which leads students to explore the flexibility of distance education (Moore & Kearsley, 2005; Newman et al., 2004). Others enroll themselves in distance education courses because face-to-face classes were already full, or because their institutions are not offering a needed class in a more traditional modality. Two models of distance education are available: one involves real-time synchronous communication technologies in order to simulate the physical classroom experience (sometimes called a "virtual classroom") and the other enables independent learners to work at their own pace (Anderson & Elloumi, 2004). Both models are considered in this study.

Institutions of higher education, including BCIT, are always trying to find ways to support continuous enrolment (Power Engineering Department operates distance education courses by offering continues enrolment); and yet there is not enough understanding about how students integrate their roles as a student with their roles as an employee, parent, friend, and valuable member of their community. Sheets (1992) and Kember (1999) recommended that research on persistence should concentrate more on these personal and situational factors, which may lead us to better understanding the process of integration between students' roles as students and their working and living environments. Students with support from friends and family were more likely to persist than those who did not receive such support (Kember, 1999, Elis, 2009). Tinto's model (1993), even though it is related to persistence of traditional students in face-to-face programs, also affirmed that environmental and personal commitment directly influence persistence.

Literature related to these three theoretical perspectives are presented in Chapter 2, Literature Review.

Scope and Limitations of the Study

As mentioned above, this study involved in-depth interviews with twenty Power Engineering students at different stages of their 1st and 2nd class certification programs at BCIT. The study was not designed to quantify the persistence rate of the power engineering students, but instead to describe in a rich way the experiences of persistent students and the challenges they have surmounted in order to begin developing a deeper understanding of the process of persistence and how it might be better supported. Given both the number of participants and the particularities of their situations, the results of the study cannot be generalized to other populations. Furthermore, interviewing more students would likely reveal additional reasons for students' persistency.

Chapter 2. **Literature Review**

As discussed briefly in Chapter 1, there is little prior research directly addressing persistence in the specific population of interest in this research. Published research on persistence in distance education (Cleveland-Innes, M. 1994, Donaldson, J. & Graham, S. ,1999, Cubeta, J., Travers, N., & Sheckley, B. , 2001, Cercone, K., 2008, Hung, Y.C., 2011) primarily focuses on non-engineering undergraduate and graduate courses. In engineering education, the focus of research on persistence has most often been on computer engineering.

The purpose of the presented literature review was to help me to better understand the observed population and the process of students' persistence. By uncovering what knowledge is already available in the scholarly literature relevant to the observed population, the persistence process itself or related factors, I was hoping to be better prepared for the defining the research questions as well as the research process for itself. To achieve these goals I drew from the four bodies of literature that I found relevant to this work: adult learning theory, persistence models, engineering students' characteristics, and motivation and educational technology that is currently used in the Power Engineering Distance education courses.

This Chapter begins with an overview of adult learning theory and its relevance to the population in this study. Research related to three adult learning theory approaches was examined starting with Knowles' andragogy approach. The outcome of this review helped me to better understand the adult learning process from the perspective of power engineering students, as well as to pinpoint the missing concepts related to power engineering students specifically.

I then discuss student persistence models starting with the original Tinto's model and ended with the Kember's model that was developed for distance education students. The review aimed to support my understanding of students' persistence and how these models might be applied to the adult power engineering distance education students.

The next step was to examine the characteristics of engineering students and their motivation to persist in the distance education courses. It was found that only a few areas of engineering (e.g. computer engineering) have courses offered through distance education.

Finally, the possible connection between educational technology and students' performance and persistence is discussed. These findings, though not directly related to the observed population for my study, suggested that there is a relationship between applied technology and students' persistence. This helped me to formulate my research questions and to develop interview questions.

This prior research informed the design of the present study and the questions it addresses and also why research on adult distance education power engineering students' persistence is needed.

Adult Learning Theories

Adult learning theory is founded on the recognition that learning in adulthood is different from learning in childhood (Knowles, 1984). Understanding how adults learn is the first and the most important step in the process of developing learning opportunities for adult students. Adult learning theory provides a starting point in the exploration of the relationships between the working environment, family environment, school environment and the adult student's persistency. It provides guidelines for the exploration of the possible effects that course design and supports from workplace, family and school might have on an adult student's persistence in a program. Adult learning theory is the major theoretical underpinning of this study, however as Merriam and Caffarella (1999) explain, each theory does not provide a solution, but it directs us in a way to understand the process and find possible solutions. In O'Neill's (2012) words, theories are primarily of heuristic value in educational design efforts. Consistent with adult learning theory, adult learners also prefer pragmatic and experiential methods of teaching. In a review of the literature, Kasworm stated:

Studies reported significantly higher preference for collegiate studies as a means to new knowledge and competence in skills, were less oriented to formal structured teaching-learning assignments, and preferred less formal student/faculty association roles (Kasworm, 1990, p. 355).

The Table 2-1 summarizes the important aspects of the adult learning theories that shaped my understanding of adult learners. Better understanding of the population included in this study helped me to shape my research work as well as to shape my research questions.

Malcolm Knowles is known as the father of andragogy. Andragogy explores the relationship between preparation, implementation and evaluation of adult education. Knowles in his book describe how he was introduced to the concept of andragogy by Yugoslavian adult educator, Dusan Savicevic:

…in 1967 I had an experience that made it all come together. A Yugoslavian adult educator, Dusan Savicevic, participated in a summer session I was conducting at Boston University. At the end of it he came up to, me with his eyes sparkling and said, 'Malcolm, you are preaching and practicing andragogy.' I replied, 'Whatagogy?' because I had never heard the term before. He explained that the term had been coined by a teacher in a German grammar school, Alexander Kapp, in 1833 … The term lay fallow until it was once more introduced by a German social scientist, Eugen Rosenstock, in 1921, but it did not receive general recognition. Then in 1957 a German teacher, Franz Poggeler, published a book, Introduction into Andragogy: Basic issues in Adult Education, and this term was then picked up by adult educators in Germany, Austria, the Netherlands, and Yugoslavia … (Knowles 1989, p. 79).

The assumptions posited by Knowles have been the subject of much debate, a frequent criticism being that Knowles was more descriptive than analytical in presenting his ideas, and that andragogy is perhaps "his own ideological exposition" (Jarvis, 1987, p. 184). In spite of widespread acceptance of the assumptions of andragogy, there has been little empirical research to test the validity of these assumptions, or to predict adult learning on their basis (Merriam & Caffarella, 1999; Merriam, 1993).

Table 2-1 Summary of Adult Learning Theories

Adult Learning Theory –research related	Knowles - Andragogy	Mezirow's Theory of Transformative Learning	Illeris Three Dimension Learning
Theory description	More descriptive than analytical	Based on cognitive and constructivist theories	Learning related processes can be studied separately but they are happening simultaneously.
Importance of adult learning process and their application for PE participants in the presented study in order to better understand adult learning process and to define research questions	The concept of self-directed learning, The concept of experiential learning, The concept of relationship between learning readiness and the adult's social role, The concept of adults as more problem centered than subject centered in their learning, and The concept of internal motivation rather than external factors	Lifelong development of personality, in order to establish progress, and that process should happen in a safe environment leading to absorption of new concepts.	Three important dimensions are included: cognitive processes, the environment, and emotion - immersed in a society / culture.
What was missing and what could be emphasized: Theories were developed but not all of them "tested"	Little empirical research to test the validity of the theory assumptions	Importance of social, cultural, political, and economic forces for adult learning.	Physical or spiritual aspects not included in the theory.

Although first published as a learning theory (1968), Knowles later acknowledged the andragogical model was based on a set of assumptions (Knowles, 1984). Knowles also later recognized that "pedagogy-andragogy represents a continuum ranging from teacher-directed to student directed learning, and that both approaches are appropriate with children and adults, depending on the situation" (Merriam, 1993, p. 8). However, while Knowles' concept of andragogy was perhaps not a comprehensive theory, "he has provided a foundation upon which theory might eventually be erected" (Jarvis, 1987, p. 185).

Andragogy is based upon five assumptions about adult learning: the concept of self-directed learning, the concept of experiential learning, the concept of relationship between learning readiness and the adult's social role, the concept of adults as more problem centered than subject centered in their learning, and the concept of internal motivation rather than external factors (Knowles, 1968; Merriam & Caffarella, 1999).

Knowles pointed out that adult learners have more experience than children and are more embedded in the culture. They also have different self-esteem from children, and a different willingness to learn. Adults and children also perceive time differently: time is more valuable for adults. Finally, adults' physical and psycho-social conditions have an influence on how they learn (Merriam & Caffarella, 1999). Some evident biological changes such as loss of hearing and sight can also have significant effects on the learning process.

In addition to Knowles's descriptive theory, which highlights some of the essential characteristics of adult learning, it is appropriate here to examine Mazirow and Illeris's theories.

Mezirow's theory of transformative learning is based on cognitive and constructivist theories and explains how adult students learn. Transformative learning is a process in which the adult student's previous ideas, beliefs, and values are newly constructed as a result of experience. In that process students and their environment will change. In the theory, adult students are also recognized as thinking within the contextual frames of social, cultural, political, and economic forces. Mezirow's (1990) theory of transformative learning connects critical reflection and an awareness of why we attach meaning to reality, which for this theory is a core feature of adult learning.

> *Uncritically assimilated meaning perspectives, which determine what, how, and why we learn, may be transformed through critical reflection. Reflection on one's own premises can lead to transformational learning (Mezirow, 1990, p. 18).*

The concept of transformative learning developed by Mezirow recognizes how people internalize new knowledge, incorporate new meanings and accept the new relationship between new and prior learning process. In his theory, Mezirow explained that it advocates individual lifelong development of personality, in order to establish progress, and that process should happen in a safe environment leading to absorption of new concepts.

The third approach to adult learning to be reviewed here was developed by Illeris (2002), who explained how the adult learning process has three important dimensions: cognitive processes, the environment, and emotion - immersed in a society / culture. Based on Illerie's (2002) approach each of these processes can be studied separately but they are happening simultaneously. It should be noted that he did not include the possibility of other dimensions of learning, such as physical or spiritual. His comprehensive definition of the learning process is described as:

> *I see it (the process of learning) as an entity which unites a cognitive, an emotional and a social dimension into one whole. It combines a direct or mediated interaction between the individual and its material and social environment with an internal psychological process of acquisition. Thus, learning always includes both an individual and a social element, the latter always reflecting current societal conditions, so that the learning result has the character of an individual phenomenon which is always socially and societally marked. (p. 227)*

Illeris (2002) presented these three dimensions schematically as an inverted triangle, where the cognitive and emotional dimensions are on top and the environment is at the bottom corner of the triangle (Figure 2-1). Based on this model, learning always takes place in a social context that influences and shapes adult learning. The environment includes the external dimension of interaction. Through attention, collaboration and communication, adult learners are integrated into the environment and they formulate their social roles. Most theories and research in adult education emphasize the cognitive dimension of learning, while Illeris points out the emotional dimension. Further, Illeris's model connects transformative learning with simultaneous changes in all three dimensions, and their influences on learner identity (Merriam & Caffarella, 1999). Learning from experience is a very important aspect of adult learning. Adults tend to connect what they learn to previous experiences and possible future situations (Merriam & Caffarella, 1999). Adult learners are also very pragmatic: they want to see that what they learn has application to something practical. Educators have brought the experiential world of adults into the learning process through cognitive apprenticeships (Merriam & Caffarella, 1999) and anchored practice bringing the real life situation into the classroom environment (Merriam & Caffarella, 1999).

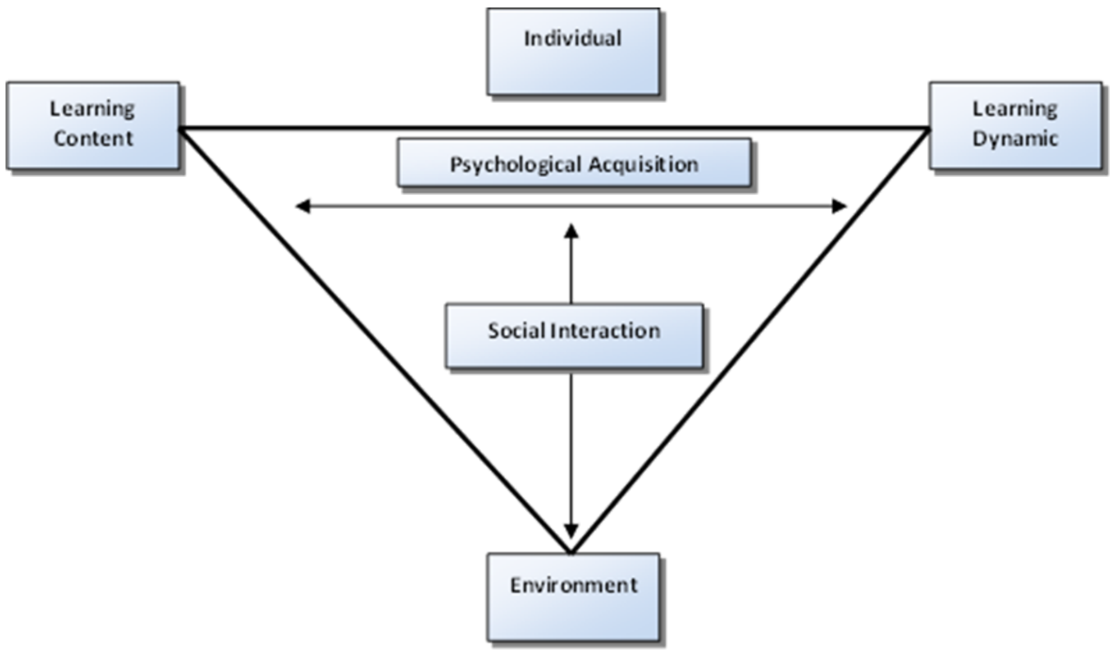

Figure 2-1 Three dimensions of learning, adopted from Illeris (2002)

These approaches were applied in The Adventures of Jasper Woodbury (1997) where the advantages of informal learning by introducing "real life" situations were proposed. The Jasper series (twelve videodisc adventures) connected math to life in the classroom by linking subject matter to students' interests and observations.

The primary goal of each approach is to develop specific skills and competencies in a particular field. The first one relates to developing real world situations or tasks that are grounded in the learner's needs as at work placements, and the second one provides an experience base in a classroom setting that simulates the real life setting, such as running the boiler in a laboratory environment, allowing students to practice their operational skills.

It is evident that adult learning theory has evolved over the years; however, several concepts seem to form its primary base. There are six assumptions that have remained unchanged: adults need to know why they need to learn something, they are responsible for their own decisions, adults have their existing experience to bring into their education, they are ready to learn what they need to know, they consider learning to be life centered and finally, adults' internal factors provide the motivation for learning (Knowles, Holton, & Swanson, 1998) and their persistence. After reviewing these adult learning theories and their concepts that could be applied in order to better understand my observed population (power engineering adult distance education students) and to use the obtain knowledge to design the presented research, the next step was to review the available student's persistence models. The following section builds on these foundational assumptions with a discussion of the three persistence models developed by Tinto, Keber, and Bean and Metzner.

Persistence Models

Three models of students' persistence are explored in this literature review, all of which have roots in the model proposed by Tinto (1975). Tinto's model was adopted, modified and included in Kember's model, as well as in Bean and Metzner's model. Their main characteristics, with their relevance to the present research, are outlined in Table 2-2.

Tinto's Model

Tinto's (1975) model, known as a model of student integration is based on Durkheim's (1961) suicide model. Durkheim believed that the level of a person's integration into the society could be used to predict the possibility of their committing suicide. Durkheim's model presented the relationship between social support of a person and a person's chance to commit suicide. As that support is better, the possibility of suicide decreases. This relationship was used as a base for Tinto's model, where drop out becomes more likely if the educational institution's support is not sufficient.

Table 2-2 Students' persistence models and their characteristics

Persistence's model-lesson learned for present study	Tinto's model	Bean and Metzner's model	Kember's model
Model's roots	Based on Durkheim's (1961) suicide model Traditional students	Based on Tinto's model Nontraditional students	Drew from the work of both Tinto and Bean and Mentzner Distance education students
Method of development	Theoretical model developed based on past research and review of the literature	Theory using 40 attrition research studies on 2-year college students.	Theoretical model developed on past research and review of the literature
Reasons for persistency	Dropout becomes more likely if the educational institution's support is not sufficient	Academic performances Educational goals, High school performance	Family support, personal motivation, the ability and the will to complete the program, previous achievements and experience in education, and institutional support.
Could be used for the future delivery mode for 2nd and 1st class courses It is mode of DE delivery in PE	Focused specifically on traditional four-year college students	Focused on nontraditional students Older, part-time, and commuter students	Distance education students' learning experience is different especially from the student - faculty interaction point of view. Kember's definition of a distance education student is descriptive of correspondence students today. It does not reflect possible faculty-student interaction in the online environment.
Research questions developed based on the obtained knowledge	"Matching" the individual and the institutions where students develop their goals, persist in their education or not.		Includes entry characteristics such as age, years worked, sex, marital status, salary, and qualification/educational background.
Possible difficulties that PE students experience	Academic difficulties, difficulties in achieving educational and occupational goals, and lack of ability to participate in the intellectual and social life of the institution.		
All PE students are off campus students so it is relevant to the present research		Looks into students' experience off campus instead of students' experience on campus exclusively.	

Persistence's model-lesson learned for present study	Tinto's model	Bean and Metzner's model	Kember's model
It is applicable to PE students not from institutional integration but from the point of view of collaboration between educational providers, industry and legislators	Stemmed from the assumption that understanding processes of integration should affect policies and procedures so as to increase students' persistence.		
Need for further qualitative or quantitative research	Was not developed based on individual results from particular institutions	Was not developed based on individual results from particular institutions	Was not developed based on individual results from particular institutions

Based on Durkheim's model of suicide, the person is likely to commit suicide because integration into society did not happen, while in Tinto's model a student's persistence will decrease if the student cannot find a way to "fit' in into different aspects of college or university life. The main difference between these two models is that Tinto's included individual characteristics of a person while Durkheim's model of suicide did not (Tinto, 1975).

Tinto's 1975 (Figure 2-2) model, focused specifically on traditional four-year college students, is meant to inform the strategies with which institutions can maintain and increase the participation of students in their studies. Tinto stressed that students' persistence is a long process, and it is described primarily as interaction of or "matching" the individual and the institutions where students develop their goals, aspirations, and expectations. Based on that interaction, students decide if they are going to persist in their education or not.

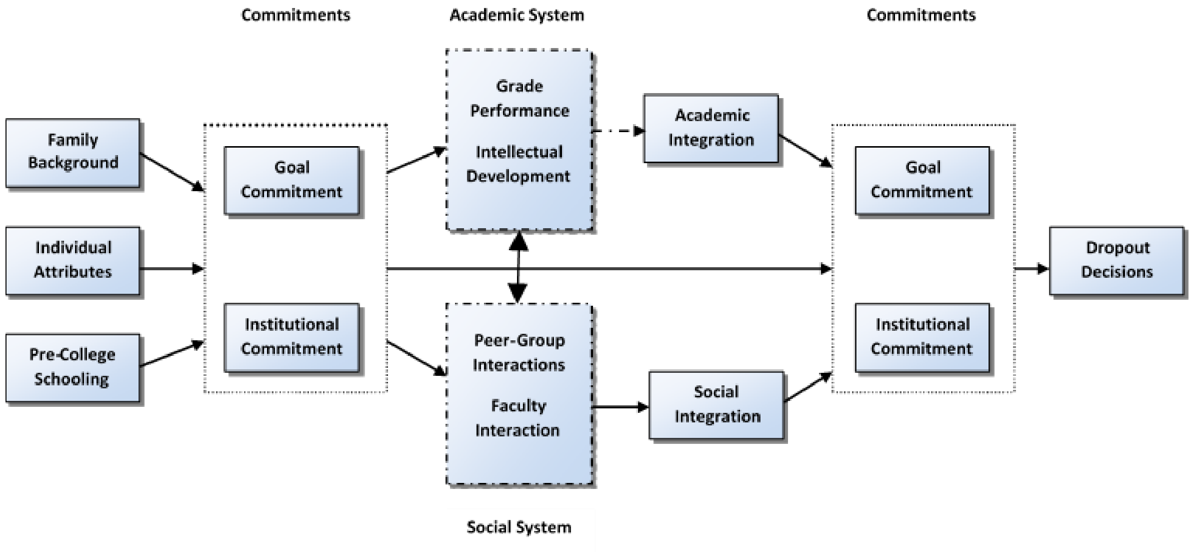

Figure 2-2 A conceptual scheme for dropout from college (adopted from Tinto, 1975, p. 95)

Tinto (1993) identifies three major contributing causes of student departure: academic difficulties, students' difficulties in achieving their educational and occupational goals, and lack of ability to participate in the intellectual and social life of the institution. However, Tinto is convinced that the most influential factor on the process of students' persistence is the quality of interaction among students and between students and the institution. Tinto's "Model of Institutional Departure" states that to persist, students need integration into formal (academic performance) and informal (faculty/staff interactions) academic systems and formal (extracurricular activities) and informal (peer-group interactions) social systems. Tinto (1982) strongly supported the importance of the educational institution's role in student persistence, as well as their integration into the educational institution's community. He believed that understanding these processes of integration should affect policies and procedures so as to increase students' persistence.

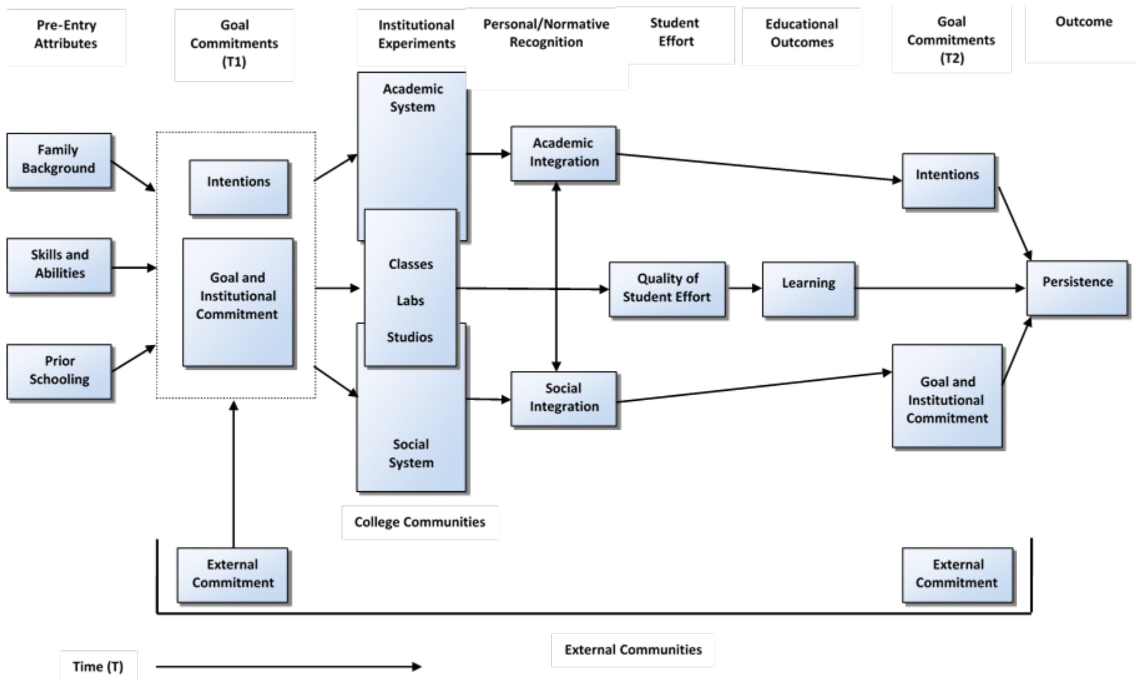

Figure 2-3 Adopted from Tinto's revised model, 1998

Tinto's model was criticized (Tierney, 1992) on the basis that it relied only on information about traditional four-year college students, and was not developed based on individual results from particular institutions. Tinto, in a 1993 publication, responded to these critics and pointed out the importance of institution specific studies that would give better information about the individual student than national studies did. Tinto's research on individual students and individual institutions enhanced the total understanding of persistence because "Only institution specific studies . . . can provide insight into circumstances" (Tinto, 1993, p. 22).

Tinto (1998) related processes of integration to educational institutions' commitment and student commitment (see Figure 2-3). Student commitment includes students' harmony with the institutional environment that affects their academic performance, and involvement in institutional everyday life, including various clubs and events. Educational institution commitment focuses on establishing and nurturing the relationships between administration, faculty and students. Between these two commitments, Tinto believed that student commitment to come into harmony with an institutional environment is the most important factor in the process of students' persistence. However, this view is not supported by other researchers, such as Bean and Metzner (1985).

With respect to its limitations, Tinto's model clearly cannot be directly applied to adult distance education students because it was developed primarily to describe the persistence of traditional undergraduate students under the age of 25 years (witness the mention of student clubs and events). Compared to Bean and Metzner's model (discussed below), Tinto's model also did not take into account the impact of the various external factors that are important for understanding the persistence of adult students in distance education programs. Tinto was aware of these deficiencies, and pointed out that his model should be redesigned for adult distance education students (Tinto, 1975).

Bean and Metzner's Model

Departing from Tinto's model, Bean and Metzner (1985) developed a conceptual model (Figure 2-4) with which they tried to explain the persistence of older, part-time, commuter undergraduate college students that they defined as non-traditional students.

Bean and Metzner (1985), relied extensively on past research and review of the literature, and they developed the first model of student attrition for the non-traditional student. The researchers theorized the need for a new non- traditional student model, as the other models relied heavily on social and institutional integration of only traditional students.

> *One defining characteristic of the nontraditional student was the lack of social integration into the institution; therefore, a different theory must be used to link the variables in this model (Bean & Metzner, 1985, p. 489).*

They perceived student attrition as analogous to workplace turnover, and they stressed the importance of behavioral intentions and intent to stay as significant predictors of persistence. Bean and Metzner developed a path model and found that attrition decisions were based on the following sets of variables:

- academic performance measured in terms of past and present GPA
- intent, which is influenced by psychological outcomes and academic variables

- defining variables such as age, enrolment status and resident status as well as
- background variables such as educational goals, high school performance, ethnicity and gender and
- environmental variables -- those factors not controlled by the institution

Beside these factors, Bean and Metzner included family support and their commitment as factors that influence students' success.

Bean and Metzner developed their theory using 40 attrition research studies on 2-year college students. .

> *A non-traditional student is older than 24, or does not live in a campus residence (e.g., is a commuter), or is a part-time student, or some combination of these three factors; is not greatly influenced by the social environment of the institution; and is chiefly concerned with the institution's academic offerings (especially courses, certifications, and degrees). (Bean and Metzner, 1985, p. 489).*

They found that only 7 out of 40 studies found social integration as the reason for attrition, and four of them showed no relationship between attrition and social integration. However, they found that one study reported that one-third of dropouts had poor social life as a major reason for leaving the school. The model highlighted academic and environmental variables as the most important influences on dropout. They pointed out that the learning environment could have a stronger influence than academic support, as well as goal commitment and stress level.

Bean and Metzner argued that the structure of the support available to this population is different from the structure of the support for traditional students, and that it is less related to the factors in the relationship with the institution and more on factors outside of the school environment, such as friends, family and employer (Bean and Metzner, 1985). In their model, the authors envisage that the student's persistence is mainly influenced by factors related to their previous study achievements and demographic, cultural and socio-economic characteristics.

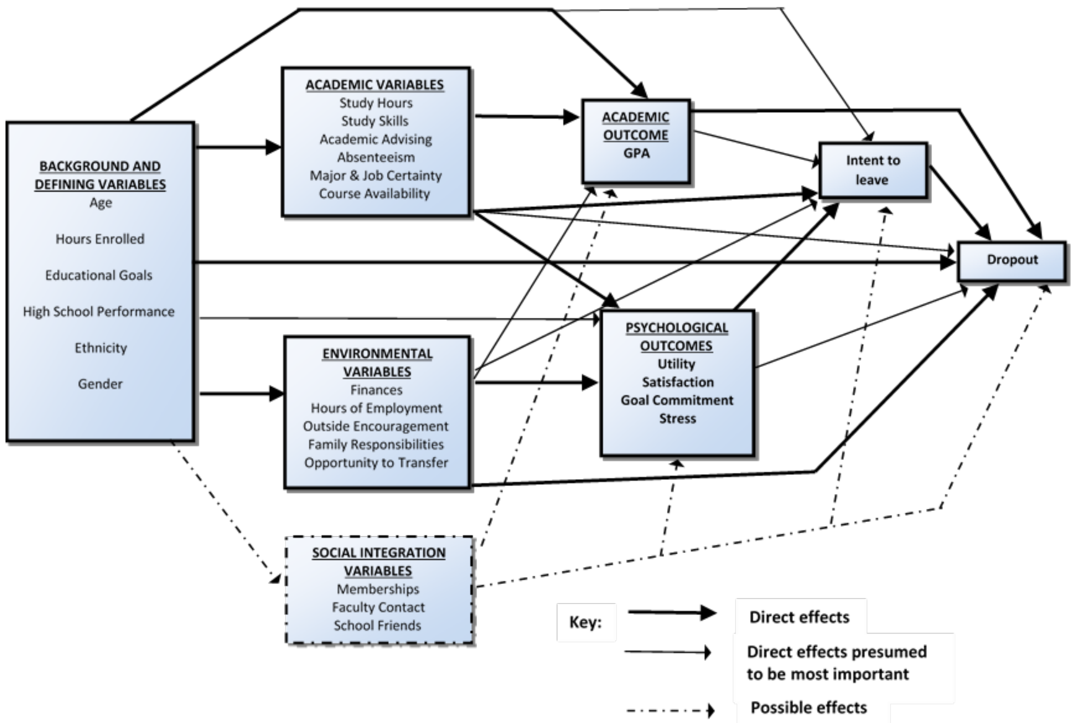

Figure 2-4 Adopted from Bean and Metzner's persistence model, 1985

In Bean and Metzner' (1985) model, the major difference in the attrition process between traditional and non-traditional students is that nontraditional students are more affected by the external environment than by social integration factors. The authors pointed out that the literature strongly suggested that social integration was not an important factor in the attrition process for non-traditional students, so they did not include it as a primary factor in their model. Instead they were looking more into students' experience off campus instead of students' experience on campus.

Kember's Model

Kember (1989) drew from the work of both Tinto and Bean and Mentzner to develop a model of persistence intentionally adapted to the distance education student. Kember (1989), after reviewing existing models including Tinto's and Ben and Mentzner's models of attrition, pointed out that they could not be directly applied to distance education students. He believed that distance education students' learning experience is different especially from the student - faculty interaction point of view. It is important to stress that

Kember's definition of a distance education student is more applicable to correspondence students, and does not reflect possible faculty-student interaction in the online environment. Taking into consideration that distance education students are most of the time not full time students, and that they are most often mature students, Kember did not take college life and academic integration into consideration in his model. In his model, external variables such as employment and family obligations are important factors in distance education students' attrition.

Despite the adaptation of Tinto's model to older students, Kember (Figure 2-5) noted that there is a further difference between adult students in face-to-face education and those in distance education. Kember's model underscores the complexity of the interactions between factors such as family support, personal motivation, the ability and the will to complete the program, previous achievements and experience in education, and institutional support. It is assumed that students in distance education are employed adults who have families, for whom it is important to have the ability to balance family, work and study commitments (Kember, 1989). Kember also believes that family circumstances, such as the number of children or residential conditions, have an important impact on students' persistence.

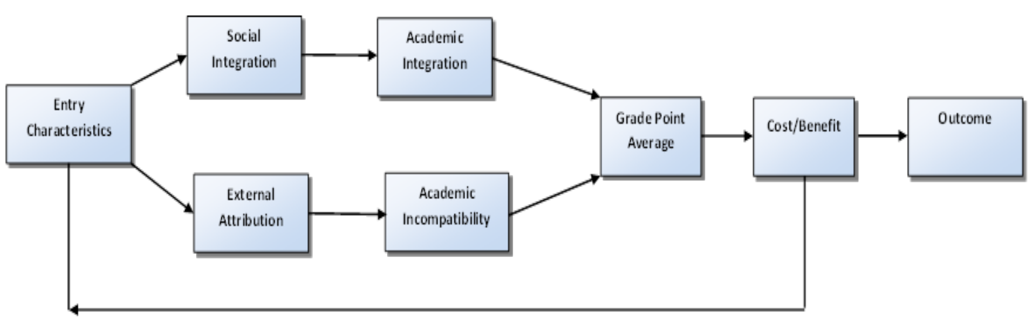

Figure 2-5 Adopted from Kember's Model of persistence in distance education, 1989

The components of Kember's model are similar to those included by Tinto, although their arrangement in the model is different. Kember suggests that social integration and academic integration enhance students' persistence, but his integration of these influences is different from Tinto's, as Kember's construct of 'social integration' refers to the student's ability to integrate his or her life as a student with other aspects of their lives (work, family and social life) – rather than their integration with the institution.

Kember's model includes entry characteristics such as age, years worked, sex, marital status, salary, and qualification/educational background. It has two paths, which he refers to as the positive and the negative path. Students on the positive path will proceed to the social integration stage of the model, which measures factors such as enrollment encouragement, study encouragement, and family environment. If students are on the positive path, they will proceed to the academic integration stage of the model, which measures factors such as a serious approach to learning, an intrinsic motivation for taking the course, and positive course evaluation. If students are on the negative path at the entry characteristics stage, they progress to the external attributes stage of the model, which measures items such as insufficient time, unexpected events, and distractions. If students continue on the negative path, they then proceed to the academic incompatibility stage of the model, which measures items such as a surface approach to learning, extrinsic motivation and negative evaluations of courses. The Kember's model is different from other models due to its ability to go through a "recycling loop," meaning that the student applies cost/benefit analyses and reflects on the level of benefits from study in comparison with the applied expense and time. All students, whether on the positive or negative path, come to the end of the process with their grade point average and then complete the process by doing a cost-benefit analysis. During the cost-benefit analysis stage, students need to weigh the benefits from staying enrolled in the course versus the benefits from dropping the course.

The factors that influence and enable adult students to persist in their education are diverse and complex (Kasworm, 2002), and they are different from the factors that affect traditional students. In her book, Kasworm (2002) highlights how adult students' goals and motivation depend on learning and living environments, and she describes five areas that have an effect on adult students' experience: work responsibilities, responsibilities to family and significant others, financial responsibilities, community responsibilities, student role responsibilities, and responsibilities to self. Very often, these areas of responsibility are in conflict, and making the choice between priorities can be a turning point for adult students in the process of their learning (Ellis, 2008). Adult students also have several external factors competing for their time and energy: jobs, nuclear family, extended family, or volunteer work. Being a student is not the only role they have. Researchers have found that the support adult students received from family and faculty is important for their persistence. Ellis (2008) in his mixed-method study, analyzed responses of thirty-three 1st and 2nd class power engineering students, and all of them expressed the significance of either faculty or family support. Sandler (2000), in his qualitative study, observed that 95% of 469 adult students in two and four year programs expressed the important effect of either faculty or family support. In some respects, faculty support can substitute for family support.

However, it is important to note that the literature reviewed by Kasworm bore little direct relation to engineering students or engineering education. For this reason, it is important to examine the particular characteristics of engineering education.

Bullen & Silverstein (2006) pointed out that any engineering education aims to develop professional competencies in students, for example:

- Knowledge of basic science and engineering fundamentals
- Capacity to communicate effectively with colleagues and the general community
- Good discipline-related technical competence
- Ability to understand and identify problems and formulate solutions
- A systematic approach to design and operational performance
- Ability to act as an individual and leader in multi-disciplinary and multi-cultural teams
- Awareness of the principles of sustainable design and development and professional responsibilities
- Understanding of professional and ethical responsibilities and commitment
- The need to undertake lifelong learning and a willingness to do so.

In my professional opinion, an ideal Power Engineering program (whether conducted face-to-face or via distance education) should be designed to foster and develop all of these qualities and more, as well as to produce creative engineers who are ready to become useful members of global engineering teams. In principle, available distance education technology and teaching approaches should be able to satisfy what

Bullen & Silverstein (2006) proposed. In addition to these general qualities of engineers, power engineers should also have the ability to understand and communicate with other areas of engineering and manufacturing. Nowadays, engineering activities are becoming more collaborative and multidisciplinary (Tenopir & King, 2004; Kemper & Sanders, 2001), so in order to stay competent and competitive in their field, successful power engineers must be prepared for continuous lifelong learning.

In order to use or adopt or develop the new model, understanding engineering students' entry characteristics would be first required. The following section presents a review of literature concerning engineering students in face-to-face and distance education programs.

Characteristics and motivation of engineering students taking either face-to-face or distance education courses

As a result of my review of literature related to the characteristics and motivation of engineering students, I learned that in a period of 15 years (1997 -2011), little research had been done related to the population of interest in the present study. In addition, more quantitative research than qualitative had been carried out with traditional undergraduate engineering students as participants. Even in the case when qualitative methods were employed, it was not clear under what qualitative theory umbrella they were conducted. Only one study was directly related to the observed population in the present study (adult distance education students), and engineering students were not included. I organized the following literature review section to help me better understand the observed engineering student population, factors that influence their decision to start an engineering program as well as factors to motivate them to persist in the engineering programs. A summary of this section of the literature review and its relevance to the present study is presented in the Table 2-3.

A survey-based case study conducted by Baytiyeh & Naja (2010) found that professional growth, including job satisfaction, motivates students' choice of engineering as a career. A Likert-scaled survey including intrinsic and extrinsic motivational factors such as personal growth, professional growth, social growth, and financial gain was completed by (n=387) undergraduate engineering students. The study involved a sample of 387 undergraduate and graduate engineering students in face-to-face engineering programs from three top-ranked universities in Lebanon: The American University of Beirut (AUB), The Lebanese University (LU), and Balamand University (BU). (The number of students enrolled in engineering in the three selected universities was 1665, 2519, and 835 respectively.) Data collection focused on four motivational growth aspects: personal, professional, social, and financial. The survey included general characteristics, such as gender and area of specialty, and students' knowledge and level of awareness of career opportunities in various disciplines before choosing engineering programs. A 5-point Likert scale (1 being unimportant and 5 being very important) was used by participants to rate their motivations for choosing engineering programs. The 30 Likert-scaled survey questions showed a reliability of 0.852.

Table 2-3 Summary of the presented literature related to engineering students' characteristics taking either face to face or distance education courses

Characteristics and motivation of engineering students taking either face-to-face or distance education courses- lessons learned	Baytiyeh & Naja (2010)	Savage & Birch (2008)	Seymour and Hewitt (1997)	Eris et al. (2010)	Tseng et al. (2011)	Haag et al (2007)	Kim & Frick, 2011
Not many research studies related to the observed population More quantitative research than qualitative research	Quantitative study	Mixed method	Qualitative method - interview	Longitudinal survey	Ethnographic interviews	Quantitative study	

Characteristics and motivation of engineering students taking either face-to-face or distance education courses- lessons learned	Baytiyeh & Naja (2010)	Savage & Birch (2008)	Seymour and Hewitt (1997)	Eris et al. (2010)	Tseng et al. (2011)	Haag et al (2007)	Kim & Frick, 2011
1997- 2011- 15 year term Different samples but no specific theory Some face to face some distance education	387 undergraduate and graduate engineering students in face-to-face engineering programs from three top-ranked universities in Lebanon: The American University of Beirut (AUB), The Lebanese University (LU), and Balamand University (BU)	97 University of Portsmouth (UK) Electronic and Computer Engineering undergraduate students enrolled in face-to-face courses	460 undergraduate students from seven engineering schools in the USA.	160 first year students, 40 at each of four campuses	36 undergraduate engineering students from the Suburban Private University	10 participants	Four hundred students were full-time undergraduate or graduate students enrolled in universities in the United States, and 400 were selected from among working professionals in a variety of workplace settings (e.g., business, non-profit, and government organizations -- engineering was not specifically included). Three hundred and sixty eight students responded to the survey. Of these, 43% took online courses as full time college students, and 52% took the courses as working professionals.

Characteristics and motivation of engineering students taking either face-to-face or distance education courses- lessons learned	Baytiyeh & Naja (2010)	Savage & Birch (2008)	Seymour and Hewitt (1997)	Eris et al. (2010)	Tseng et al. (2011)	Haag et al (2007)	Kim & Frick, 2011
Study outcomes that was used to design presented research and its research questions	This study shows that students chose the path towards an engineering career because it promised to provide financial security while at the same time offering a sense of enjoyment and satisfaction	It was found that students' preparation before entering the program was a very important factor in their persistence.	It was found that students were not adequately prepared for engineering programs.	It was found that parental and high school mentor motivation to study engineering, and strength in math and science were important in persistence in engineering programs.	They reported that 50% of students emphasized the connection between their persistence and their high school preparation.	Mentioned poor instruction as a factor contributing to students' decision to drop from the program.	Presented data suggest that students may choose distance education courses when face-to-face courses are not available or convenient Students are more motivated when they start distance education courses if they feel comfortable using the available technology Students are aware that the learning goals are relevant to real world problems.

Analyses of students' responses identified intrinsic and extrinsic motivation as equally important in maintaining the engagement of engineers in the learning process.

Intrinsic motivation is defined as an internal aspiration to complete a particular task or activity because it gives students joy to develop a particular skill, or they feel it is morally the right thing to do. Extrinsic motivations are connected to any form of reward such as money, good grades, etc. This study shows that students chose the path towards an engineering career because it promised to provide financial security while at the same time offering a sense of enjoyment and satisfaction.

Savage & Birch (2008) conducted a mixed-methods study of 97 University of Portsmouth (UK) Electronic and Computer Engineering undergraduate students enrolled in face-to-face courses. The study employed a quantitative measure of student motivation before entering the program, and also involved interviews with students after entering the program. The main finding reported from this study was that motivation in engineering students is positively influenced by both the study environment and the goals that they set before starting the program. It was also found that students' preparation before entering the program was a very important factor in their persistence.

On the subject of preparedness, Seymour and Hewitt (1997) conducted a three-year qualitative study involving undergraduate students from seven engineering schools in the USA. The purpose of the study was to examine factors that affected four-year college and university student's decision to switch from science, mathematics and engineering majors into other majors. They interviewed 460 students from seven Institutions of higher education. Based on collected data they found that 40% of 460 participants in engineering undergraduate majors were not adequately prepared for engineering programs. Their findings are suggestive of how well high school educators are prepared and motivated to encourage students to pursue engineering careers. In their study 75% of participants expressed that the importance of adequate high school mathematics and science teachers is not only related to their teaching abilities and academic knowledge, but is related as well to their passion towards science and engineering, which may be passed on to their students.

A study carried out by Eris et al. (2010) aimed to identify factors related to undergraduate students' persistence in engineering programs. In their four-year study, they surveyed students who expressed interest in studying engineering seven times. They longitudinally surveyed 160 first year students, 40 at each of four campuses. The survey was conducted two times in the first year, two times in the sophomore year, two times in the junior year and one time in the senior year. Based on the collected data they found that parental and high school mentor motivation to study engineering, and strength in math and science were important in persistence in engineering programs. They suggested that mentor involvement before college might increase student motivation to study engineering, and enhance a confidence in math and science skills.

Tseng et al. (2011) focused on the experiences of persisting and non-persisting undergraduate engineering students from the Suburban Private University[1]. Suburban Private University is a research institution with approximately 14,000 undergraduate and graduate students. About one fourth of 1600 first year students have engineering majors. This study was based on data collected from ethnographic interviews with 36 students. Frequencies of codes that emerged from the data were used to identify the most common problems students faced in their engineering programs. They reported that 50% of students emphasized the connection between their persistence and their high school preparation. Further, they suggested that preparation was not only related to high school math and science material, but also introduction to the engineering field. The same connections were noted in Prieto et al.'s (2009) review paper, based on 30 reports from universities in Australia, the USA and the United Kingdom, where introduction to engineering was reported to play a key role in student's persistence.

Savage & Birch (2008) examined the motivation of a group of students in the Department of Electronic and Computer Engineering at the University of Portsmouth. They attempted to define 'intrinsic' and 'extrinsic' motivation of students using a quantitative research approach. The research was divided into three parts:

- recording a quantifier of student motivation before entering the department
- designing, piloting and implementing a questionnaire

[1] The educational institution is referred to using a pseudonym in order to protect its privacy

- informal conversations/interviews with students

Prior to the main study, a pilot study was carried out. The questionnaire was given to nine first and second year engineering students. Based on the pilot study results they decided to reword three questions and remove four questions that were considered confusing for students. Several criteria were applied in order to select students that had spent the majority of their education in the UK, that had not attended independent schools, and were not direct entry students or students who had transferred from other Universities or other departments.

Informal conversations/interviews were conducted with 97 students. The researchers found that a majority of students were intrinsically motivated (49 out of 97) and there were no significant differences in motivation levels between the different years of study in face-to-face engineering degree programs. Further, the motivation of undergraduate engineering students appeared to increase with the use of real-world problems. More specifically, real-world problems appeared to increase intrinsic motivation, while not demonstrating the real-world relevance of engineering coursework appeared de-motivating and increased students' inclination to drop out.

The structure of face-to-face engineering programs is typically sequential, so that each course cannot be taken without satisfying prerequisite requirements. Programs and courses have a very rigid structure that has to be presented and explained to students prior to their enrolment. Misunderstandings or misconceptions are another element that decreases the persistence of engineering students. In their quantitative study, Haag et al (2007) reported that six of their ten participants mentioned poor instruction as a factor contributing to their decision to drop from the program. Four of the participants reported positive relationships with at least one of their professors, and appreciated the efforts others made to mentor them. Six participants were disappointed with their experience with student advising in engineering. For these reasons, adequate-quality advising can enhance students' persistence (Metzner, 1989, Prieto et al., 2009; Schmidt et al., 2012). Besides this, Tyson (2012) stated, "Engineering graduates value the degree but not the instruction, suggesting some tension between the students and faculty" (p. 482).

Tinto’s model does not clearly correlate students’ persistence to student-faculty relationships. Perhaps for this reason, this aspect of persistence has not been fully explored in the literature. Seymour (2006) asserted that the quality of both teaching and student-faculty relationships are decreasing, which contributes to lower student persistence. She believes that adequate professional development for faculty could enhance student persistence.

During the literature review for this thesis, no specific studies were found regarding the motivation of engineering students taking distance education courses; however, one relevant study was conducted with a broader population (Kim & Frick, 2011). A sample of approximately 800 adult learners was selected from working adults and full-time adult students across the United States who had taken or were taking online courses. Four hundred students were full-time undergraduate or graduate students enrolled in universities in the United States, and 400 were selected from among working professionals in a variety of workplace settings (e.g., business, non-profit, and government organizations -- engineering was not specifically included). Three hundred and sixty eight students responded to the survey. Of these, 43% took online courses as full time college students, and 52% took the courses as working professionals.

Kim & Frick’s data suggest that students may choose distance education courses when face-to-face courses are not available or convenient, and that they are more motivated when they start distance education courses if they feel comfortable using the available technology and are aware that the learning goals are relevant to real world problems. It is important that students feel that distance education courses are “right for them.” If this condition is not satisfied, it is likely that the student’s motivation will decrease (Kim & Frick, 2011). Furthermore, it is important that students feel that the right educational technology has been used to deliver the course. The following section presents applicable technology for engineering distance education courses and with the focus on one that are employed in power engineering distance education course.

Distance education technology (DET) applicable for engineering courses/students

The main objective of this section was to highlight relevant findings with regard to the connection between technology and student persistence. It is expected that a new generation of college students starting their studies today will be better prepared to take advantage of the technology they are offered, in face to face or distance education courses, in order to achieve their academic goals (Nora & Snyder, 2009). The impact of available distance education technology on students' persistence, considering that BCIT offers 2nd and 1st class power engineering courses only through distance education mode, is one of the sub-questions on which the current study has been focused. The power engineering department has been implementing the D2L learning management system and a virtual laboratory as well as virtual classrooms in order to nurture students' engagement in their education. The implementation, application and effect of these technologies on students' performance and motivation were a point of interest in this part of literature review section. There were limited numbers of scholars' work related to engineering distance education programs/students. Traditionally, engineering were delivered in the face-to-face mode, due to either "traditional" way of course delivery, or the accreditation body's request related to required practicum hours.

The approach that I adopted for the literature review in this section was related to the technologies currently used in BCIT's Power Engineering distance education courses. The existing literature covers the implementation of similar, if not identical technologies in other engineering programs, and their relationship to the student's performance. The findings reviewed in this section were used to better understand the possible connections between educational technology and students' performance. The findings are summarized in Table 2-4.

Figure 2-4 Relationship between students' performance and teaching technology applied

Lesson learned	Battalio (2009)	Felder & Silverman (1988)	Pashler et al. (2009)	Byrne, 2007	Chung et al. (1999),	Hung (2011)	Nickerson & Corter (2007)	Nowak, Watt and Walther (2004)	Cataldo (1998)
Raised the question about available technology at PE distance education program and students' performance	Relationship between student performance and their learning styles in collaborative and self-directed versions of a distance education technical communication course	Aspects of learning style in engineering education	Connection between educational background and the learning process. .	Learning styles	Support tools offered in distance education university computer engineering courses and students' learning process	Effects of face-to-face and web-based discussions in the process of learning Boolean functions	Comparison between students' performance in class lab and virtual lab	Preferred classroom laboratories over virtual labs	
Not many mechanical engineering students and not many engineering distance education students were involved	120 undergraduate students	130 engineering students	Need proper methodological standards	38 Process & Chemical Engineering	28 Computer engineering students	52 computer-engineering students	29 mechanical engineering students	58 students were recruited from communication courses at a large public university	Civil engineering students One group had class lectures and the other had virtual classroom lectures

Lesson learned	Battalio (2009)	Felder & Silverman (1988)	Pashler et al. (2009)	Byrne, 2007	Chung et al. (1999),	Hung (2011)	Nickerson & Corter (2007)	Nowak, Watt and Walther (2004)	Cataldo (1998)
	38 different majors, with 33% from engineering programs, 8% from biology, and 7% from English, with the remaining 52% scattered among the remaining 33 majors							Seven groups had face-to-face time, and eight groups used the collaboration system	
Age distribution similar to the population involved in the present study	51% were over 26 years of age. Of this group, 30% were 26 to 35; 16% were 36 to 45								

Lesson learned	Battalio (2009)	Felder & Silverman (1988)	Pashler et al. (2009)	Byrne, 2007	Chung et al. (1999),	Hung (2011)	Nickerson & Corter (2007)	Nowak, Watt and Walther (2004)	Cataldo (1998)
There is a relationship between available technology and students' performance. This helped me to shape my research question and interview questions.	Obtained higher grades in the collaborative version Reflective learners preferred working independently	Engineering students were identified as visual, sensing, inductive, and active	No evidence for a connection between visual or verbal delivery methods and students' success	Visual, sequenti al and reflectiv e learners	Students from the treatment group participated more and generated more ideas than students from the control group Discussions for treatment group were active and productive Students from the treatment group produced better reports, with better integration of ideas that were developed through online discussion tools, than students from the control group	Students using discussion forums were able to transfer their own ideas and integrate them with presented course material, as well as to connect them with their prior knowledge and experience significantly better than students from the control group.	Out of 26 students, 3 described the virtual labs as "more effective", while 21 described them "about the same", and only 2 "less effective"	Groups using the virtual classroom system were found to be as effective as the face to face groups.	Reports did not differ significantl y between the two groups

Distance education technology (DET) provides a variety of flexible platforms to postsecondary education institutions for delivering courses to students at home or in the workplace, at any time. Available DET offers students:

- Interactive learning environments (students to students, students to educators)
- Access to updated learning material anywhere, anytime
- Assessment tools with limited or no time delay

Designing and developing distance education content is a process that requires different factors to be merged together for the purpose of delivering and enhancing learning (Battalio 2009, Allen et al. 2002). Allen et al. (2002) pointed out the importance of the relationship between students' learning styles and the particular education technology used in the distance education environment.

According to Bates (2015), distance education course should be designed in such a way as to (with certain web-based tools) guide students to summarize, explain, and reflect in order to enhance students' learning process. Asking students to summarize a lecture could help them get the main ideas and correlate them with one another. When they are asked to explain, they should use real examples in order to show their understanding. Reflecting should help students to build their own knowledge.

The study conducted by Battalio (2009) observed a relationship between student performance and their learning styles in collaborative and self-directed versions of the distance education technical communication course. He collected data from a sample of 120 undergraduate students enrolled in nine sections of the course during a period of two years. The students' age distribution was as follows: 51% were over 26 years of age. Of this group, 30% were 26 to 35; 16% were 36 to 45. They were enrolled in 38 different majors, with 33% from engineering programs, 8% from biology, and 7% from English, with the remaining 52% scattered among the remaining 33 majors. Data collected by means of a survey covered questions related to students' Internet, Blackboard, and general computer experience; current employment status; distance from campus; age range; as well as reasons for taking the course online. Based on the data Battalio observed that active learners obtained higher grades in the collaborative version and that reflective learners overwhelmingly preferred working independently. Offering different options of the same distance education course was judged advantageous, particularly since student success is a major consideration for any educational institution. To enhance the ability of reflective learners to adapt to an interactive environment, a collaborative version could be a reasonable solution.

Relatedly, Felder & Silverman (1988) surveyed 130 engineering students and 46 engineering professors in order to explore:

- Aspects of learning style in engineering education
- Engineering students' learning styles as well as teaching styles of professors
- Students with learning styles that are not addressed by engineering education methods

Based on their analysis, they argued that the learning preferences of most engineering students and the teaching styles of most engineering professors are not compatible. Their survey suggested that most engineering students viewed themselves as inductive learners. Half of the 46 professors identified themselves as inductive and half as deductive learners, but all agreed that their teaching was almost purely deductive. Many or most engineering students were identified as visual, sensing, inductive, and active, and some of the most creative students are global thinkers. On the other hand, most engineering education is auditory, abstract (intuitive), deductive, passive, and sequential. The authors point out that this incompatibility could explain poor student performance.

In order to accept the correlation between learning and teaching styles Pashler et al. (2009) asked for more adequate evidence. He argued that most of the studies that examine the relationship between learning and teaching styles do not satisfy proper methodological standards. Besides students' learning styles, he proposed that students' educational background could be important factor in the learning process. He also pointed out that there is hardly any evidence for a connection between visual or verbal delivery methods and students' success.

Pashler et al. (2009) also suggested that the learning styles hypothesis should not be used to explain such differences. They conducted a review of research related to learning styles and found that literature failed to provide psychometrically defensible instruments to test learning styles. At the same time, they did not oppose the possibility that different instructional modalities might be applicable for all students and all contexts of learning. They do agree that instructional methods are different for different disciplines, such as literature or engineering, and that the optimal ones should be applied for each discipline. These findings suggest that with a little judgment and flexibility, engineering professors should be able to teach to a wide variety of students and support all different "learning styles." For example, the curiosity of global thinkers can be satisfied by beginning with the big picture and introducing details one by one. The details introduced sequentially also satisfy the needs of the inductive and the sequential thinkers (Kapadia, 2008).

Another survey was conducted with 38 Process & Chemical Engineering students at University College Cork, Ireland. The most striking outcome of the survey was how non-homogenous the group was. It was found that students were visual, sequential and reflective learners. This does not imply that teachers should try to satisfy all learning styles, but that teachers should try to apply a range of teaching techniques (Byrne, 2007).

Learning management systems such as WebCT, D2L, Moodle and others may be used to mediate courses to varying degrees (Chung et al., 1999). "Limited" refers to when the platform is used solely to post the content and assignments. If the learning platform is used for collaboration and interaction then the use is described as "moderate," and finally if it has elements of multimedia and simulations then the use is "extensive."

Chung et al. (1999), in their research studied the relationship between support tools offered in distance education university computer engineering courses and students' learning process. They also examined the level of students' engagement in different learning activities such as summarizing, explaining and reflecting described by Bates (2015). They selected these activities because they wanted to enhance individual learning processes, where students learn new concepts through knowledge building activities. They wanted students to summarize the lecture content in order to give their own view and understanding of the presented material. Students were also asked to give their own examples and to make connections between examples and presented material.

Randomly chosen participants in Chung et al.'s study (1999) were 28 Computer engineering students who were divided into two groups: 12 students were in the treatment group (with support tools) and 16 were in the control group (without support tools). Support tools were developed in order to encourage students in the treatment group to use learning strategies such as planning/monitoring, summarization, and explanation. Data were collected using pre-survey responses, archived communication data, group project data and post-survey responses. Descriptive statistics was used to compare the frequency and patterns of discussion participation between the two groups. One tail T-tests was conducted between the two groups with alpha level at 0.05. The major findings from this quantitative study were:

- Students from the treatment group participated more and generated more ideas than students from the control group
- Online group discussions (for treatment group) were active and productive
- Students from the treatment group produced better reports, with better integration of ideas that were developed through online discussion tools, than students from the control group

Distance education technologies and high-quality content may encourage interactions among students, but also require constant participation and facilitation by experienced teachers (Pan et al., 2006). However in studies carried out by Perlamen et al. (2010) and Hung (2011), students found some learning objectives in distance education courses took too long to complete, were frustrating, and in need of better explanation.

Hung (2011) examined effects of face-to-face and web-based discussions in the process of learning Boolean functions (function that is applied in the design of circuits and chips in computers) using the Karnaugh map (K-map - a diagram that is used for a different combination of the variables of a Boolean function.). Participants in this study were 52 computer-engineering students at Taiwan’s National Chiayi University. Students were randomly assigned to either one of two experimental groups or a control group. All groups were given a content pretest prior to instruction. In the following week, all students in the face-to-face discussion and distance education experimental groups received training in discussion skills. The control group used only course material presented by their teaching assistant. All groups were tested four times: pre-test, two midterm tests and a final test. The results showed that students from the face-to-face and distance education experimental groups performed better than students from the control group that were not offered any discussion neither in the form of training or in the class. The researchers found that students using discussion forums were able to transfer their own ideas and integrate them with presented course material, as well as to connect them with their prior knowledge and experience significantly better than students from the control group.

To support the learning styles of engineering students while implementing highly visual content of engineering courses using multimedia, audio and visual tools are required. However, as was pointed out in Ravet & Layte (1997), these tools should be used to help learning, and not to distract students. The available technology needs to be used in a manner to support web-based learning, and not be imposed on it, since applying the wrong technology can negatively influence students' learning. In order to make the right decision, the technology's capabilities and its limitations should be analyzed. Mayer (2005) in his book pointed out:

> *...presenting some information in a visual mode and other information in an auditory mode under certain, well defined conditions can expand working memory capacity and so reduce the effects of an excessive cognitive load (p.147).*

Virtual Laboratory/classroom

From the engineering student's point of view, using distance education technology could keep them up to date with new information in their field (Nickerson & Corter, 2007). Engineering students can also benefit from distance education technology if they have not been exposed to practical experience with certain equipment. For this purpose, virtual labs can offer a variety of the practical skills students need for industry, or can provide an understanding of the required skills (Nickerson & Corter, 2007). Virtual labs can also satisfy the economic needs of educational providers because they increase the time during which a physical lab can be used (not only in the day time, but 24 hours).

Scholars have taken different positions regarding the effectiveness of virtual labs. Nowak, Watt and Walther (2004) preferred classroom laboratories over virtual labs, but they were examining these with regard to the social aspect of lab interaction, not from the point of view of effectiveness in achieving cognitive outcomes. A study by Nickerson &

Corter (2007) included 29 mechanical engineering students in their junior year taking an Applied Dynamics course. In this course, labs were used to explain the conceptual understanding of the topics and to give students an opportunity to collect and analyze data. Engineering students needed to perform six labs during the course. Three lab experiments (free, step, and frequency response of a mechanical vibration system) were given as remote labs, and three others were given in the traditional hands-on format dealing with rotor balancing, gear dynamics and dynamic response of high-speed machinery. The two lab formats (remote versus hands-on) were compared by gathering data on learning outcomes, and by measuring student satisfaction. Learning outcomes were measured by exam scores and lab grades in the course. Course exams were constructed to include one or two questions on the content of each of the labs. Student satisfaction with the remote labs was assessed by a questionnaire. Twenty-six students rated the effectiveness of remotely-operated labs in comparison to the traditional ones. Out of 26 students, 3 described the virtual labs as “more effective”, while 21 described them “about the same”, and only 2 “less effective.” Learning outcomes for the content of the remote labs versus the traditional labs were assessed by questions on the midterm and final exams. Obtained results were similar: the mean proportion of correct answers for the remote-lab contents was 0.60, while for the hands-on labs it was 0.61.

In order to overcome frustration regarding the written explanation of learning material and time needed to complete them, real-time, audio and/or video-mediated virtual classes can be employed as a supplemental teaching platform. Students enrolled in distance education courses find that self-pacing, immediate feedback, student-student and student-instructor interaction, and opportunity to access material anywhere and anytime, enhance their learning process. The following studies addressed applications of virtual classrooms in distance education programs, though only one addressed engineering students specifically.

For the first study (Nowak et al., 2004), a virtual classroom or TIC (Time Independent Collaboration) system was used as a communication tool rather than a lecture delivery tool. Fifty-eight students were recruited from communication courses at a large public university in the eastern United States. Participants were divided into groups of three or four. All students were assigned the same task, a 12-to-15-minute mock presentation on the subject of how to balance Internet privacy and national security. Students met at assigned times once per week for five weeks. Seven groups had face-to-face time, and eight groups used the collaboration system. Students were evaluated based on their final presentations by three Ph.D. students in Communication and Rhetoric. Groups using the TIC system were found to be as effective as the face to face groups.

For the second study by Cataldo (1998), a virtual classroom was used to substitute for class lectures for a three-hour laboratory for civil engineering students. The virtual classroom was tested by dividing the class into two groups. One group had class lectures and the other had virtual classroom lectures. For both groups the same test was used and they had similar reports to present. Students' performance on their tests and reports did not differ significantly between the two groups.

Though there have been no recent studies on using virtual classrooms for engineering courses, this does not mean that virtual classrooms are not present in the engineering area. Pro vice-chancellor V. K. Singh from Gautam Buddha Technical University (GBTU) told *The Times of India* on March 2011 that engineering students will be able to benefit from lectures taking place at other colleges in the country through virtual classrooms. (At the same time, Singh pointed out that virtual classes will not substitute for physical classrooms.)

A virtual classroom offers visual interactive teaching. Engineering faculty believe that learning occurs when the student is able to draw or create an image of the learned concepts. A virtual classroom supports rigidity and abstract nature of engineering courses and also supports creative, analytical and collaborative thinking in addition to decision making skills traditionally delivered in the conventional classroom environment. (Abu-Hajer & Holden, 2007).

Even though there is some evidence of a relationship between the use of technology and students' persistence, there is a need for more empirically and theoretically driven research studies that will explain the benefits or misperceptions of technology as they relate to students' persistence (Nora & Snyder, 2009).

Significance of This Study to the Literature

As the previous sections have detailed, substantial research has been done on the persistence of engineering students in degree programs, and the nature of their persistence, as well as the suitability of the educational technologies used to enhance learning and persistence. It is clear from the literature review presented above that the majority of the research to date has been quantitative or mixed method in orientation, and has primarily been conducted either with students in disciplines other than engineering or in relation to face-to-face engineering programs serving traditional full-time students. Since the typical profile of power engineering students differs in many respects to the populations that have been studied, a deeper understanding of power engineering students is needed to better address the challenges they face in persisting with their studies.

Previous research on adult learning, persistence, and engineering students' motivation, as well as available and applicable distance education technology for engineering courses, have contributed greatly to my understanding of the complexity of the process examined in the present study: the persistence of adult 2nd and 1st class power engineering distance education students. The literature surveyed above also helped me to understand the observed process from a different prospective, not only as an engineer (power engineer) and as an education provider, but as a researcher who is inspired to better understand the persistence process through a qualitative research approach.

The findings from existing literature raise a number of important implications, which helped me to develop my research questions and design my study. First, research related to adult learning has developed theories, but not all of them have been empirically "tested." Second, research related to students' persistence also resulted in different models for different student populations (traditional students, non-traditional students, distance education students), but none were developed based on the population of interest for the present study, or a very similar population. Finally, the findings of the existing literature related to available distance education technology shows that some relationships exist between the technology applied and students' performance, but again the populations studied are quite different, and most studies have been carried out under the quantitative research umbrella that does not offer participants the opportunity to share their experiences in depth. When participants can choose their own words in a more open-ended research process, researchers may develop a quite different (and possibly superior) understanding of a phenomenon. With this in mind, it appears that further research into the process of 2nd and 1st class power engineering distance education students' persistence is needed. Such research is necessary not simply to understand the dynamic of the observed process, but also to help all power engineering stakeholders: industry, education provider, and the legislative body to more effectively support students in their educational journey.

By developing a greater understanding of the persistence process of this unique student population, it is hoped that the present study will make an innovative and valuable contribution not only to knowledge in the power engineering context, but will also add to the growing body of research relating to engineering students' persistence.

Chapter 3. Research Methodology

The previous Chapter reviewed several relevant theories of postsecondary students' persistence, and research on the application of Distance Education Technologies (DETs) in engineering and other disciplines. Through this review it became clear that current theories of persistence have been developed in relation to the needs and experiences of students who are very different from the adult distance education students at the centre of the present study. Furthermore, the relevant empirical research has usually not addressed the unique needs of engineering students, and has largely been conducted in a quantitative mode that has focused on the evaluation of specific interventions or tools, rather than the development of a better understanding of students' needs. A sharpened focus on persistence has this research looking for more effective ways to support student success. This research is concentrated on the student's success as measured by their persistence to complete a 2nd or 1st class power engineering program. My hope is that the developing persistence model will help students to sustain their motivation and develop a sufficiently supportive environment to attain their goals.

Building on this review, the current Chapter will explain why Charmaz's (2006) approach to qualitative research was adopted for the present study.

Introduction

Why a qualitative study of power engineers' persistence?

Adult education and distance education have been areas of extensive research activity. However, previous research has not looked at these aspects of education practice from the engineering programs point of view. Very few research activities have focused specifically on adult engineering students taking distance education programs, despite their unique needs, and no previous research has used a qualitative approach to examine the persistence of adult engineering students taking distance education programs.

A qualitative research approach allows researchers to be more spontaneous and flexible in exploring poorly-understood phenomena in their natural environment (Rudestam & Newton, 1992). Qualitative research is especially applicable for exploring student issues and concerns, and for investigating the interpretation and meaning that students give to events they experience (Rudestam & Newton, 1992).

Three fundamental assumptions guide qualitative research studies:

- a holistic view which seeks to understand phenomena in their entirety in order to develop a complete understanding of
    - a person,
    - process, or
    - situation
- an inductive approach in which the researcher does not impose much of an organizing structure or make assumptions about the interrelationships among the data prior to making the observations, and
- naturalistic inquiry, a discovery-oriented approach in the natural environment (Rudestam & Newton, 1992).

These ideas influenced my choice of a grounded theory approach to examine the experiences of adult distance education power engineering students taking 1st and 2nd class power engineering distance education courses in the BCIT Power Engineering Department. Specifically, this study explores currently enrolled students' experiences with regard to their motivation, home/work support environments and technology use, and how these support or impede their persistence to complete courses.

According to Creswell (2003), there are three considerations in matching a research design to a problem:

- the audience,
- the problem itself, and
- the personal experience of the researcher.

Qualitative research involves studying a small number of subjects in depth to develop patterns and to understand meanings. Qualitative researchers tell a story (Creswell, 1998; Patton, 2002). Qualitative research is an:

inquiry process of understanding based on distinct methodological traditions of inquiry that explore a social or human problem. The researcher builds a complex, holistic picture, analyzes words, reports detailed views of informants, and conducts the study in a natural setting (Creswell, 1998, p. 15).

In each respect mentioned by Creswell (2003), the present study appears to match his rationale for qualitative research. Based on the review of literature presented above, it appears essential for the power engineering community (including industry, the legislative body and educational partners) to understand the process of persistence among 2nd and 1st class adult distance education power engineering students, due to their high demand (IPEC 2015, Ellis, 2008) and current low level of persistence. The process of 2nd and 1st class power engineering students' persistence has previously been explored only using quantitative methods (Ellis, 2008) which did not furnish a deep understanding of the process of student persistence. Finally, the researchers' experience related to the power engineering society aligned with the third consideration for qualitative study according to Creswell (2003).

Grounded Theory

Grounded theory (Creswell, 1998) was created as a research method that aims to develop a theory that is based on data that are systematically collected and analyzed, in areas of practice that are under-theorized in traditional research. As a practicing power engineer and educational technology researcher, I see grounded theory as an opportunity to breathe life into social science. Grounded theory is an inductive method that allows the researcher to develop a theoretical description of the general characteristics of some phenomena while, at the same time, keeping the description close to empirical observations or data.

The main difference between grounded theory and other established qualitative research traditions is its specific approach to the process of developing theory. Grounded theory is a research method that proceeds in a way nearly opposite to traditional hypothesis-driven research. Instead of starting from a hypothesis and attempting to prove or disprove it, the first step in grounded theory is to collect data. The

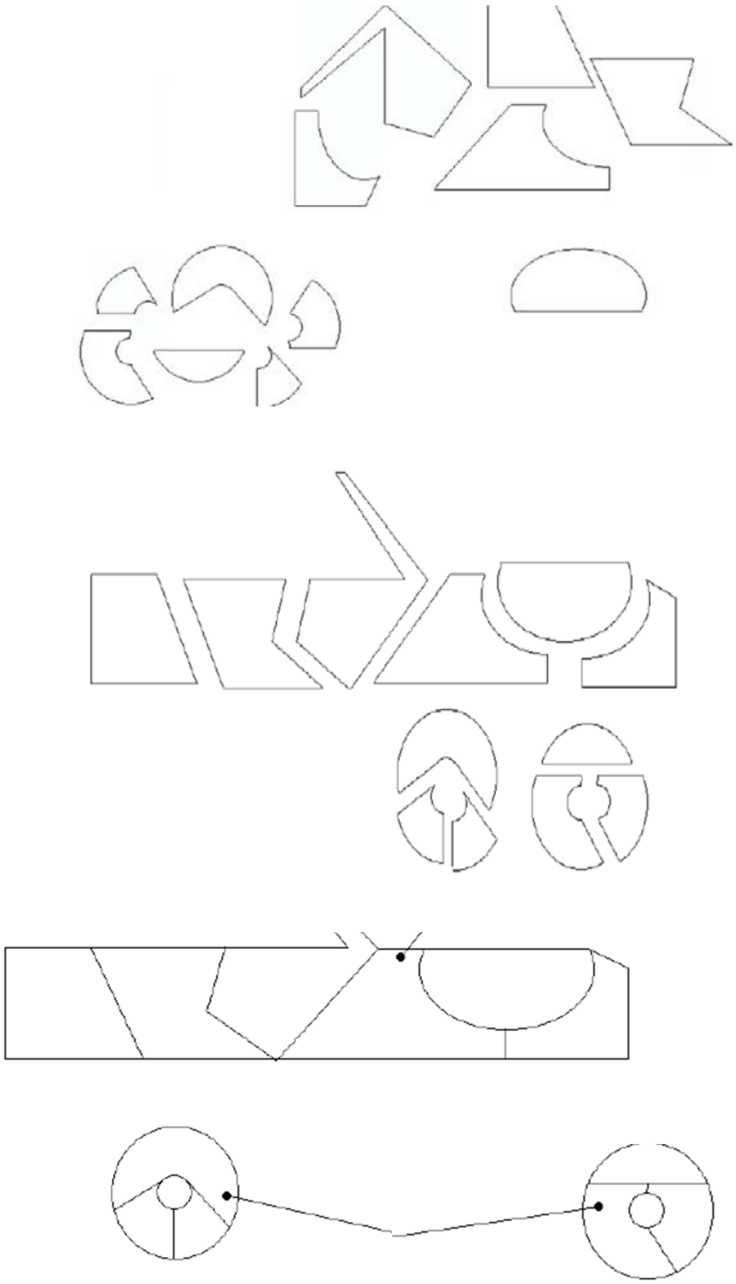

Figure 3-1 Puzzles in the process of Grounded theory development

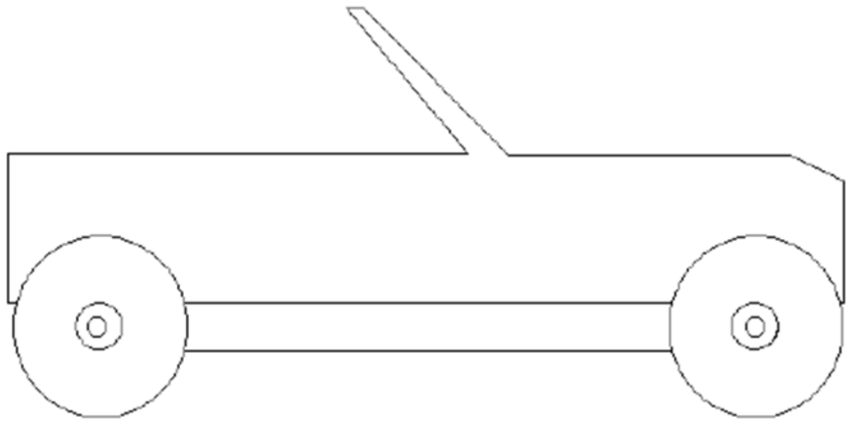

Figure 3-2 Final outcome of Grounded theory study

key points from the collected data are extracted and highlighted, and they are sorted using a series of codes. The codes are then grouped into similar concepts. From these concepts, categories are formed, which present the basis for a theory. I visualize the process of theory development as a process of using puzzle pieces to form a whole picture (see Figures 3-1 and 3-2).

The essence of the grounded theory method is as follows: instead of going from an established hypothesis about certain social phenomena, the process of theory development progresses from collected data (Figure 3-1 Individual puzzles), or going from the source of the social phenomena with their essence and connections. The process includes the following steps:

- The researcher observes and examines the particular social process (phenomena)
- Notes from the observation or testing, or sound or image records are then carefully read out several times and examined
- The researcher recognizes the meaningful units (characteristic statements of the participants of an event or events, pictures, processes)
- The researcher groups these basic "plot" phenomena, events, attitudes, into larger units ("concepts", connecting the idea of a more complex relationship, or regularity)
- These ideas are compiled in a "theory", or an interpretation of what was said or what happened. The researcher tries to understand and possibly predict future courts, behaviors, events, happenings (Figure 3-2.). The theory is then developed based on the collected data- puzzles.

Creswell (2006) explains that the goals of grounded theory are to paint a process and develop a theory for the particular group of people who experience a process in a particular setting. It is possible that published theoretical models of the process are available, but for different groups of people or different settings, and these models may be incomplete. The researcher begins with no pre-existing theory, hypothesis, or expectation of findings, and therefore allows a theory to emerge directly from the data – that is, the theory is grounded in the data. This theory can then be discussed in comparison to existing relevant theories.

Different Grounded Theory Approaches

If Strauss and Corbin's strict procedure is followed as Creswell (2006) suggested, data collected from 20 to 60 participants are analyzed through the application of open coding techniques, or line-by-line analysis where researchers look for words and sentences in the text that have meaning. This helps researchers to identify concepts. According to the formal steps of grounded theory, researchers should not stop sampling until saturation is reached, or when no additional information is found in the data. Grounded theory uses diverse sources of data, the most common of which are interviews, observations, and memos which evaluate situations, records of events and feelings. Researchers keep track of how ideas are developed with memos in every step of their research.

Even though the nature of the data gathered in a grounded theory study is very open and flexible, Strauss and Corbin define a specific procedure in analyzing and comprehending it. They prescribe the "constant comparison" method, where interview texts are analyzed line by line, preliminary themes are chosen, and they are then compared with other transcripts in order to establish and maintain consistency in the coding of transcripts, as well as to identify negative cases. Further, researchers search for links through the identification of concepts that may be used to explain the phenomenon under study. This process is called axial coding, and it is performed by defining relationships and establishing a core category. Axial coding presents the basis for theory construction (Creswell, 2006).

The grounded theory approach was first developed by Glaser and Strauss, however its evolution took different paths – not only with an involvement of the third influential grounded theory researcher, Charmaz, but also among these two pioneering researchers. Charmaz, in her 2006, book expresses respect for the pioneers of grounded theory, however she took grounded theory research under the constructivist and even social constructivist umbrella and "moved grounded theory away from…positivism," focusing on it "as a set of principles and practices, not as prescriptions or packages" (p.10). The constructivist paradigm denies the existence of an objective reality,

> *…..asserting instead that realities are social constructions of the mind, and that there exist as many such constructions as there are individuals (although clearly many constructions will be shared) (Guba & Lincoln, 1989, p. 43)*

Under the constructivist paradigm, concepts such as truth, reality, right or good must be understood through multiple lenses within a certain context.

Epistemologically, constructivism emphasizes the interaction between researchers and participants and the observed process. The outcome of that interaction is that researchers are not only objective observers, but also active participants in the process.

Charmaz (2006) also acknowledges that Glaser and Strauss's different backgrounds led to their diversion later in their careers, where Glaser devoted himself to "grounded theory as … [systematic] discovery" while Strauss (working with Corbin) became more interested in "verification" and emphasized the constant comparative method (p. 9). The research process proceeds through data collection that is often described as inductive in nature (Mills et al., 2006), meaning that the purposes of the research do not have a concept of approval or disapproval inherent in them. It is the storytelling process where the researcher analyzes data by constant comparison, first data with data, and then comparisons are made between data interpretations converted into codes, and categories and more data. This approach is usually called the traditional approach to grounded theory (Charmaz, 2006).

Strauss and Corbin do not believe in the existence of a "pre-existing reality out there." They believe that truth is enacted, which follows a relativist ontological position.

This view goes in a different direction from the traditional approach, which views the development of theory as data emerging from a “real” reality (Mills et al., 2006). Even though Strauss and Corbin did not position themselves under a certain paradigm, they can be seen as a bridge between two extreme streams of grounded theory.

> *Their work demonstrates a mixture of language that vacillates between postpositivism and constructivism, with a reliance on terms such as recognizing bias and maintaining objectivity when describing the position the researcher should assume in relation to the participants and the data. Nevertheless, they mix these ideas with observations such as “we emphasize that it is not possible to be completely free of bias” (Mills et al., 2006, p.3).*

Strauss & Corbin recognize the plural characteristic of “truths” and they also recognize the necessity of the interaction between researchers, participants and observed process. Charmaz (2006) points out that Glaser and Strauss separate grounded theory from the participants while for her, grounded theory develops from interaction between the participants and the research process. For her, grounded theory has the interpretative form of the research problem rather than an exact picture of it. As a constructivist researcher under the ontologically relativist and epistemologically subjectivist paradigm, Charmaz reshapes the interaction between researcher and participants in the research process. According to Charmaz, rich data will give the researcher solid material for building a significant analysis and build the relationship between researcher, participants and the process of research. She believes that this interaction will result in theory development, and that theory could not be developed from collected data alone. Data are not “windows of reality” (Charmaz, 2006, p. 524).

Following Glaser’s approach, new researchers should learn the process of the research through researching the process (Heath and Cowley, 2004). Heath and Cowley recognize that Glaser and Strauss share the same ontology but that they have some differences in epistemology. Glaser believes that development of new theories, rather than analyses of new data based on existing theory, will increase knowledge. He believes that a researcher should come into the process of research “clean”, completely free from his/her past, which is opposite to Charmaz’s support for the constant interaction between the researcher with his/her background, process, and area of research (Charmaz, 2006).

For Glaser, prior understandings should be based only on the general problem area, and learning *not to know* is crucial to retaining the validity of collected data. On the other hand for Strauss, both use of prior knowledge and literature review will lead to stimulation of theoretical understanding and theory development. Strauss also suggests that the research question should identify the research phenomena.

From Glaser's point of view, researchers should be comfortable with the confusion of the research process and yet should wait for concepts to emerge through the constant comparative method. Traditional grounded theory asks of researchers that they enter the field of interest with as little information as possible about the research problem, which in theory should not yet be a problem because it is not discovered yet. In this way Glaser believes that researchers

> *remain sensitive to the data by being able to record events and detect happenings without first having them filtered through and squared with pre-existing hypotheses and biases (Mills et al., 2006, p.4).*

Researchers should stay away from participants and possible available literature, which will make researchers "empty" and ready for the development of new theory. Glaser claims that the researchers in traditional grounded theory must be a *tabula rasa*, or blank slate, when entering a field of interest, in order to be able to develop valid theoretical sensitivity. On the other hand, Strauss and Corbin assert that the literature with available data could stimulate researchers' analytical skills in the process of data analyses (Mills et al., 2006).

Similarly, Charmaz (2006) sees a literature review as not only a source of important findings, but also a source of an argument for the report as such. For Strauss and Corbin, researchers shape the data by their interpretations, which moves analysis from description to interpretation. This is also the path that Charmaz (2006) follows. She sees grounded theory as flexible, but systematic, guidelines for collecting and analyzing data.

For Glaser, the endless possibilities allow the theory to be discovered rather than constructed around a predetermined framework. For him, coding from the data is the fundamental analytic tool that will highlight the theory, which is developed from emergent data. He uses three forms of codes: open, theoretical, and constant comparative. Open coding is the initial step of theoretical analysis, and development of codes from collected data. This step of coding ends when the core categories are located.

> *Theoretical codes are ‘conceptual connectors’ that develop relationships between categories and their properties (Glaser, 1992, p. 38)*

Constant comparative coding is the validation of the theory that is developed. In order to validate the developed theory, Strauss and Corbin follow the ‘axial coding’ methods that organized the data into preconceived categories, as strategies to develop the relationship between the process and participants. Glaser asserts that theoretical saturation can be achieved without complex details, where Strauss supports a detailed procedure and complex coding system (Heath and Cowley, 2004). Charmaz (2006) believes that in the process of coding, unexpected ideas might emerge. She emphasizes that data and codes should be constantly compared to each other, and then codes coming from one set of data could be used to examine and highlight another set of data. Besides this, Charmaz gives memo-writing high priority in the process of constructing a grounded theory and suggests that memo-writing is the pivotal step between data collection and the draft of the report.

> *It [memoing] prompts you to analyze your data and codes early in the research process (Charmaz, 2006 , p. 72)*

A key principle in constructivist grounded theory is that data and data analysis are constructed from interaction between the researchers, participants and the process of research -- where in traditional grounded theory researchers, by having the authoritative role of experts, present the objective view of research, which is the “real” reality. Charmaz (2006) has been critical of the ‘objectivist’ stance within classic grounded theory, advocating instead for a mutual relationship between the researcher and participants resulting in the creation of a shared reality.

According to objectivist grounded theory, the result is not influenced by the researcher, who should be out of the “picture”; rather the result represents objective facts from a ‘‘real’’ reality. Ultimately, it can be concluded that constructivist grounded theory is distinctly different to the classic methodology. The main and most important difference

(Table 3-1) is that in constructivist grounded theory participants and researchers construct their realities and present multiple perspectives to the process of research.

In either form, grounded theory asks for rigorous, systematic, and specific procedures (such as coding and memo writing) that aid the establishment and the development of theory from qualitative data that is being collected. Researchers check, recheck, think, rethink, establish their ideas and findings *throughout* the process of data collection. It is a very iterative process, which is repeated until the theory is grounded in the data. In the process of theory development this constant comparison process is similar across all grounded theory approaches, except that Charmaz's process adds an important and unique component: memoing (Table 3-1)

Table 3-1 Data analyses; Glaser, Straus and Corbin and Charmaz compared

	Strauss and Corbin	Glaser	Charmaz
Initial coding	Open coding Use of analytical technique	Substantive coding Data dependent	Constant comparing data and codes
Intermediate phase	Axial coding Reduction and clustering of categories (paradigm model)	Continues from previous phase Comparisons, with focus on data, become more abstract, categories refitted, emerging frameworks	Continues from previous phase With constant memoing process
Final development	Selective coding Detailed development of categories, selection of core, integration of categories	Theoretical Refitting and refinement of categories which integrate around emerging core	Theoretical coding Refitting and refinement of categories which integrate around emerging core with continues memoing
Theory	Detailed and dense process fully described	Parsimony, scope and modifiability	Coming from constant memo writing

Choice of Grounded theory

The present study was conducted using the constructivist approach to grounded theory research, related to the experiences of adult distance education Power Engineering students at BCIT, and how these experiences enhance or impede their persistence to complete their courses. This method, fitting under an ontologically relativist and epistemologically subjectivist umbrella, offers an interactive relationship between the researcher (the author) and participants in the research process. That interactivity puts the researcher (the author) in the position to listen to and analyze participants' stories as openly as possible.

> *There is a sense that researchers need to immerse themselves in the data in a way that embeds the narrative of the participants' narrative interaction in the final research outcome. This immersion is played out through the use of coding language that is active in its intent and that helps to keep that life in the foreground (Charmaz, 2006, p. 526).*

During the process of narrative interaction, researcher and participants learn from each other and become one entity, with the purpose of developing the theory that will help them to understand each other.

During this interaction, the researcher constantly reflects on the process using different stages of memoing (sorting memos, integrating memos), which forces the researcher to remember, question, and observe participants and the data that they generated together. Charmaz's constructivist grounded theory approach was followed in this thesis because it includes the participants' voices throughout the process of analysis. Memoing is an essential instrument to articulate this process.

I positioned myself as a participant's partner, and I see this as an important part of a constructivist grounded theory approach. I value the individuals' stories. The data becomes alive when I reflect on these stories, and I believe there are multiple views of the problem. The main research study, as well as my prior pilot study process, had the following steps (Figure 3-3.):

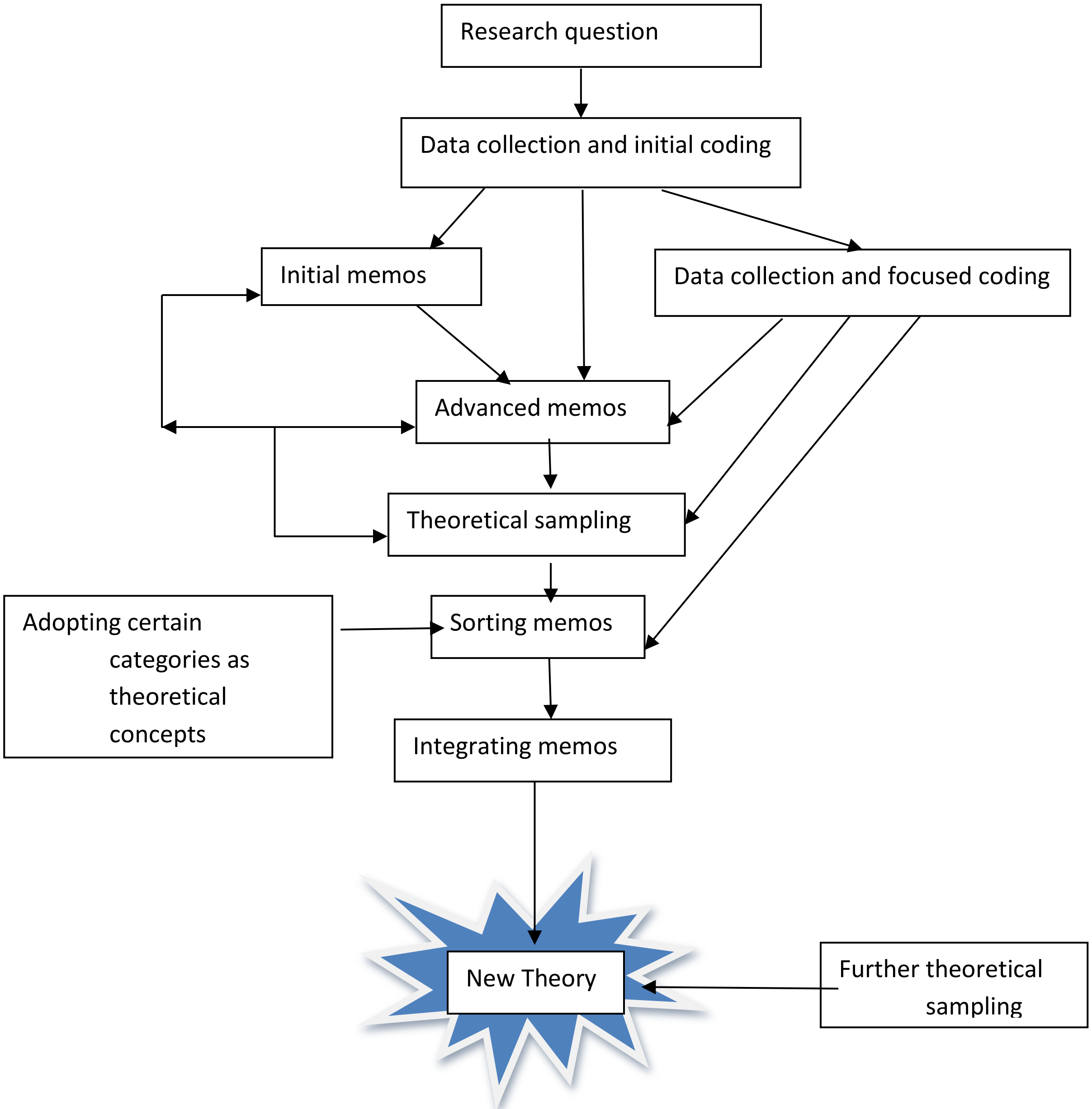

Figure 3-3 Grounded theory – flow chart following Charmaz's approach

Grounded theory supports the observation of the relationships and processes of the phenomena in depth. As a researcher, I entered the study with no theory of power engineering distance education students' persistence in 2nd and 1st class courses; only with knowledge of the power engineering field as well as knowledge of the available power engineering programs at BCIT and a great hope to take collected data and shape them into a useful discovery. Going through the research process, I realized that this method gave me the opportunity to build a new understanding of the phenomena related to power engineering adult distance education students' persistency. Through this research project, the grounded theory approach showed its strengths:

- It requires detailed and systematic procedures for data collection, analysis and theory development
- The emergent theory opens the door for future research into the observed phenomenon
- It keeps the researcher flexible and open minded, allowing the researcher to look at the data through different lenses
- Collected data, emergent codes and developed theory occur during the period of time and these processes are overlapping with the purpose of understanding the observed phenomena

I also experienced some of the reported weaknesses of grounded theory:

- Huge volumes of data
- Uncertainty in deciding when the data are "saturated"
- Time consuming and sometimes confusing process of data collection/analysis
- A researcher can be misled with the flexibility in the process of research and miss steps in the very constructive and defined research process
- Very demanding of the researcher's experience, patience and persistency

My main reason for choosing Charmaz's grounded theory approach, as discussed in the previous sections, over Glaser's or Strauss and Corbin's approaches was driven by Charmaz's "approval" of performing a literature review before conducting the research, and the connection between the available research results and the research I knew was needed to enhance practice. Glaser's approach asks for no usage of existing theory, due to possible influences on how researchers collect and interpret data. Also the flexibility offered in Charmaz's approach was attractive to me; and I felt that having no flexibility in the research process could be a disadvantage for my researcher.

Grounded theory demands a strong understanding of how to design the research process related to the human environment to be studied. Not having enough understanding of the environment to be studied might lead to improper sampling. The necessity of grounded theory research process is constant comparison, which can take a very long period if it is not designed properly, and may even take the research to a dead end. For the purpose of keeping the main research on track, a pilot study was conducted prior to the main research. The pilot study helped me to develop the skill for proper data collection and theoretical sampling. The pilot study also provided me with experience in the process of interviewing, memoing, constant comparison and coding.

Chapter 4. Data Collection and Analysis

As discussed in Chapter 2, previous research studies related to students' persistence have either been quantitative or mixed methods in orientation. Due to their methodological limitations and limited applicability to the students at the focus of the present study, prior studies have highlighted the importance of a handful of influences on student persistence, such as academic preparation, family background, and support systems.

The present study aims at constructing a theory of persistence among adult power engineering distance education students. A qualitative approach to this phenomenon was expected to involve an overwhelming volume of collected data; however it offered the opportunity to support a better understanding of the challenges faced by this unique group. The main source of data was a set of in-depth interviews that offered participants the opportunity to explain their experiences as adult power engineering distance education students in their own words.

After the pilot study was completed and some experience had been gained in the process of interviewing, as well as in the data analysis process, the main research study was conducted. The following sections describe data collection and analyses for the pilot study as well as for the main study.

Population, Recruitment and Sampling

The BCIT Power Engineering Department provides education to 900 distance education students per year, including 79 students enrolled in 2nd class distance education courses and 20 students enrolled in 1st class courses. As explained in Chapter 1, the power engineering programs require the completion of between two (4th class) and eight (1st class) courses in total. The Power Engineering Department is very flexible with regard to admission to these programs: there are no specific admission criteria which students have to satisfy. The Department believes that some students obtain necessary knowledge later in the program, and therefore students who might not have done well in high school or in their previous education have been admitted and given an opportunity to obtain the 4th up to the 1st class power engineering certification. This admission policy has historically posed challenges for the Power Engineering Department and its instructors, including a high attrition rate and students who were under-prepared for the rigors of academic courses.

I obtained permission to conduct this study from the BCIT Research Ethics Review Board, as well as from the Simon Fraser University Office of Research Ethics (Appendix E). This review process helped to ensure that the rights of the participants were carefully considered and protected. Participants were informed of the purpose of the study and the data collection procedures, assured of confidentiality, and informed of any risks associated with their participation in the study. The only risk that was identified was related to participants' names and they were assured that pseudonyms would be used in all reports of the study. Participants were also assured of their ability to voluntarily withdraw from the study at any time without consequences. Participants were given a letter outlining their rights, and were asked to provide written consent to participate in the study prior to any data being collected.

A pilot study was conducted first with a limited number of participants in order to expose myself to the grounded theory approach.

Pilot Study

For the pilot study, interviews were conducted with two 2nd power engineers and one 1st class power engineer. A theoretical sampling approach was used to identify potential participants. Theoretical sampling involves "selecting groups or categories to study on the basis of their relevance to the research questions" (Mason 1996 pp. 93-94) and "based on their ability to contribute to an evolving theory" (Creswell 1998 p. 118).

Charmaz (2006) pointed out that theoretical sampling is best used when some key concepts have been discovered. Initial data collection is commenced with a "random" group of people, who have experienced the phenomenon under study, to begin to develop concepts before theoretical sampling. The present pilot study started with theoretical sampling, opening the door for the main research study and theoretical sampling that would later generate further data to confirm and refute original categories embedded in data from pre theoretical sampling. In theoretical sampling (Coyne, 1997; Knight et al.,2003) participants,

> …need to be individuals who have taken an action or [are] participating in a process that is central to the grounded theory study (Creswell, 1998, p 114).

The main characteristic of theoretical sampling is that quality is more important than quantity, and the sampling should be supported by clear criteria. In the pilot study, I employed two criteria:

- Students must have completed the 2nd or 1st class Power Engineering BCIT courses
- Students should represent three main industrial sectors in which the majority of student are working, such as:
    - power plants,
    - process plants or
    - oil and gas plants.

Main study

Creswell's principle that "qualitative research…purposefully select[s] participants or sites…that will best help the researcher understand the problem and the research question" (Creswell, 2003, p. 185) as well as lesson learned from participants in the pilot study related to different stages in their power engineering journey were used to identify participants for the main study. At the beginning of the study, all students from the 2nd and 1st class power engineering distance education courses and available graduates from the 2nd and 1st class power engineering distance education courses were considered possible candidates for interview. (For graduates, availability was based on whether current contact information was known.) Students invited to participate included those taking the last course from the 2nd and 1st class power engineering distance education sequence and some students who were half way to program completion. Also, I decided to include some students at the starting point of the program with hope to hear their voice and their expectation of the program they decided to take. A Power Engineering distance education program assistant contacted potential participants by e-mail. In the e-mail invitation, potential participants were informed that the future research would be related to how and why students complete the programs in Second and First Class Power Engineering at BCIT. Potential participants were also informed that if they agree to participate in this study, it would involve an interview that should take about 60 minutes of their time and that they would not be paid for their participation. They were offered to contact the researcher by either e-mail or phone if they wished to participate, and the interview would be scheduled at their convenience.

Out of 99 registered 2^{nd} and 1^{st} class distance education power engineering students at different studying stage, 15 ultimately participated in this study. Out of these 99 students, only two female students were registered in the 2^{nd} class courses. One female student did not participate due to her busy work schedule. Additionally, the program assistant was able to obtain contact information for ten 2^{nd} and 1^{st} class program alumni, and five alumni participated: two from the 1^{st} class and three from the 2^{nd} class program. The participants (1 female and 19 male students) and their different stages in the power engineering journey are presented on Table 4-1.

Table 4-1 Students at different points in the Power Engineering journey

Number of completed courses	2nd Class Power Engineering	1st Class Power Engineering
One	2	2
Two	2	
Three	2	2
Four	3	
Five	1	
Six	1	
Completed 2nd Class Program	2	
Seven		
Eight		
Completed 1st Class Program		3

In order to support the “bracketing” process as well as to satisfy the validity of the research I decided to have another member of the Department present during the interview process.

Interview data collection

For the pilot study as well as for the main study, I decided to use face-to-face interviews as the primary method of data collection. In grounded theory research, interviewing is the most appropriate and most commonly used method of data collection (Charmaz, 2006; Rapley, 2004; McCracken,1988).

Creswell (2003) points out that the disadvantages of an interview include the fact that the researcher’s presence may bias the responses, and that people are not always articulate. Using the experience obtained during the pilot study as well as my experience working in the power engineering field for 25 years, I was confident that I would be able to organize and guide an interview with my participants in a professional manner, and draw out responses with follow-ups when participants were not forthcoming. Creswell viewed interviews as a preferred method of data collection because of their ability to look into the world of participants’ feelings and experiences and the interactivity between the researcher and participants. Lempert (2007) advocates interviewing because of the ability to a collect large amount of data with additional clarification if needed.

Pilot Study

For me, it was mandatory to gain experience of interviewing prior to the main research study. In addition, choosing the interview as a main source of data collection is supported by the understanding that “people are experts on their own experience and so best able to report how they experienced a particular event or phenomenon” (Darlington and Scott 2002, p. 48). However, trust must be established between the researcher and participants (Charmaz, 2006). I felt that being part of the power engineering community could help me in communication with participants so with face-to-face interviews I also hoped to be able to capture an interviewee’s emotions and behaviors.

Since I am a member of the power engineering community and will naturally make assumptions about the phenomenon examined in this study, “bracketing” is required during the whole process of research, including interviewing, data analysis and final theory development (Charmaz, 2006). The practice of bracketing originated in phenomenology, and is intended to ensure the validity of the research process by making the researcher’s assumptions explicit to avoid any influence on the study process (Fischer, 2009). During the interview, I did try to “bracket” myself and yet, at the same time keep myself engaged with participants. As one example, I discovered that using the word *persistence* instead of *retention* helped to establish a positive tone with my interviewees. During the pilot study, I gained practice in reminding myself to let participants express themselves without interjecting and “putting my words in their mouth.”

In the pilot study I also gained practice in constantly reflecting on the collected data, where memoing (a mandatory part of the grounded theory research process) took an important part. My biggest challenge in the research process was to suppress the feeling of being unhappy (or almost angry) that students did not complete their programs. I accomplished this part of bracketing by looking into positive aspects of students’ persistence. Having another faculty member with me during the pilot study process helped me to avoid interfering with participants’ testimonies (Tufford & Newman, 2011).

My intention for the interviewing was to explore the views, thoughts, feelings and experiences of participants relevant to the observed phenomena, while trying to understand them and involve them in the cyclical process of collecting data and developing the embedded theory. I used an interview guide as recommended by Creswell (1998), in order to have structure and "natural flow" to the interview process, with questions carefully worded and ready to be asked. However, I gave myself the freedom to formulate follow-up questions in the moment. Using the interview guide (Appendix A) in the pilot study helped me to develop my personal interviewing technique, and to see how participants responded to the questions. The pilot interview guide was developed based on the knowledge obtained from the literature review, as well as suggestions and comments from my supervisor and the BCIT faculty member who was present during the pilot study interview process. The interview guide went through three revisions before it took the form used in the main study. The principal changes made through this revision process related to the questions posed about the participants' backgrounds, including name, age, gender, family status, and employment status as well as background in the power engineering field. Changes were also made to the wording of questions in order to make them more open-ended and ensure that they were not leading. The organization of some questions was also adjusted: they were grouped under themes relating to the students' previous experience, support from family and, employers and program faculty, and the benefits of completing the program.

Due to my full-time job and participants' own limited availability, the pilot interview process lasted six months. Even though Creswell (1998) suggests 20-30 interviews in the grounded theory approach, for the purpose of the pilot study, to gain interview experience, to step into the challenges of coding and to support the conceptualization of the main research study, the number of interviews was limited.

All interviews were held on the main campus of BCIT in a campus cafeteria in order to have warm, comfortable and familiar environment. All interviews of the pilot were performed with the presence of another faculty member in order to support the bracketing process. Interviews were recorded with verbal permission. Some scholars, such as Glaser and Holton (2004), think that it is better not to record the interview but instead take notes, so as not to become overwhelmed with recordings. In the pilot study, I employed both digital recordings and notes, because I was not certain that the recorded data would not miss some important points that participants would make. I also felt that using my notes would serve well in the additional clarification of participants' statements. Finally, note-taking helped me to stay focused in the interview process, as Glaser (2004) pointed out.

I did let participants know that I would take some notes, and this did not appear to produce any disruptions during the interview process. Taking notes helped me to keep in contact with the participants' responses, yet did not interfere with their talk. In this way, I had a "silent" conversation with the participants and collected data. Knowing that it is expected to add subjectivity to the notes, recorded data serves as the raw data, but supports the conversation between collected data and the researcher.

Each interview in the pilot study was approximately 60 minutes in length. I tried to stay in the range of 60 minutes, during which I was trying to get "fresh" data that I could compare with existing data. In this process, taking notes helped me to stay connected to the data. This process was ongoing, especially during the interview process for the main study and during the process of analysis; but it has continued even as I am writing this.

Main Study

Interviews were conducted at the participants' convenience, and like the pilot study were approximately one hour each in length. The interviews took place at the BCIT Library for students able to participate in person, to ensure a neutral environment (as opposed to the author's private office). Preference was given to in-person interviews when possible, due to the advantage of visual social cues. It was considered that social cues such as body language might offer the interviewer additional information. Only three in-person interviews were recorded due to participants' wish to not be recorded. For all other in-person interviews, the researcher relied on paper-and-pencil notes. The lessons I learned from taking notes during the interview process for the pilot study became very important during the main research interview process, as some of the participants did not want to be recorded and some needed to be interviewed via telephone for logistical reasons.

For those who were not able to attend an interview in person due to their job duties or other needs and responsibilities, interviews were conducted via telephone. The possibility of using video chat (e.g. “Skype”) technology was considered, but interviewees expressed discomfort with using this technology, so only telephone interviews were conducted. For these interviews the researcher relied exclusively on paper notes.

During each interview (regardless of whether an electronic recording was made) I took extensive notes. At the end of each section of the interview guide, I read my written notes to the interviewee in order to ensure the validity and completeness of my notes. I originally planned to conduct a follow-up interview with each participant if necessary, but due to reaching “theoretical strength” with the data obtained in the first pass of interviews, a second interview was not conducted.

An open-ended interview approach was applied to ensure that the research questions were covered. As Patton wrote,

> *A qualitative design needs to remain sufficiently open and flexible to permit exploration of whatever the phenomenon under study offers for inquiry. Qualitative designs continue to be emergent even after data collection begins (Patton, 2002, p. 255).*

The key interview questions used are provided in the Appendix A; however, some questions had sub-questions and follow-ups in order to clarify respondents’ answers. The questions changed during the course of the research to reflect my level of understanding of the observed process (Creswell, 1998; Rapley, 2004; McCracken,1988). As issues emerged, questions were also added to explore these issues in greater depth. Examples of questions related to emerging themes are those related to students’ prior educational background, and those related to the psychological outcome theme, as well as to the pain that students experienced during the course of their studies.

Data Analysis and Verification

The data analysis process followed Charmaz’s (2006) approach (Figure 3-3). I found that collecting data, preparing interviews, going through the interview process, writing notes and memos are a continuous, nonlinear process that leads to further data collection and analysis. As Coffey and Atkinson pointed out,

> Letting data accumulate without preliminary analysis along the way is a recipe for unhappiness, if not total disaster. (Coffey and Atkinson 1996, p. 2)

Initial coding of the pilot data as well as of the main study data followed Charmaz's advice to use gerunds in order for the researcher to: "detect processes and stick to the data." This coding process starts with the following questions (Charmaz, 2006):

- What is the data a study of?
- What does the data suggest?
- From whose point of view?

Pilot Study

In the process of data analysis during the pilot study, it was difficult to say when the initial coding stopped and the focused coding started, because of the constant conversation between data, codes and myself. Once a smaller number of "new" codes were formed with emerging initial codes, the process of categorization started. This process was the hardest for me. It was challenging to avoid keeping all of the data in the process, and at the same time not be overwhelmed by the quantity of data. Creswell (1998) suggests that not all data will be used in theory development, and some codes will be taken out of the whole "picture." I did not want to force data into the process, since I wanted data to "naturally" flow in the theory development process even though I knew that I did not have enough data for theory to be embedded in. To satisfy that "natural" flow I had to go back, talk to the raw data again, and develop more codes, categories and written memos.

Memoing

Charmaz (2006) strongly recommends memo-writing. For me, memo-writing was essential to building the relationship in the conversation between the raw data and myself. At the same time, it was very hard for me to keep memoing. I realized that writing the memo is like allowing the data to rise into a new "creature"; it was a living process. In addition, as with any live process, it does change with time. At the beginning of the memo-writing my memos were messy and incomplete, and also mixed with my opinions. At the very beginning in this process, I tried instead of describing data to analyze data. For this purpose I used small sketches where I set the participants in the middle and had their testimonies presented as clouds (Figure 4-1).

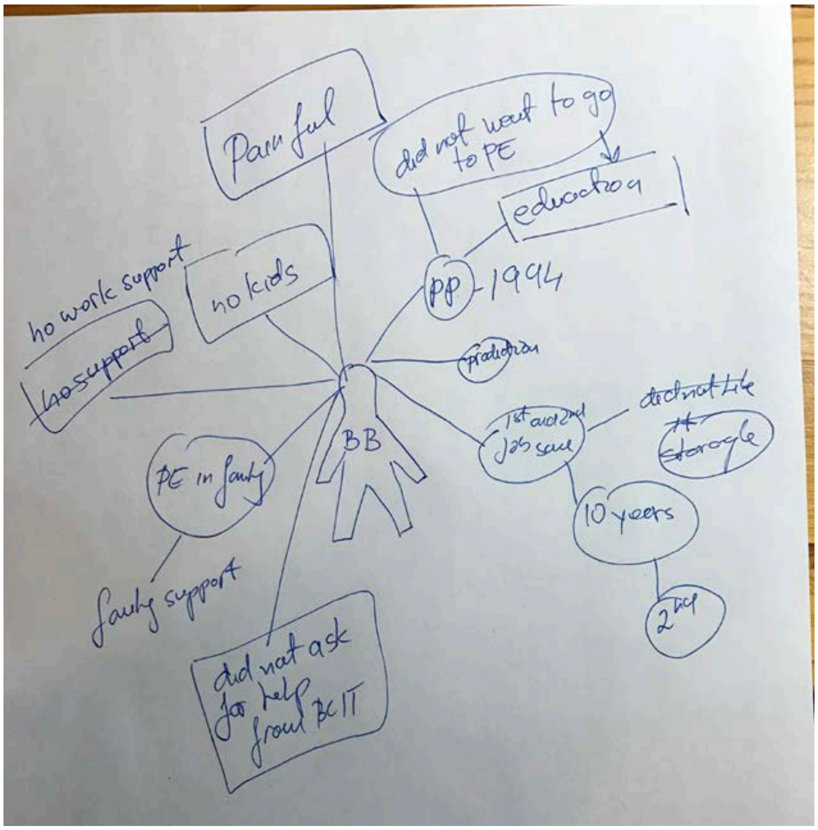

Figure 4-1 Coding process

I believe that my problem as one having previous knowledge about the power engineering field was that I wanted at the very early stage of memo writing to see all the connections between the collected data, and to develop theory. I needed to increase the uncertainty in order to allow the corpus of data to grow and not force a premature conclusion to the study. I had to “free” myself from the burden that I had to develop theory, so I was writing (drawing) memos in a sense to convince myself that it was acceptable to go back and change it in order allow a theory to develop.

Constant comparative analysis

The pilot study, conducted with data from pre-theoretical sampling, followed the constant comparative method of analysis, which involves constantly examining the similarity between the old and new data (i.e., previous interviews and most recent interview, their differences and variations, throughout the research process. Practically, the data analysis process is not linear, but follows a cyclic pattern that involves constant comparison of emerging data and its collection from the field, as well as constant comparison of all new data with emerging codes. This process requires that data analysis be done almost immediately after each collection, so that further collection can be done based on theoretical sampling. This cyclic process continues until the data are saturated (Charmaz, 2006; Coyne & Cowley, 2006).

I followed Charmaz's suggestion to look into data immediately after each interview was done, and for each participant I made a small drawing (e.g. Figure 4-1) with initial codes. After each interview was completed, I connected these drawings into the large drawings with the possible connections between the initial codes. I had these drawings on a big piece of paper so I could visualize the possible connections between their initial codes and to make any changes if it was needed. When the first cycle was completed I went back to the data and considered possible new codes and connections.

Charmaz (2006) suggests that data are saturated when obtaining new data does not lead to new categories from which new theoretical understanding can be produced. It is very important to not confuse saturation with repetition. In order to maintain a distinction between these two similar and yet very different things, it is helpful to think of "theoretical strength" instead of data saturation. "Theoretical strength" is related to the strength of data reflecting a certain code. This does not imply that "theoretical strength" depends on the number of occurrences of a code. Rather, theoretical strength depends on the strength of data that describes a certain code and that could be developed from one or ten collected from interviews data. It was expected that data would not reach "theoretical strength" based on the number of interviews. This emphasizes the quality of data over quantity of data in order to reach "theoretical strength".

Coding and data categories

The constant comparison process permeates the coding procedure, which involves sorting and analyzing data, and makes this process alive. Codes can be thought of as connections between raw data and theory embedded in raw data. In the coding process, the large quantity of collected data is condensed, so that deriving meaning from the data becomes more manageable. Coding is therefore a process of reducing the quantity of raw data, and aiding the development of concepts and theory embedded in it. On the other hand, the coding process can potentially complicate an already massive and complicated corpus of raw data, because it involves a deep and creative conversation with data, not just a dry sorting of them.

During the initial coding process (also known as an “open coding” process), I was connected to the raw data for the first time. Following Charmaz’s advice (2006) I tried to keep codes “short, simple, active and analytical.” I also tried to use codes that would give me the best interpretation of raw data as well as to keep them alive so that I could reword them if needed.

As a grounded theory researcher, I found the process of coding very challenging. I was certain that a large number of codes could complicate the coding process, but choosing the right ones that will satisfy “theoretical strength” was my primary goal. I wanted to avoid merging codes into categories based on the “possible” similarity in the process description. The list of these codes related to the three original transcripts from the Pilot study are presented in Appendix B. Examples of initial codes and the data presenting these codes are shown in Table 4-2.

After the initial codes were developed from the raw data, the development of the “initial” theory grounded in the data obtained from the Pilot study was started with a focused coding process. This process asks for a more conceptual approach that includes the decision-making process related to grouping codes into categories, presenting the grouped codes as building blocks in the process of developing the “initial” theory. During this process it is very important to continue to recognize the similarities as well as differences in the collected data. This is the first step where I reflected on the data and started to build the theory embedded in it (Coffey and Atkins, 1996).

Table 4-2 Example of Initial Coding Process

Original raw data	Initial Code
Graduated from Power and Process program way back in 1994, obtained work experience, in production environment more running the process and production equipment. First and second job were the same. First was temporary position with more hours as an operation junior engineer. Over 10 years I developed the plan to go for 2nd from 3rd class. During these 10 years I was working as a 3rd class power engineer and I started working on my 2nd class courses(BB)	Getting experience as a young engineer
Initial I wanted to study electronics. After high school and I did not know how to progress to next step and my father asked me to take Power and Process engineering courses and he had influence on my choice of education. He told me that Power and Process engineering is very extensive. I took the math and science to prepare and it took me three years to get ready for this program. It was waiting period. (BB)	Did not want to go to PE
To expand my knowledge in the industry. Also job security, more job opportunities. (CC)	Expand knowledge Job security More jobs

During the focused coding process, not all codes were used in developing the analytical groups. Some of them were grouped based on similarity, and some of them were not. Because of the "isolated" codes, the focused coding process asked for revisiting the initial coding, or even revisiting the raw data. In this process, I had to go back to the raw data and "talk" to them. I tried to keep them alive so I could either see their place in the process with confidence, or not use them at all in further analyses.

At the same time, I tried to come to a smaller number of categories. Some codes I could not place in the emerging categories, which resulted in further reconsideration of the categories. I did not want to force any merging, because I felt that could potentially influence the further development process and understanding. During this process, certain categories seemed to naturally arise from the raw data, while others asked for further analyses to justify grouping them and placing them under certain categories. For example, the Education category, as well as the Family Background category in the pilot study were naturally developed from data (see Figure 4-2). My next challenge was to relate these categories to each other, and build another brick in the "initial" theory development, theoretical coding.

In the process of theoretical coding, categorizing data was not the primary task. The focus was placed on obtaining relationship between categories that had emerged from focused coding. This process presents the final "brick" in the development, because it compiled my previously-developed categories into the "main" categories. At the same time, theoretical coding allowed me to notice possible missed relationships between codes and return to categories from focused coding, or even further, to initial codes from raw data. This emphasizes the nonlinear characteristics of the theory development process in the grounded theory approach.

Theoretical coding should result in one or more "main" categories that lead to a theory explaining the observed phenomena (Charmaz, 2006). From the researcher's point of view, this is the main brick that holds together the theory, which tries to explain the observed phenomena.

The challenge I experienced in this process was to reach a level of certainty that these two "main" categories present a strong base for the theory that is to be developed and presented by the main research work. As I discussed earlier, theoretical coding required me to go back and revisit the developed categories or codes and make sure that these are connected and presenting, in the best possible way, the persistence of mature distance education power engineering students. In the pilot study process, I stopped the data collection without reaching "theoretical strength", knowing that the purpose of the pilot was not to develop theory, but to help me gain experience with qualitative interviewing, understand the cyclical nature of collecting and analyzing data in grounded theory, and understand the process of coding and theory development. I also expected that doing the pilot study would help strengthen my rationale for using a grounded theory approach in the main study. Based on the experience of the pilot study, I found that my personal involvement with the research environment produced rich

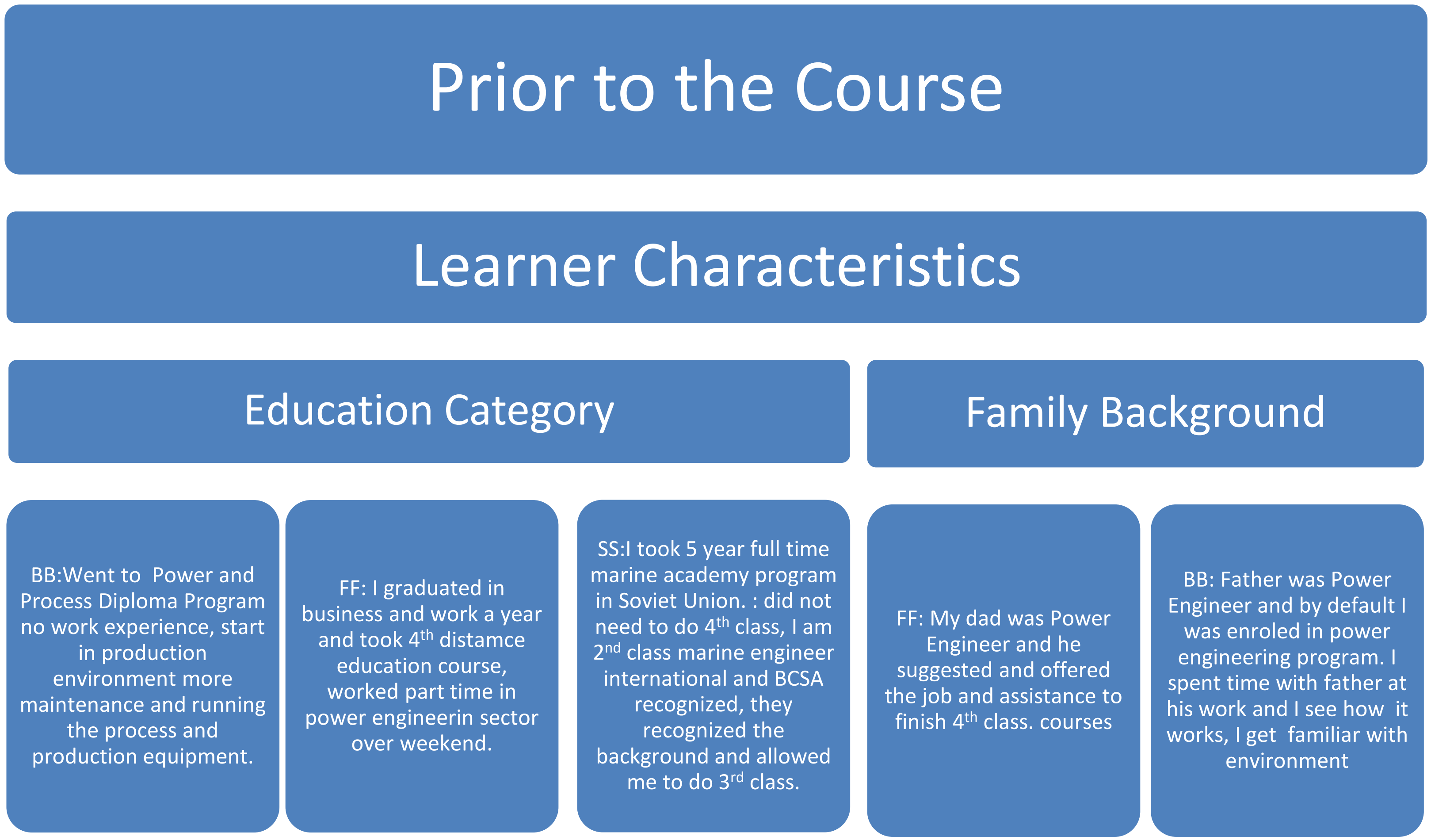

Figure 4-2 Example of Coding Process – Pilot Study

data that could serve as a starting point for a possible theory, and further collection for the main research work.

The purpose of the pilot study with persistent 2nd and 1st class adult power engineering distance education students was to test procedures, practices and materials I had in view for the main study – specifically my interview skills, the interview guide, and the time needed to conduct interviews. Collecting data in the pilot study aided in devising the process of coding and memoing, though not so much in the process of theory development due to the small number of participants .

During the pilot study I was able to gain experience with the use of the grounded theory approach to pursue an understanding of a social and cognitive phenomenon; ability to persist in a particular kind of academic program, under their particular life circumstances. This purpose matches the general purpose of qualitative research:

> to gain an understanding of the nature and form of phenomena, to unpack meanings, to develop explanations or to generate ideas, concepts and theories (Ritchie et al. 2003 p. 82).

The following section will explain the main research study process, which followed immediately after the pilot study was concluded and applies all lessons learned in the pilot study. Lessons learned during the pilot study process were the driving forces for the main study research process.

Main Study

Coding

In the same way as the process observed in the pilot study, coding in the main study included three main steps (Charmaz, 2006): Initial coding, focused coding and theoretical coding. Initial coding is the starting point where the researcher and raw data meet each other. Charmaz's (2006) advice is to keep theses codes simple and short, and keep them "alive," meaning that changes are possible if necessary, and codes are not set in stone. It is recommended to start with what is called *in vivo* coding, or taking the exact wording from the participant that keeps their voice alive. Looking deeper into these *in vivo* codes may open new views and new understandings, and helps the researcher progress to the next step in the coding process – focused coding. The initial coding process for the main research study ended with 232 initial codes, which are presented in Appendix C.

Focused coding is the most significant part of the coding process, in which the initial codes are merged into new ones that are more analytical in nature. Focused coding encourages comparison between the chosen (descriptive) initial codes and the raw data. It is important for the researcher to be able to analyze the initial codes list and to identify the higher-level categories into which these codes can be grouped, because the outcomes are analytical categories where the process of theory development occurs. Focused coding is the first step in establishing the relationship between codes and concepts. It is important to point out that during the process of focused coding; the initial coding is still alive. During the process of focused coding, some codes were grouped based on their similarity to one another (Charmaz, 2006; Dey, 2004). A list of revised codes is presented in Appendix D.

In this process, it is important to form categories but it is also important to explore and observe the connections and relationships that might emerge from focused coding. Keeping codes "alive" in this way also helps in finding possible gaps in the process of theory development. This gives the researcher the opportunity to go back to the field for further data if necessary to fully explore the phenomenon. Communication between the coding, theory development and raw data shows how the whole process under grounded theory follows a cyclic path. Further analyses go under theoretical coding that explore existing categories and summarize them in one or more "core categories" which centralize the researcher's understanding of the observed process (Charmaz 2006, Lampert, 2011).

From this description it is evident how the three-stage coding process grows from the ground to higher level abstractions, following cycles in the coding process as well as in the process of theory development. This process gradually led me to the conclusion that "theoretical strength" had been reached by the time I had analyzed my 20th interview.

Memoing

In the memoing process the researcher constantly talks to the data, already developed codes and categories, in order to bring the whole process to a higher level that will reveal relationships within data, codes and categories, and their properties and conditions (Charmaz, 2006). During the pilot study process, I did not fully emphasize the memoing process as Charmaz suggested; however, I fully realized the importance of memoing in the main research study. Through memoing, I started talking to my data and thoroughly developing my understanding of it. Naming the categories and trying to explain them encouraged me to express the connections between them more clearly and placed them into the whole picture of the observed phenomena.

The final step in the grounded theory approach is theory development, which offers an understanding of the observed process by identifying patterns and associations (Coffey and Atkinson, 1996). It describes the phenomena and explains the processes underlying the phenomena. Creswell (1998, p. 65) pointed out that the "final product" of a grounded theory study

> *is articulated toward the end of a study and can assume the form of a narrative statement (Strauss & Corbin, 1990), a visual picture (Morrow & Smith, 1995), or a series of hypotheses or propositions (Creswell & Brown, 1992).*

Analyzing the data in a qualitative study is an inductive process (Creswell, 1998; Guba & Lincoln, 1989; Patton, 2002). "Qualitative analysis transforms data into findings. No formula exists for that transformation" (Patton, 2002, p. 432). Unlike quantitative analysis, there are no prescribed formulas for analysis. A qualitative study typically produces imposing amounts of data. Developing codes and categories in order to establish common meanings with significant patterns is the central and most important task in any qualitative study (Creswell, 1998).

For Charmaz, coding is the essence of the development of grounded theory. According to Charmaz,

> *coding is the pivotal link between collecting data and developing an emergent theory to explain these data. Through coding, you define what is*

happening in the data and begin to grapple with what it means (Charmaz 2006, p. 46).

I used Charmas's method, which captures actions or processes described by using gerunds as codes. Using Charmaz's suggestions, these codes should stay as close to the data as possible. The outcome of the coding process after ten interviews is presented in Figure 4-3. The names of the initial codes were changed in the final persistence model presented in Figure 6-1, which is in agreement with the grounded theory development process (Charmaz, 2006).

Throughout the study, I wrote individual (for each participant) and conceptual memos. The individual memos were a reflection of what I learned from each participant about their experiences. I also used memoing as a reflection on the interview process, so I could improve my skills in order to obtain data that would represent participants' experiences and feelings in the best possible way. After a few interviews, I observed potential categories and I decided to compile memos related to interviewed participants into memos related to these potential categories. This helped me to observe the relationship between codes within categories and to fit the potential categories with the observed phenomena.

Creswell (1998) and McMillan and Schumacher (2001) outline several verification procedures to enhance trustworthiness in qualitative research:

- prolonged engagement in the field,
- triangulation, peer review or debriefing,
- negative case analysis,
- clarifying researcher bias,
- member checks,
- a thick rich narrative description,
- external audits

Following Creswell's advice of using at least two procedures to enhance trustworthiness in qualitative research, in this study I employed member checks and collected data were reviewed by another member of the Department that was present

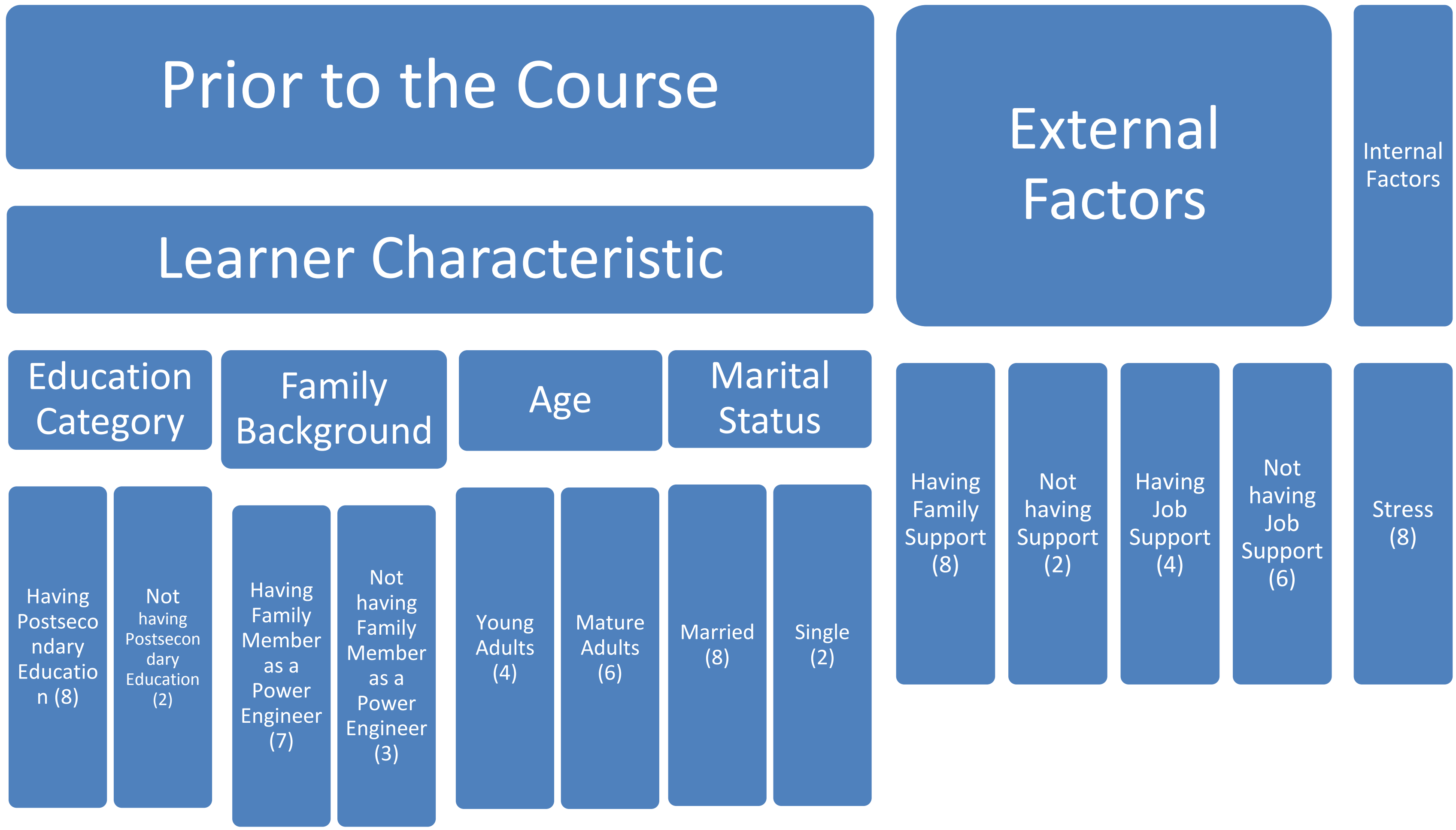

Figure 4-3 Example of Coding Process during the Main Study

during the interview process. The member checking process involved two participants and one BCIT faculty member (who was present during the pilot interviews) reviewing the collected data (notes and recordings) to ensure their accuracy. This faculty member generously offered to check the collected data (notes and recordings) from all participants. I also shared the overall results of the study (before the thesis defense) with the participants to ensure that their meaning had been accurately captured in my quotations. Three of these participants gave me positive responses and expressed interest in the final theory. Other participants were asked to provide their comments, but due to their busy schedules they did not provide any. However, these participants did express interest in the final research report when it was available.

The following steps were incorporated in order assure quality during the study:

- For every interview that was recorded, a transcript was developed and compared with the recording (if available)
- Individual memos were written just after each interview, in order to organize my initial thoughts and allow constant comparison between my reflection and data
- The constant comparative method was used in order to not only keep obtained data in order, but also to support the process of connecting concepts (categories) to my developing theory of adult power engineering students' persistence.

As this description makes clear, data collection, data analysis and data validation were developing simultaneously with the researcher's experience. I believe that this is the case with any other research method, and using Grounded theory is not different from any other method, it develops with experience. I found that there is no unique set of guidelines for a beginning grounded theory researcher.

Limitations of the Grounded Theory Approach

The first and most important limitation of the grounded theory approach is that data are collected from a small number of participants relative to the size of the population. Therefore using this study to understand the persistence of power engineering students in Canada must involve a process of naturalistic generalization (Stake & Trumbull, 1982). Naturalistic generalization emphasizes practical, functional application of research findings that naturally connects with readers' ordinary experiences. As readers consider the in-depth particulars described in research studies, they may view similar circumstances in their lives through "new lenses." Gobo (2004) states that generalization is either justified by statistical logic, or through the nature of the sampling process based on theoretical sampling. This being the case, it is possible that my theoretical sampling could compromise the broader application of the research findings.

Another limitation of the study is related to the coding process, which constituted my data interpretation. There is no doubt that my data could be coded in different ways by another researcher. This implies that two researchers could come to different conclusions, looking at the data through different lenses. The coding process was informed by my 25 years of experience in the power engineering field. This is the nature of interpretive inquiry (Miles and Huberman, 1994). The coding process in the grounded theory approach is very time consuming and tedious work. Sometimes it is challenging to decide when to stop the constant comparison that the grounded theory approach asks for. A summary of what constant comparison involves is best provided by Charmaz. She explains:

> *Generating codes facilitates making comparisons, a major technique in Grounded theory. The constant comparative method of grounded theory means:*
>
> - *comparing different people (such as their views, situations, actions, accounts, and experiences),*
> - *comparing data from the same individuals with themselves at different points in time,*
> - *comparing incident with incident,*
> - *comparing data with category, and*
> - *comparing a category with other categories.*
>
> *It is essential that researchers have to ensure that constant comparison is ongoing, as it is the process by which they sort the emerging themes on account of their similarities and differences. (Charmaz 2006, p. 259)*

As a researcher conducting qualitative research under the grounded theory umbrella, I believe I will need more research to be as certain as I would like to be about the outcome of the coding process. Even Glaser (1978) observed the limitations of developed codes as a battle between ones that agrees with each other and ones that opposes each other in the process of theory development.

Furthermore, based on Charmaz's guidelines (2005), the researcher should recognize and acknowledge that no analysis is neutral, even though researchers sometimes claim neutrality. Researchers are not passive observers of information, they are active in the process of grounded theory research. I could have had someone else conduct the interviews to reduce the power differential between the interviewer and interviewee, but this would not have supported a crucial aspect of the grounded theory approach – bonding between the participants and the researcher (myself).

Chapter 5. **Results**

As discussed in prior Chapters, previous research conducted on the topic of adult distance education engineering students' persistence has been largely quantitative in nature. This research has suggested that adult learners are autonomous, self-directed learners, who construct new knowledge by combining new information with past experiences. They tend to be more internally motivated than younger, more traditional engineering students as well. For adult learners, learning is related to changing social roles; they need to see the benefit of the new knowledge, and the sooner they see it the more prepared they will be to involve themselves in the learning process (Knowles, Holton, & Swanson, 1998; Merriam & Caffarella, 1999).

The present study was designed to examine the phenomenon of power engineers' persistence qualitatively, and use the stories of adult distance education power engineering students who have persisted in 2nd or 1st class power engineering courses to explore the following main research question and sub-questions:

- What theories (including existing theories or modifications of them) might explain the persistence of second- and first-class adult distance education power engineering students?

    - What is the relationship between students' family and work place support and their persistence?

    - What role do student perceptions of the learning environment and learning technology play in persistence?

While addressing these questions, I hope to understand whether there are identifiable differences in the stories of adult distance education power engineering students, and despite differences, what commonalities there are among them.

Codes and Emergent Themes

The interview guide was structured to help me examine the participants' power engineering journey from earlier days to the present time. All individual interview transcripts/notes were coded with initial, focused and theoretical codes, supported with constant memoing in order to obtain the embedded theory of adult distance education 1st and 2nd class power engineering students' persistence.

Even though the questions in the interview guide were organized to follow certain logic, the theoretical codes collected from the data were allowed to develop inductively without prior assumptions about the relationships among data, initial, focused and theoretical codes. The persistence model I developed considers processes prior to taking and during the 1st and 2nd class distance education power engineering courses.

Prior to taking the distance education 1st and 2nd class power engineering courses

Learner characteristics: Family heritage

Learner characteristics, as an indicator of adult distance education 1st and 2nd power engineering students' persistence prior to taking the distance education 1st and 2nd class power engineering courses, includes a student's family background, including role models, educational background, marital status, and age.

Existing research has examined the role of a family member (either grandfather, father, mother, sister, brother or uncle) in the education and occupational choice of students (see Table 5-1). Any of these family members being power engineers appeared to be the driving force behind the decision of many of my participants to enroll in 1st and 2nd power engineering distance education courses.

Table 5-1 Family background in Power Engineering

Participant	Family member
FC	Father
BV	Father
JR	Uncle
KU	Father
KB	Grandfather
JN	Father
JN2	Uncle
SF	Grandfather
CM	Father
RN	Father, Son

A few illustrative quotations from my interviews provide a sense of what the influence of these role models meant to my participants in terms of their educational choices:

> *My father encouraged attainment of a hard, technical skill set or Trade. My mother encouraged academic advancement. (CM).*

> *I got a job in business and a good job in the mining industry in BC but the economy of the early 80's went down so my dad who was a PE suggested and offered the job and assistance to me to finish 4th class. (FC)*

The influence of these role models was important to my participants' occupational choice as well:

> *My father was a PE and therefore by default I went into the PE field. During that time I was working with my father and he advised me that a 2nd class certificate is the "best" certificate. I did the research and [realized that with that certificate] I could work as a shift engineer. I wanted to still be involved with operation and yet obtain 2nd class. I set the goal where I wanted to go. (BV)*

Educational Background

In order to understand adult distance education 1st and 2nd class power engineering students' persistence, it is important to understand the significance of students' previous educational background, while not treating it solely as a limiting factor. Table 5-2 lists the previous educational backgrounds of all participants. The educational backgrounds are very diverse, from no previous background in power engineering to postsecondary education (a Master's degree and PhD in either Chemical or Marine engineering). Some participants openly questioned the value of postsecondary education as preparation for careers in power engineering, and considered practical experience more valuable as a measure of a good power engineer. As one participant put it:

> *I think that being in the field is more important than taking courses. However, we have to do it and so I am doing it. I do not like it but in order to receive pay and being able to get a better job is making me to do it. (JN)*

Four students pointed out that having the right previous education, knowing how to study what to study, and where to study has a big impact:

> *To finish homework and stay on top of the work, one must find a proper environment to study: I need more time and fewer distractions from home. (SF)*

> *However I did take physics in high school and found that provided tutorial was very helpful. (KB)*

> *[BCIT should have] more tutorial one on one. (AS)*

> *Having the right place and the time [to study] is important, as well as asking for help. (DD)*

Table 5-2 Previous Educational Background

Participant	Educational background
FC	Diploma
BV	Diploma
JR	Diploma, Degree
KU	Degree
KB	2 one-year Post-secondary programs
BK	Some
DD	Diploma
DT	Diploma
JN	2 one-year Post-secondary programs
JS	Some Post-secondary education
MB	Diploma
SF	Diploma
CM	PhD
NV	Diploma
JG	Diploma, Degree
SY	Master

Age and marital status

There is no clear influence of age on persistence (Figure 5-2), though most of the participants were married (Figure 5-1). However, some participants expressed the view that it would be easier to complete the program without having family or being married. Participant JN, who was 21 years old, pointed out:

> *I am not married and my parents supported the idea of taking further education, so I want to further my carrier in PE. I found it is easier to do the studying before having my own family.*

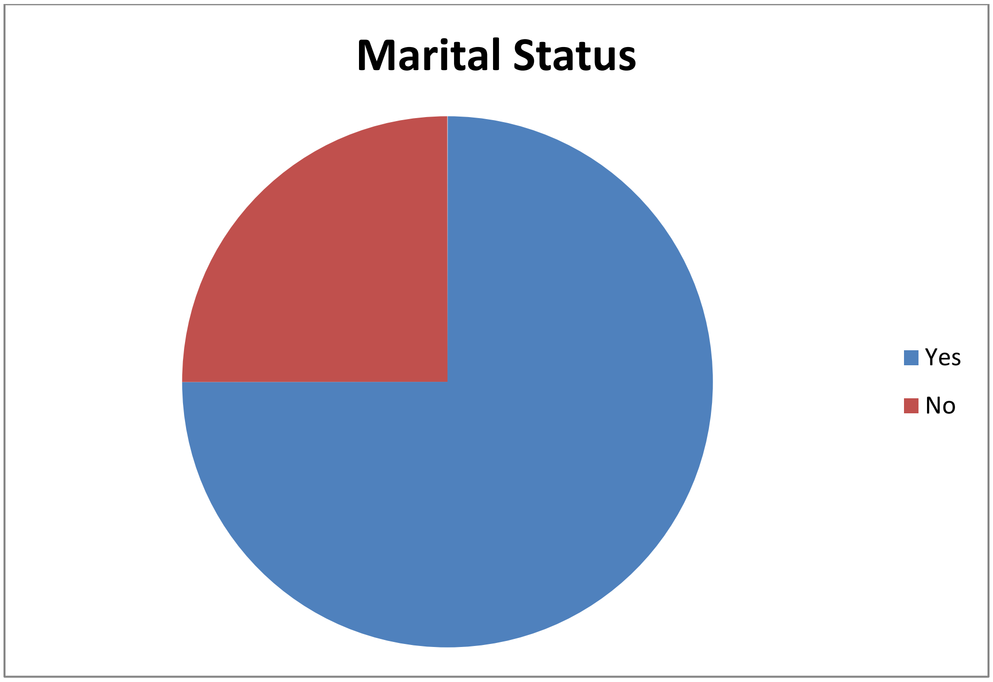

Figure 5-1 Students’ marital status

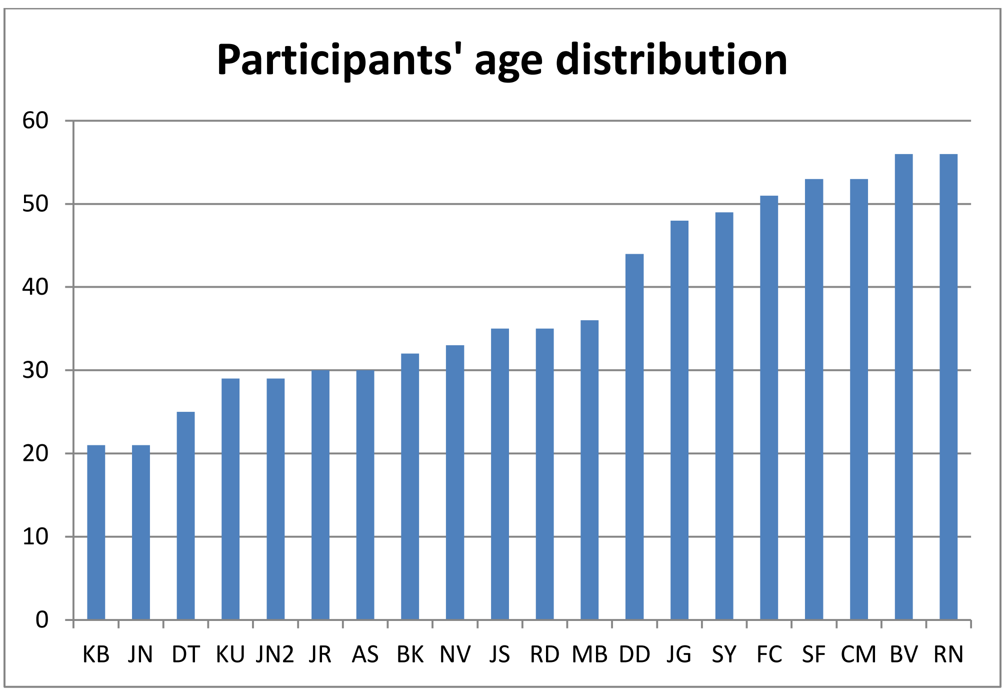

Figure 5-2 Participants’ age distribution

Internal factors

Instructor–student interaction

Participants were asked what role their instructors played in their educational journey through the 2nd or 1st class power engineering courses. Figure 5-2 shows the distribution of students' responses to the question, organized as positive (P), neutral (Ne), and negative (N) responses. In seven cases instructors were perceived to have had a positive impact, in three cases a negative one, and in ten cases instructors were not perceived to have had any impact.

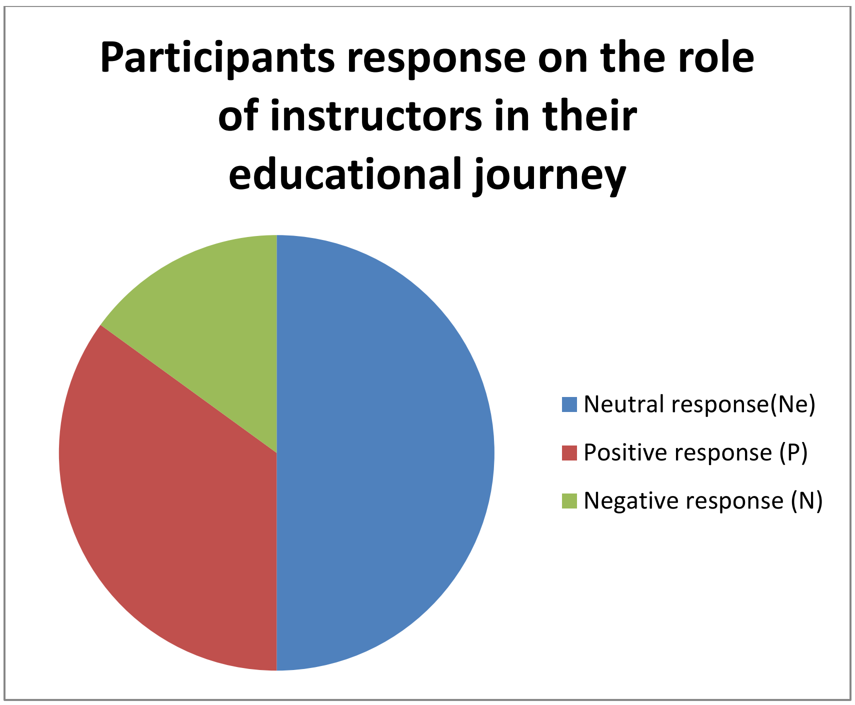

Figure 5-3 Participants responses on the role of instructors in their educational journey

The following quotations provide a sense of the range and complexity of the participants' views on their power engineering instructors:

> *I have great respect for the faculty. It is challenging, at first, to have others realize the benefits and great potential for Power Engineering. When I started the 4th Class course, I was skeptical. I presumed that 'steam' was old technology. Thankfully, I continued with this discipline. (CM)*

They have been very supportive of me. They are great. They have the passion and capability to do their job. (JG)

They made me feel that not only could I continue on in Power Engineering, but also continually encouraged me toward even greater goals. The people are very encouraging and make me want to achieve great things. (NV)

These three participants had strong educational background for their studies in power engineering. For the majority of participants however, instructors played a very minimal role in their educational journey through the 2nd and 1st class power engineering courses. For most of the participants, their lack of interaction with instructors was their own choice. However, three participants pointed to a lack of interaction and action from the instructors' side. Two participants expressed concern that instructors did not respond in ways that seemed appropriate to them. They reported receiving poor or no help from faculty:

I think we do not have enough contact so it is really hard to say. However, if I ask for help they will help, but I do not ask that often. I talked to co-workers instead and try to get help that way. If that does not work then I would ask for the help that BCIT offers. It takes some time for an instructor to get back to you. (KU)

It is really good. They are very supportive. It is me who is not asking for help. (JN)

I have heard that some people who did not go through the full time Power and Process program did not receive the amazing sense of welcome that I, and others from my class did. I can't say they could have been more supportive in any way, but I do know others who didn't feel as supported. The common theme seems to have been that others from my work received responses that were so impersonal as to feel rude and illogical. (NV)

The sense I drew from participants was that when students begin their studies in power engineering distance education courses with supportive faculty in a friendly climate, it could make an important difference to their persistence. Four of my participants were fortunate to have had that experience. In some cases, this interaction with faculty coincided with improved grades and academic performance:

I had a great experience, they welcomed me, and the initial experience was at the top of the scale. The moral support, especially from some members *with past experience, was natural and great. I've been thinking of ending my career in PE education. I am very thankful (SY)*

They are a great blend of instructors and personalities that enjoy what they do and are great at passing on knowledge to the newer generation. Some may get frustrated at times when students don't understand a concept but that's normal in any industry. (JR)

I still keep in touch with them. They have gone above and beyond my expectations. Keep up your great work. (JG)

Co-workers were also mentioned as sources of support. BV pointed out:

At work I got some information and received some helpful worksheets and study material as well as help from coworkers.

Assignment level

Another theme in the interview data was how the amount and length of assignments related to participants' persistence:

I started [the assignments] with a lot of enthusiasm, but I was quickly overwhelmed by how long many of the answers needed to be, and how difficult many of them were to find in the material provided. I spent a lot of time on Google trying to find information. (NV)

As well, many of the questions that state where an answer is have the wrong location in the books, or reference material that has been removed from the books altogether. They were all difficult for me considering that I am 53 and I was away from school for so long. (SF)

The course material is overwhelming, too much; less could be better (KB)

On the other hand, some students reported finding the assignments very useful:

Thermodynamics and Applied Mechanics have been very useful for me to learn the concepts and principles. The questions are very clear, and the answers very accurate. Those are the subjects that many power engineers *find difficult, but with the study materials I get from the BCIT distance education program, I find them pretty easy. (JG)*

I don't remember what the course was. It was one of the 2nd class courses. On that course, I finished my BCIT study and wrote my BCSA exam shortly after. And surprisingly, two questions on the exam looked very familiar to me. I passed that exam easily. I think it was pure luck. (JG)

The 2nd class drawing paper. I had drawn so many sketches and diagrams using the engineer format that I did a really nice three dimensional view drawing, did the other three questions and had an hour to spare. (RN)

The participants often referred to time management as a cornerstone to persisting in any of the power engineering courses. They also found balancing academic and social life to be crucial in the persistence process. The students must, KB said:

Study 10-20 hours every week, schedule and structure studying time throughout each course.

As BK pointed out, students must also set priorities in relation to family life:

They [the assignments] are all a pain in the a.., but it has to be done. The pain is there, especially with four kids.

Regardless of the individual's preparation in high school, time management was a skill that needed to be honed immediately. Participants suggested that enough time does exist for adequate studying *and* social experiences, if the time is well managed:

It appears to me that managing the time and setting priorities is the most important. I am still young and easily distracted. I have to be sure that I am away from all distractions, so the classroom works best for me. (JN)

Participants also highlighted the importance of finding balance in their lives. They felt that sacrifices needed to be made sometimes, but a persistent student also needs to have some breaks. CM and MB pointed out the importance of spending time with family in order to recharge for further study:

I work from Monday to Friday and return home each evening. My wife works at home. My wife and I have dinner together. We each attend to our chores (i.e. study, work, personal, etc.) and then we spend the evening together (CM).

I think I try to not bring it home, so they do not have to do anything special. I try to spend time with them and help my wife as much as possible considering that I do work 1200 km away (MB).

Technology issues

The Usability of the Learning Management System

Answers related to questions about BCIT's Learning Management System (LMS) could have revealed students' satisfaction with the availability and quality of learning materials in the courses, as well as the perceived connection between the material and the knowledge required for government exams. However, my interviews revealed that the majority of students did not use the LMS for anything more than posted assignments. They completed their assignments through the system, but repeatedly pointed out that they would prefer a face to face course if it was available:

…I would say they [the assignments] were done with books, not so much online. I did not use it [the LMS]. It is done more by correspondence mode. (FC)

I did not use [the LMS] much. It was hard to get information from. Besides using it for assignments, I did not use it. I still prefer face to face classes. (BK)

I did take three courses, but I used only my assignments. And there are lot of questions to answer and info to find. Not too much contact with instructors or the course itself. I did not take any other course so I am not sure is that good or not, but it looks to me that students are pretty much on their own. (KU)

Some students had more experience in face to face classes, so they wanted to have some form of blended or mixed-mode power engineering course. As JR suggested:

All my previous power engineering courses were face to face, which was beneficial since I was new to the industry. Now I am progressing on my *own, with the help of assignments posted on the course site. For supplemental training or enrichment, prerecorded seminars would be beneficial.*

Five participants described the LMS as offering them the ability to control their time, and to ask for help at any time they need it:

It means that I have control of my time. I will manage my time, and ask for help. (KB)

[I have had] excellent experience with the process, LMS support, and people. Good support in terms of assignments and questions. Good turn-around time for assignments. (CM)

I think for people who are self-motivated, distance education is a great tool. I tested the model and it worked for me, and I am happy that I took it when I needed. I hope that others see the value of this DE program. The courses that BCIT offered were great, I like variety, I enjoy getting help from instructors, [and] these DE courses offered different tools. With my personal situation, I did not need interaction with instructors. I followed the structure and achieved my goal. That might not be the case with some of my coworkers. They needed more help and BCIT tried to offer that help. (SY)

External Factors

Sources of Support

As part of the interview, participants were asked to describe the sources of support they had used during the program. These sources of support included faculty, family, and support at work. While most students described faculty as sources of support, some of them explained that they had not even asked for help when they needed it (Figure 5-2):

I should have spent time with instructors, asked more questions (KB)

They [the faculty] provide help when you ask for it. I do not use the tutorial very often, but when I used it they answered my questions related to the assignments or the program in general. (BK)

> *I did not ask for help, did not feel I had to. It would be good if somebody had contacted me. I feel that I would do it when I can, and in the best way I can. (DT)*

Some of my interview questions and conversations were designed to address the support provided by coworkers or family, and in most cases, my interviewees described what from my own experience is the inevitable truth about studying in power engineering, or for that matter in any engineering field: one cannot complete it alone. Any engineering program, including power engineering, is rigorous and requires multiple levels of support. The participants were asked what advice they would give fellow students who struggle or consider giving up. The overwhelming response was “ask for help.”

> *I would suggest taking what BCIT offers and ask students to follow the structure [in the LMS]. If that is followed the rest has to do with the students’ knowledge base. I followed the structure and I completed the program. I am a structured person. (SY)*

> *…yes from friends, share the hardness of the course. My parents were always supportive and it was part of my motivation to make my parents proud of me. (BV)*

> *Having the right place to study and the time, these are important. Also, ask for help... (DD)*

Participants noted that peers and coworkers were also important sources of support. As BV said,

> *If you are struggling, get together with people; when you don’t understand something, it’s okay afterwards to go talk with the coworkers who did it before.*

Each student had a story about asking for help and some of them as NV highlighted the incredibly inclusive working environment. NV had a positive workplace experience:

> *This is a very nurturing environment…stable environment, I don’t feel like I am on my own.*

Some students explained how their coworkers (and not so much their fellow students taking the same course) helped them to persist in their power engineering courses. These students suggested that their relationship with coworkers with whom they share "shifts" (time spent at work) is another important aspect of the help they needed. Participants offered various examples of how their coworkers aided in their ability to persist in their pursuit of higher-level credentials in Power Engineering:

> *When I was working for the chief I learned a lot from him. He talked to me and when I had the opportunity to go for 1st class I took it. Yes, I can take the plant over [now], but that was not in my reasoning, it was more for personal learning. I had him as a mentor; in my normal duties he helped me a lot. (FC)*

The previous examples reveal how the support of co-workers can facilitate learning; but this support is not always available. The following example, which may not be an isolated case, reveals that the workplace can also sustain a culture of cheating that may work against academic persistence:

> *I had colleagues [in other plants], and they had knowledge of what is coming on the [government] exam. In my plant we struggled, as we had no knowledge on what is on the exam. People will pass papers, and we did not. If you have 20 people, they will go challenge the exam and get an idea of the exam and get exams out and pass them on to others. (CM)*

In spite of this example, co-workers were usually referred to by participants as sources of support in the studying process.

In most cases, participants' families were also sources of support for their persistence. With the exception of five participants, many of the participants asked their families when they were in need of support, primarily of an emotional nature. Supportive parents or partners provided listening ears, empathetic understanding, unconditional love and acceptance, encouragement, and occasionally, career advice:

> *My family (wife, mother, father, and extended family) understand my desire to learn. They have been very generous and gracious and I work to return this favor. I have used vacation time, with my wife's blessing, to study or sit for examinations. (CM)*

> *Supporting the idea of education. They like when I come home and complete the paper, yes they do like it and yes they do like to spend time with me. It is hard to balance the two but we are managing. (MB)*

Relatedly, participant BV explained that he "shares the hardness of the course" with family, and gained some confidence and relief to find that he is not alone on that journey.

Financial support

Fifteen out of twenty participants expressed that they would not have persisted with the 2nd or 1st class power engineering courses if they had not had financial support from their employers (tuition support), and/or time off from work for their studies.

> *[My] company offered to pay for the course and time off. As long as they pay for it, I am OK. (KU)*

> *Yes, my employer offered to pay for the course and offered time off, as well as incentives once I completed the program and obtained the certification. (BK)*

> *I had support from my workplace, my employer paid all the expenses. That is great support and serves as an influence. I am not saying that I would not do it without the financial support, but definitely with the support it is much better. (MB)*

Psychological Outcomes

Reasons for pursuing higher-level certification

As part of the interview, participants were asked to discuss their personal reasons for choosing to complete 2nd or 1st class power engineering courses. Figure 5-3 summarizes participants' responses to this question. The reasons stated by participants included more money, a better job, or greater job security. Few participants expressed a belief in the value of better education for the sake of better understanding or intellectual satisfaction. Further, even though modern plants require environmentally friendly, efficient and sustainable operation, surprisingly none of participants stated that they chose to complete 2nd or 1st class power engineering courses due to a concern for or appreciation of the environment or a desire to make a contribution to society. Most stated that they chose this course due to the promise of greater career stability and financial reward. Participant JR shared his reasons to obtain 2nd class certification as:

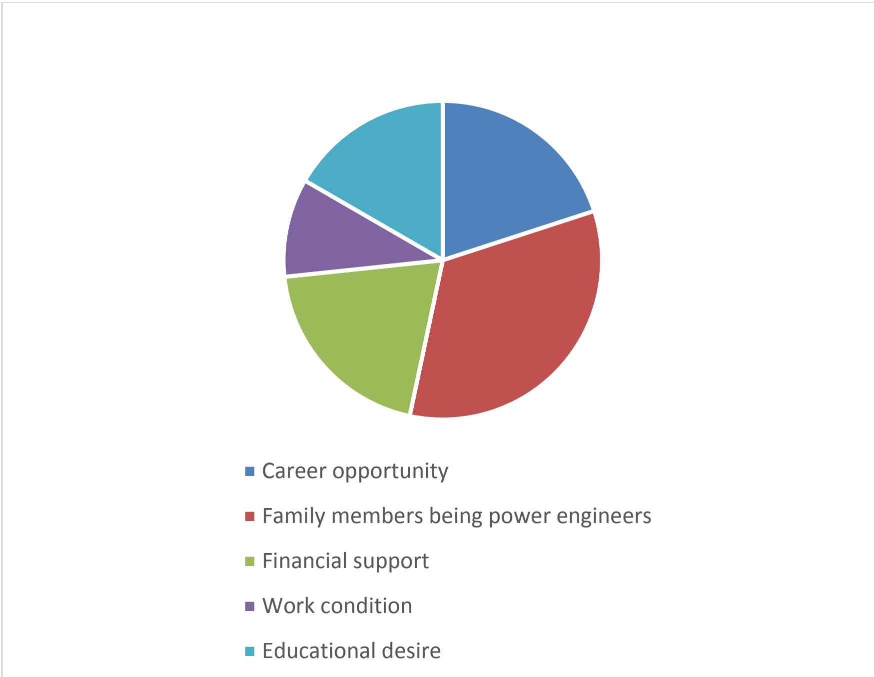

Figure 5-4 Reasons for choosing to complete 2nd and 1st class Power Engineering courses

- Career stability (at the time)
- Interest in process and plant operations
- Encouragement from family to take the course

Participant JG simply said,

It was basically a job market oriented decision.

As Figure 5-4 shows, the structure of opportunity, including a greater variety of job opportunities, opportunities to secure a better job after completion, and higher earning potential were very appealing to many of the participants. For example:

I like to be thorough. I was told by a superior that the BCIT certificate has a higher value when seeking employment overseas. (RN)

…my work environment is a major factor in my decision making. The people who hold a Second/First class power engineer position in my workplace are approaching their retirement, so I decided to study for my Second/First class and make use of it as soon as possible. (JG)

Participants in this study gained the resilience needed to meet the challenges of their courses from the hard fact that completion of 2nd and 1st class power engineering courses was worth it for them. NV said:

The market for thirds appears to be heading toward saturation, and I knew I wanted to achieve my 2nd class. Many of the people I worked with had said that the difference in difficultly between the 2nd class and 3rd class exams was significant, so I wanted to give myself every advantage I could get to be sure I passed.

Some participants had a big-picture mentality and, as CM said,

Desired to attain the complete Power Engineering certification hierarchy (4th to 1st Class). Power Engineering is an excellent technical grounding for further career and academic advancement.

CM also stated that completing the program was worth the time and effort because:

Power Engineering challenges the individual to gain theoretical, academic knowledge but also to demonstrate this knowledge in the workplace through practical application. Power Engineers are less 'pigeon-holed' as either academics or grunts in industry. Personally, Power Engineering gave me the opportunity to become a leader. Power Engineering gave me confidence in both academics and real-world application. I may not have pursued higher masters or doctoral level education if not for grounding in Power Engineering. I feel accomplishment, dignity, and am without fear of advancement or challenge.

Relatedly, participants acknowledged that persistence was about making a choice and choosing an attitude. JG said:

I started working as a third class power engineer in the steam plant in the Pulp and Paper industry in 2012. As some people retired, I moved up from a bottom job role to an assistant shift engineer in just 2 years. I was very lucky that way, but the job turned out to be very challenging to me as a rookie. It was the BCIT distance education program that helped me to gain the knowledge and skills to handle my job. It made my learning curve much *less steep than it would have been without. Seeing the great benefits from the program, I am taking the first class courses now.*

BV focused his positive attitude on making a difference in his life:

Over 10 years I developed the plan to go for 2^{nd} from 3^{rd} class. During the 10 years working as 3^{rd} I started working on my 2^{nd}. I did the research and I could work as a shift engineer. I want to be an Operator, but not too high of a rank. I set the goal where I wanted to go.

Simply put, from students' testimonials, 2^{nd} and 1^{st} class power engineering is perceived as a good foundation, even if one does not know what to do afterward. JG explained,

I don't know what I'm going to do in my life but I know if I get my 1^{st} class power engineering certificate, then I've got a lot of options.

Challenging careers with large salaries and better hours or job security were exactly what challenged these students to persist. Focusing on the many benefits and flexibility of power engineering as a career clearly aids in the persistence of these students. In this respect, my findings accord with those of Baytiyeh & Naja's (2010) study of engineering students' persistence.

Stress

Completing the required courses for 2^{nd} or 1^{st} power engineering certification may be worth the rigor and hard work in students' opinion, but it does not come without stress. Hard times and pain were mentioned frequently when students described their feelings and emotions related to persistence (Figure 5-5).

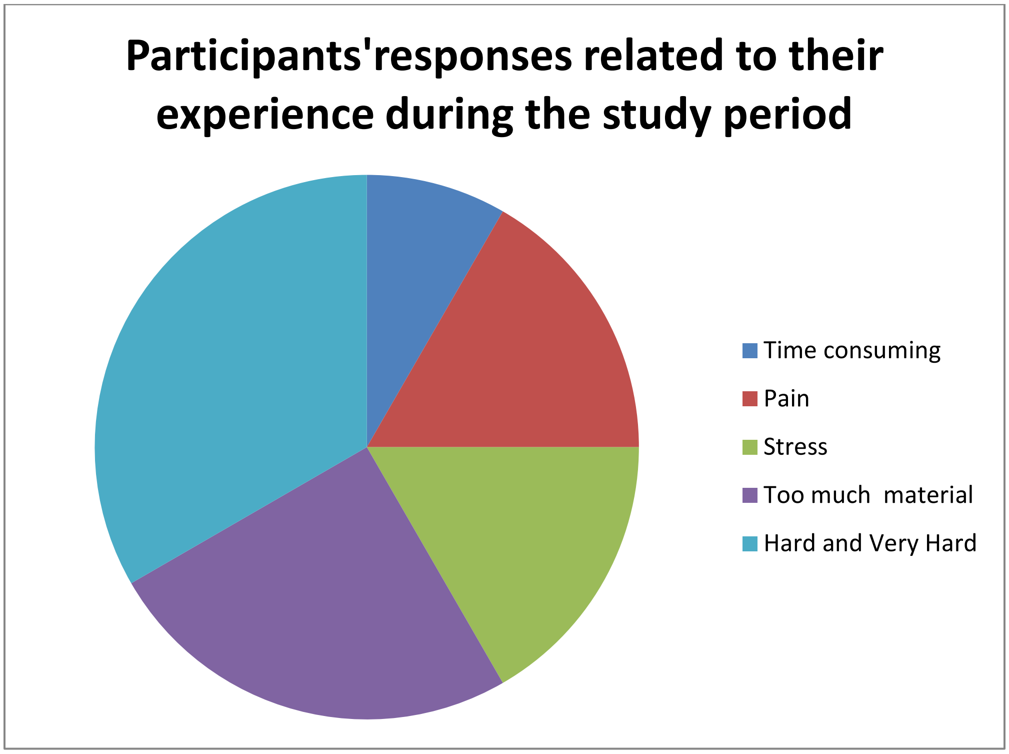

Figure 5-5 Students' responses related to their experience during the study period

In the interviews, participants discussed the sources of their stress, how they coped with it, and also the lack of understanding from their coworkers. The quantity of work, the degree of difficulty, and the demands of going through the program while keeping up with their paid work all created stress that highlights the emotional dimension of students' persistence (Illeris, 2002). BV offered the following example:

> *I did it in order. The first two courses were the hardest, thermo and applied mechanics. At that point I did not look at the book and [had to overcome] a lot of inertia to start. The hardest part was to start and commit. After month it got easier. Initially it was hard, and eventually it got easier.*

Each one of the participants described outlets to relieve stress and regain their focus. Stress was common facets of students' experiences in the 1st and 2nd class power engineering programs. Persistence in power engineering requires students to manage the rigor and stress. They also need to confront complex problems and find ways to comprehend all of their assignments. One of the participants gave the following advice to the future 2nd and 1st class power engineering students:

> *I would let them know that they need a lot of time and that the courses are extremely volume heavy. I would never discourage anyone from learning and taking the courses. (NV)*

The following Chapter 6 presents the persistence model developed under the grounded theory umbrella, discussion about developed persistence model as well as reflection on presented research. The recommendations which are discussed in Chapter 6, are based on the participant's voices and research findings.

Chapter 6. Summary and Discussion

The previous Chapter presented the findings of the present research. These findings have been derived from students' testimonies about their experiences of persistence, following the grounded theory method. The findings indicate that, from the participants'/students' perspective, persistence in power engineering distance education at the 2nd and 1st class levels is a complex phenomenon influenced by a variety of factors. These factors should be taken into consideration by all stakeholders involved in the power engineering field, including educational institutions, industry members that employ power engineers and the legislated body that regulates the power engineering field.

The present Chapter has three primary purposes. First, with the concepts and issues developed from the research findings, to reflect on the main research question, as well as the sub questions shared at the outset. These reflections are presented in the first part of the Chapter. The second purpose of this Chapter is to connect the research findings to existing theoretical concepts that underpinned the present research – particularly the adult learning theories and persistency models reviewed in Chapter 2. Observing relationships between the research results and existing theories is an important part in the process of situating the research outcomes relative to the theoretical framework. The third purpose of this Chapter is to use the research outcomes to develop practical recommendations for educational institutions and industry members involved in power engineering.

As a reminder to the reader, this research was drive by the following research question:

- What theories (including existing theories or modifications of them) might explain the persistence of second- and first-class adult power engineering students taking distance education courses?

As well as the open-ended sub-questions:

- What is the relationship between students' family and work place support and their persistence?

- What role do student perceptions of the learning environment and learning technology play in persistence?

These questions were the starting as well as the ending points for this research journey. The main research question explores power engineering students' persistence in the distance education environment. Later in this Chapter a persistence model developed under the grounded theory umbrella is presented, illustrated (Figure 6-1) and discussed. To foreshadow, this study found that a key distinction in the persistence of 2nd and 1st class power engineering distance education students, as compared to other students, is that the main driving forces for students' persistence are family history in the power engineering field, opportunity for better wages, job security or working hours, and financial support from the workplace.

Even though the grounded theory process takes the collected empirical data as the pure, isolated source of the embedded theory, relating the findings to existing theoretical concepts is an important part of the overall research process, because it clarifies the contribution of the presented research to the existing pool of knowledge. Making the connection to existing theories also allows this research process to enhance later scholarship. Finally, the validity and overall quality of the research findings are supported and explained by their connection to existing theories.

> *Literature discussing similar findings is important as well because it ties together underlying similarities in phenomena normally not associated with each other. The result is often a theory with stronger internal validity, wider generalizability, and higher conceptual level. (Eisenhardt 2002, p. 17)*

Connecting the developed theory to existing literature increases the generalizability of theory developed under the grounded theory approach. The links are important because the developed theory rests on a limited number of interviews (20 in the present study), within a limited area of research (power engineering). As Eisenhardt suggested:

In this situation, any further corroboration of internal validity or generalizability is an important improvement. *(Eisenhardt 2002, p. 18)*

Relating to Prior Research on Engineering Students' Persistence

As mentioned above, the purpose of this qualitative study was to develop a grounded model of mature distance education students' persistence in power engineering courses. The study investigated the relevant factors, processes, and experiences involved in students completing 2^{nd} and 1^{st} class power engineering courses. Existing research on persistence in engineering has been mostly quantitative in nature, and has focused on predicting persistence based on prior academic performance, such as high school grade point average, class rank, and math or science grades. This research has ignored potentially important influences in students' backgrounds and life circumstances. Furthermore, all prior research has related to full time programs, and no research has examined adult engineering distance education students, who face unique challenges to their persistence and anticipate unique rewards for it.

In the literature reviewed for the present study, most studies were related to traditional students (full-time students in their 20s) participating in engineering programs in face-to-face mode. No prior studies identified in my review have examined the phenomenon of persistence from the perspective of adult distance education students studying part time in engineering or power engineering programs. Since the literature has not covered either persistence in engineering distance education programs or persistence among adult distance education power engineering or engineering students, this study examined why and how these students persist by incorporating their voices in developing an understanding of the persistence process. The study considered differences in age, educational background, family history in the power engineering field, as well as experience with distance education.

By all accounts, persistence in any academic program is a complex phenomenon, which involves the interaction of many factors. To understand the interplay of these factors, the study pursued a grounded theory methodology, and included individual interviews with 20 participants selected according to their stage of completion in a 2nd or 1st class power engineering program (just starting, in the middle, at the end, or completed). Through theoretical sampling, the study also represented various power engineering sectors (power production, pulp and paper, oil and gas) where the majority of students are employed.

Data were collected from January 2015 to February 2016 from participants presenting a variety of complex profiles. One group of participants had strong educational background for power engineering, and made early decisions to proceed with a higher level of coursework in the field. A second group of participants made later decisions to extend their ambitions, based on family encouragement and the structure of the opportunities presented to them in the workplace. These opportunities included opportunities for advancement (e.g. superiors' retirement), and financial support from their employers for further studies. Perceptions and experiences with the educational institution itself and the culture of engineering education varied depending on students' educational background and their previous experience with distance education in general.

A Model of Persistence in Advanced Power Engineering

Based on the themes developed from the participant interviews, a model of persistence among adult distance education 2nd and 1st class power engineering students was developed (Figure 6-1). The developed model was tested by applying the participants' testimonies to it to ensure that their data did not contradict the model. Two testimonies from participants who expressed interest in the final model development were applied to the model by another member of the Power Engineering Department at BCIT in order to reduce the possibility of interpretive bias on the part of the researcher. These two testimonies were found to be in line with the developed model.

The presented model has two main types of entities/processes related to students' persistence: those occurring prior to attending the courses and those occurring during course attendance. The main aspect prior to attending the courses is learner characteristics, with four influential elements: age, marital status, educational attainment, and family history in power engineering. This aspect is coherent with Kember's model, which also includes entry characteristics such as age, marital status and education.

The main aspects of the second main type of process/entity – those occurring during course attendance, are external and internal factors that can be either positive or negative. The external positive factors entity includes family support, workplace support and financial support, while the negative external factors entity includes time pressure and lack of workplace support. The internal positive factors entity includes success with academic assignments, and instructor support while negative external factors entity includes stress due to academic assignments, inadequate instructor support and the usability of the learning management system (LMS). These two positive and negative directions parallel the two paths, positive and negative, that Kember's model introduced.

It is hypothesized based on the data and analysis from the present study that all these factors converge to psychological outcomes that include satisfaction, stress, accomplishment of career goals and financial rewards. A noteworthy difference between the present model and Kember's is that Kember's model converges to social outcomes, referring to the student's ability to integrate his or her life as a student with other aspects of their lives (work, family and social life). In contrast, the model developed in the present research converges to psychological outcomes and integration with the institution. Given the non-traditional engineering students at the focus of this study, who have existing careers and family lives, it is integration with the institution that is most essential to the persistence of adult distance education 2nd and 1st class power engineering students. All students, whether on the positive or negative path, factor in

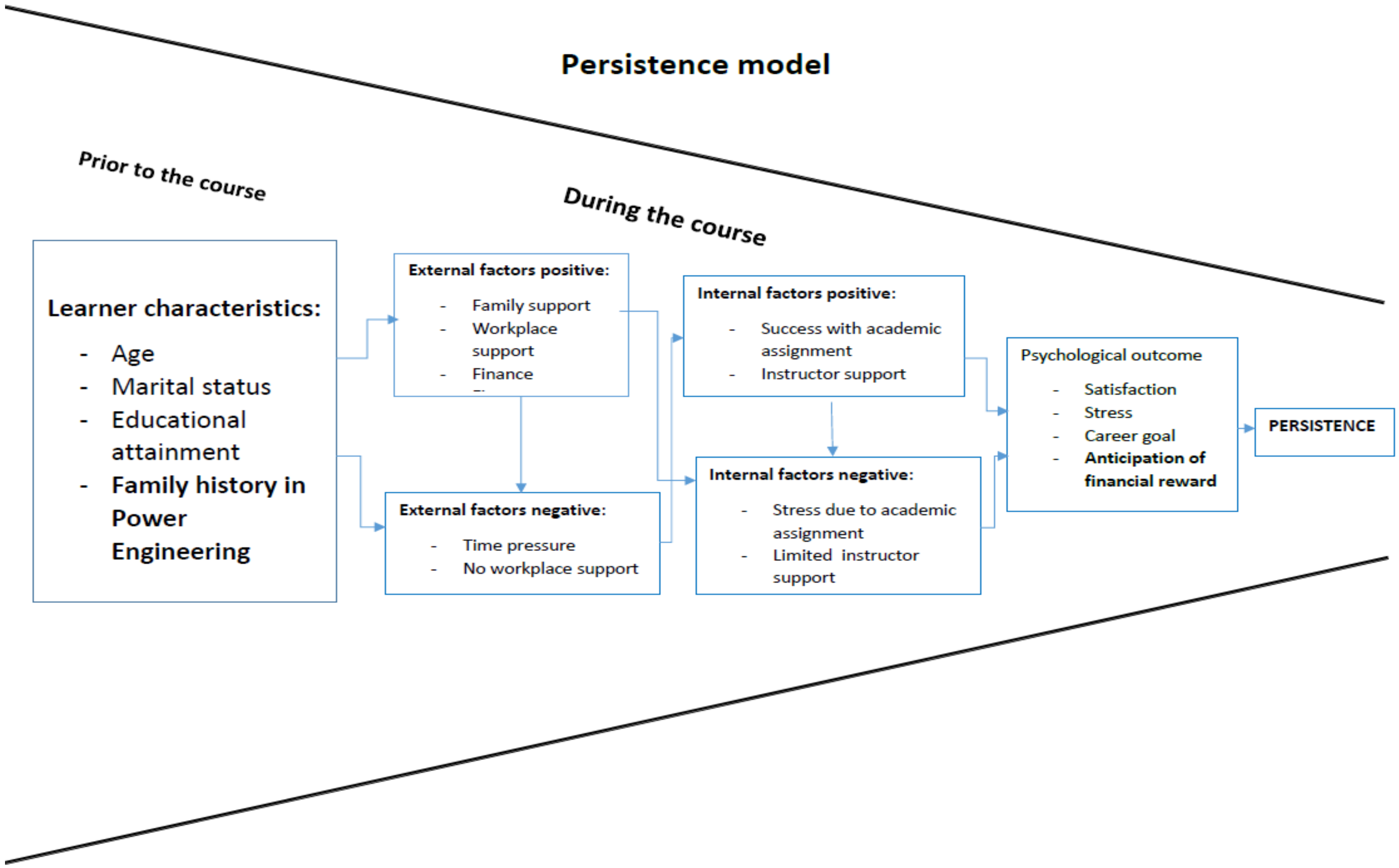

Figure 6-1 Persistence model of adult distance education power engineering students

psychological outcomes such as satisfaction, stress and career goals as well as anticipation of financial rewards in order to persist in the 2nd and 1st power engineering distance education courses.

The following sections summarize and discuss the findings regarding processes prior to and during attending the courses, as well as the psychological outcomes of these process that converge to the observed outcome - students' persistence.

Summary of Findings

Some prior literature (Raymond, 2009) suggested that non-traditional students were more likely to persist than traditional ones. The participants in the present study belonged to an age-diverse group: the youngest was 21 and the oldest 56. Those students who persisted in the 2nd and 1st class power engineering courses fit two patterns (Figure 6-2). One group was in their early twenties and late thirties, and made their decisions about pursuing a higher level of power engineering certification as early as high school. However, throughout their four years of high school they did not make any plans about their coursework that included engineering-related courses. Their decision to pursue power engineering was based on the influence of a family member or members that were involved in the power engineering field. Within this group, some participants felt power engineering was a logical or natural choice considering that they had a grandfather, father, brother or uncle who worked as a power engineer. Similarly, Eris et al. (2010) found that parental/family motivation to study engineering were important to persistence in engineering programs.

A second group of participants were in their early forties to late fifties, and often chose to challenge 2nd and 1st class power engineering courses as a result of encouragement in the workplace, or to secure better job opportunities and more quality time with family. This finding is in accord with the results of a survey-based case study conducted by Baytiyeh & Naja (2010). They found that professional growth, including job satisfaction motivates students' choice of engineering as a career.

Oftentimes, students who were part of this second group were also influenced by a family history in the power engineering field, as the first group was. However, many of these participants faced a greater number of obstacles and barriers than the first group experienced, due to greater family or community obligations.

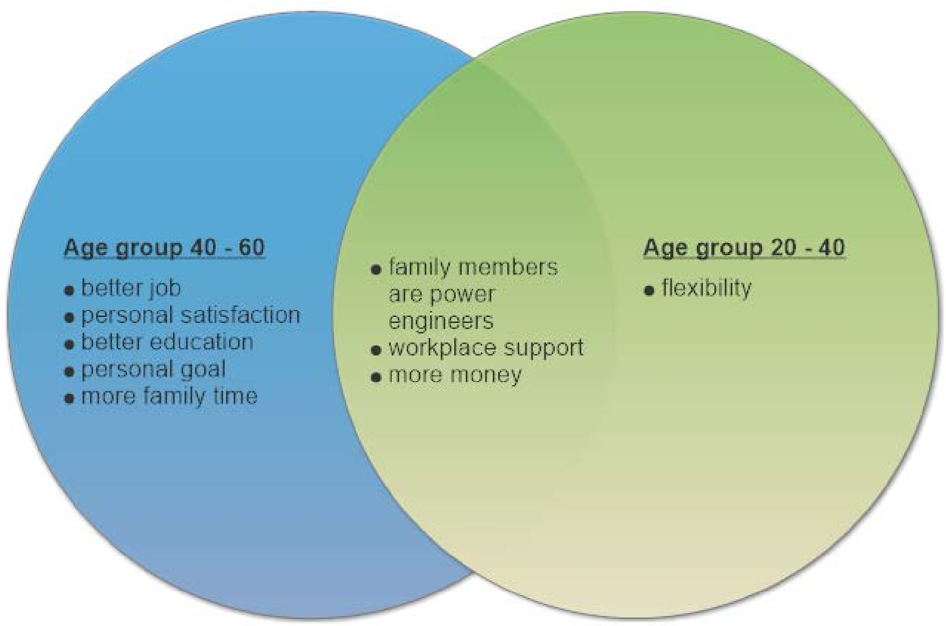

Figure 6-2 Students' reasons for pursuing higher-level certification in PE

Given that all students face barriers and obstacles (such as inadequate academic background, poor institutional fit, and workplace and peer bias), how have these power engineering students persisted? This study determined that a combination of financial, family and workplace support have been the primary forces encouraging persistence. The nature of these power engineering students is to be motivated almost exclusively by the structure of opportunities in the workplace and by financial rewards, rather than a fascination with the subject or by intrinsic rewards associated with learning. While obstacles have made power engineering students aware of their lack of academic background and shaken their confidence in their academic abilities, the final reward was strong enough to drive them to persist. Only six students participating in the study were clearly passionate about engineering, and of these only three appeared to have their hearts in it, or had a global view and vision for the future of power engineering. This outcome is not in full agreement with Baytiyeh & Naja (2010) study where students chose the path towards an engineering career not only because of financial security but also because of a sense of enjoyment and satisfaction that engineering field offers.

Among the participants in this study, very few matched the profiles of persistent students from other engineering fields, where the need to prove to themselves and others that they could succeed is often a driving force (Borrego, 2009). Like persistent students in other engineering areas, the participants in the present study dealt with stress, performance and time pressures. However, they developed an ability to put these challenges into perspective in order to obtain balance and financial security in their lives.

Persistent students are also resourceful students (Borrego, 2009) who have learned how to set goals and achieve them through networking and adaptation. They have learned how to play the system, for example learning where to obtain additional resources to prepare for their exams. They seek out the information they need, even if they have to visit many different “exam” sources, including other students, faculty, staff, family and friends.

While persistent students in this study had a variety of educational backgrounds, most of them did have prior postsecondary education, either in the form of a one or two-year diploma or degree. A small number had even earned graduate degrees, including a Master’s in Marine and Chemical Engineering, a Master’s in Business, and even a PhD in Organizational Leadership. Variations in academic background created deficits for some students, particularly those who did not have formal education in either power engineering or another engineering field. Deficits were especially common in higher-level math and science classes, and vocational classes such as technical drafting. Students with academic deficits experienced higher levels of frustration with power engineering educational requirements that assumed a certain level of technical background. More than one participant described the process of learning in the power engineering program as a painful or even as a “torturous” one.

Existing literature on persistence suggests that engineering students in general have academic strengths in math and science, and have attained high achievement in those subject areas. In contrast, many of the participants in the current study did not have existing strengths in math and science; in fact, they may have had weaknesses in both areas. Relatedly, some participants believed their primary strengths were their hands-on skills, and that they would learn everything they needed in the work environment.

All these factors combined – family history and academic background as well as financial aspects, influenced students’ choice of power engineering as an occupational field. The primary reasons expressed by students for choosing 2nd and 1st class power engineering as an occupational field were very consistent. At the top of the list were family influence and expected financial rewards, followed by exposure and hands-on experiences, and the structure of opportunity. Thus, family members sometimes pressured these students to choose power engineering for the sake of job opportunities and financial stability. Senior power engineers in the workplace and faculty members in the BCIT Power Engineering Department were mentioned by very few students as influences on their choice to pursue 2nd or 1st class power engineering certification.

Experiences during Course Attendance

Many of the participants in this study entered their power engineering programs feeling certain about their choices. However some uncertainty, normal developmental tasks and adjustment issues common to the postsecondary experience, in combination with a rigorous academic program and new technology (related to the distance education delivery method) overwhelmed many of these students. Many students reported experiencing severe stress during 2nd or 1st class power engineering courses. Due to the lack of communication, faculty members were often unaware of these problems impeding the academic success of participants. Some students, in particular graduates from the 2-year Diploma Power and Process power engineering program that BCIT offers as a full time program, were disappointed with the instructional support provided.

Students' experiences with power engineering education in the higher-level courses were dependent in part on the faculty members who had provided support to them, as well as on their own academic background and study habits. While some faculty bent over backwards to support students, some others did not. The way power engineering was taught in the fully online mode did not prove effective for some participants, who expressed the need for more traditional face-to-face courses.

Some power engineers aiming to obtain a 1st and 2nd class of power engineering certification dealt with discouragement or even disapproval from their peers in the workplace as well. Not being supported by fellow members of the power engineering field (often due to the potential of moving from a unionized to a non-unionized work placement) had negative results, with additional stress and decreases in the strength of the persistence process. In addition, a lack of strong power engineering role models and inadequate advising did not help these participants.

Discussion

With this summary as background, we can return to the primary question that drove this study: How do 2nd and 1st class adult distance education power engineering students persist despite the many obstacles they face?

In the course of the data collection and analysis, I was surprised by some of the statements of these adult distance education students, and I am continuing this research process with the view that the picture they painted of their persistence process will help to define a path for the next generation of power engineers. Most of the positive and negative events appeared to be internal to the participants, though some of the negative events seemed to arise from external, environmental sources. It became clear that most students did not make use of the learning management system to its full capacity. They used it only as much as was necessary to get assignments and required course material, however they preferred face-to-face delivery over distance education, and felt they had not received sufficient faculty support. While some had not asked for such support, others clearly expected it. Making an effort to change these negative factors into positive ones is a clear massage I received from participants.

Participants were very vocal about their negative experiences with the engineering course environment and materials. However, they also shared experiences that were more positive, such as family support and workplace support. Although the data were subject to the error of reminiscence, they did provide evidence of a different learning climate for power engineers (as opposed to more traditional engineering students) which highlighted differences in educational background as well as their reasons to enter into and progress in the power engineering field.

A family tradition (i.e. having family members as power engineers) demonstrated an important influence on students' choice of power engineering, and it is a common denominator for most of the participants. Another shared motivating factor for the persistence of most of participants were financial outcomes and better job opportunities. Few expressed interest or academic background in the field. Interest in power engineering and certainty about the choice of an engineering occupation in some cases were developed through relevant work experiences. The fact that some participants ended up where they are today is a tribute to their persistence and self-reliance, and certainly it is also a tribute to the dedication and concern of those individuals who have made a choice to be supportive, particularly family members, co-workers and (less often) instructors.

A final comment worth making is about the emotions that were often elicited through the interview process – both my own and those of the participants. Some of the participants had dealt with the uncertainty of finding the right path to accomplish their goals as newcomers to Canada, or they had faced major health issues. Some of the participants had dealt with family issues in the course of their studies, such as taking care of their grandchildren or running a private business in order to support their dependents. Many participants struggled with insufficient educational background for their studies, which made the learning process painful and stressful. In some cases, it was obvious that their pain still existed, and that the experience of processing that pain was on-going. Through these descriptions of painful learning experiences, I gained a strong sense of the disconnection between these students' occupational choice and their personal interests. One participant was particularly descriptive (BV):

> *I did not look at the [text]book, and it was big inertia. The hardest part was to start, however the commitment was there and it was painful to start. After*

> *a month, it got easier. Initially it was hard and eventually got better. Overall it was a positive experience, though initially was painful. Physically I had headache, and after one month, I made it through.*

Reflections on the Qualitative Research Process

Research work under the qualitative umbrella asks for the collection and analyses of an amount of data that could potentially be overwhelming and tedious. However, this approach also offers the possibility for deeper understanding of the observed phenomena than is possible in most cases with a quantitative study. The interview process offers opportunities for participants to contribute to a more in-depth understanding of complex issues such as persistency.

Going through the process of qualitative research I observed several advantages which surprised me. One advantage that I experienced is related to the opportunity to see the process through the participants' eyes. I was able to feel the process through the participants' surprising and holistic stories. Participants allowed me to live their lives vicariously, to grow with them from their early adult ages to the present time where the educational, environmental and social aspects of their lives have fully developed.

Another advantage of the qualitative research paradigm was the ability to have flexible and spontaneous conversation with each participant. At the end of the interview, when I asked if anything could be added, Participant BV told me that I now knew more about him than anybody else in his life. I had a warm feeling and was proud that a participant opened up to me and shared his life story. That warm and friendly atmosphere allowed me to explore the participants' lives with additional questions related to the specific focus of the research. Having the interview guide is mandatory in the interview process, but it is only a guide. It can and it should be flexible so that adding questions relevant to participants' unique experiences is possible.

Research under the qualitative umbrella, I also found, demands continued commitment and enthusiasm from the researcher. It was sometimes difficult to simultaneously correct and edit transcribed interviews, and code transcripts as recommended in the grounded theory approach. The logistics of scheduling interviews to find a time and place that will work for participants was also challenging. But the value of grounded theory as a qualitative study approach and as an effective approach to build new theories and understand new phenomena is in generating concepts that will have different meanings to different people, and that the final theory is open to modification and new data.

Recommendations

The findings of this study support some recommendations for both power engineering educators and the industry that employs their graduates. Since these adult power engineering students were telling their own stories about their own personal experiences, they were given the opportunity in the study procedures to make their own recommendations for exposing and encouraging young power engineers to choose engineering, as well as recommendations for retaining young power engineering students in their 2nd and 1st class power engineering courses. Some of the following recommendations echo the voices of participants who have lived the experience.

Recommendations for Engineering Programs

The experiences of persistent students in the 2nd and 1st class power engineering programs reveal that many have experienced discouragement due to lack of relevant educational background, lack of workplace support, or lack of faculty support. Support programs could be designed to address these needs (such as counseling, tutoring, and mentoring programs) and help students through these discouraging experiences. Small group counseling and mentoring seem particularly promising as approaches, since the results of this study indicate continuing needs in those areas.

Educational institutions offering power engineering programs should also send a clear message to potential students about the availability of help related to study skills, time management skills, or possible “bridge” programs that will improve their academic preparedness. It is discouraging that so many of the participants in this study did not avail themselves of the support that they were entitled to as students.

Some career guidance related to the power engineering profession, as well as more prerequisite academic requirements for power engineering should also be introduced into power engineering distance education programs. Considering the strong message from some participants that they believe they learn best on the job, any prerequisite math and science courses should incorporate creative hands-on activities that are related to the power engineering field. At the same time, these courses should improve students' interest, confidence and abilities for their chosen field. Finally, students' motivation for these courses could be enhanced by involving members of the power engineering society, senior power engineers from industry, members of the Institute of Power Engineering or Boiler Safety Authority as speakers, to address the importance of the course material for students' career success.

The results of this study also indicate a need for changes to institutional and workplace culture in the power engineering field. This change needs to come in the form of changed attitudes toward the value of having power engineers with a 2nd and 1st class level of education working in the field. It is not a straightforward, linear process to improve the climate, culture and values of power engineering, but it will be helpful to the long-range prospects of the field.

When I asked the question, "After having these experiences with distance education power engineering courses, what advice would you give to someone who has decided to take this path?", one of the participants stated (CM):

> *Ensure that you create a schedule, be honest regarding your strengths and weaknesses, speak with your family regarding the time commitment, and dedicate the appropriate amount of time each day to succeed. Consider whether you are a self-starter (assertive) or require stewardship to succeed. Consider how your peer group affects your actions. Decide what level of responsibility that you desire during, and at the end of, the upgrading process.*

This advice, as well as most of the 20 stories told by these adult power engineering students, indicates a need to rethink the mission of the education provider and its commitment to these adult power engineering students, in order to prepare them for their learning journey. What follows are a number of suggestions to work on the system to improve the climate and culture of power engineering education.

First, adult power engineering students should be met with a welcoming attitude. This welcoming attitude should begin with a distance education orientation document or webcast, and continue throughout their studies. Participants in this study suggested that the power engineering field loses potential students by the way in which we prepare them for their studies. Offering information, advice, and guidance to potential power engineering students in the form of an introductory course may help students to find their path in the power engineering educational journey. As suggested above, this course should incorporate the views of industry leaders in order to paint a clear picture of industry requirements and expectations.

Second, the academic backgrounds of adult power engineering students should be more closely monitored and evaluated in an effort to provide bridging programs appropriate to students of various profiles. The importance of remedial academic preparation in math and engineering fundamentals should be stressed to students through the admissions process.

Faculty working in power engineering programs should also incorporate collaborative teaching methods that will include other engineering fields and industry members, in order to promote connections and mutual respect among different engineering fields. Courses should be designed to connect the theoretical principles with students' workplaces, so that they can see the value of the presented theory. Including simulation technology in the learning process could also help students to enhance their understanding of the strong connection between academic courses as math, thermodynamics or applied mechanics and efficient, effective, environmentally responsible and (most important) safe operation of power plant equipment.

Third, power engineering faculty should work on connecting power engineering students with successful power engineers from field and also to connect them with students from other engineering areas. Offering possibilities of interaction between faculties and students inside and outside of the course environment could provide students with better sense of belonging to the power engineering field, so that better dialog between faculty and students can occur. Faculty and advisors must also be willing to listen to and deal with personal problems that impede academic success, by making referrals to institution-wide student support resources.

Applying a proactive rather than a reactive approach in monitoring the students' progress should be incorporated in the everyday practice of faculty in power engineering. This could include, for example, sending notifications to students and asking them the reasons for slow or no progress. Done sensitively, this could help in the process of establishing friendly and trustful relationship between faculty and students. It is possible that students feel lost and have a hard time getting back on track. With just a short e-mail asking how they are doing and what problems they might be experiencing, students could develop a perception of the caring and warm learning environment that our program offers to them.

Finally, it would be useful to carry out a survey of educational guidance practices, as well as educational obstacles, before admission into a 2nd and 1st class power engineering program. The survey should include questions related to students' academic background, needs for bridging programs in math and science, and knowledge related to distance learning technologies. This survey could be used as students' pre-assessment tool in order to define how well students are suited to the higher level power engineering courses from an academic point of view. The orientation for potential power engineering students should also include some testimonials from successful 2nd and 1st class power engineers.

Recommendations for Industry

This study provides support for two main changes to industry support for higher-level certification in power engineering.

First, since these persistent power engineering students were largely motivated by the structure of the opportunities surrounding them, industry-sponsored scholarships would likely provide further encouragement for students to obtain much-needed 2nd and 1st class power engineering qualifications. As participant SY expressed, even though he struggled to communicate to his co-workers why further education was important to him, he did have financial support:

> *I was working with great people, but [they] did not understand my goal. They did not value education. But my power engineering courses were covered by employer. That was great.*

Another participant NV, stated:

> *My current employer pays for the courses as well as the books required, so that was encouraging in terms of taking the courses.*

Industry leaders might consider organizing a pool of successful 2nd and 1st class power engineers who would be available for creating a more positive and more educationally-oriented working environment. These successful power engineers could positively inspire potential 2nd and 1st class power engineers offering different workshops through power engineering community.

My second recommendation for industry is much more difficult to implement, but is equally important. Because many areas of power engineering are traditionally supportive of obtaining knowledge through on-the-job experience rather than through formal education, the industry must make cultural changes for a larger proportion of students to persist in achieving higher-level certification. To address the cultural stigma attached to higher-level study, the industry could more overtly support continuing training for employees at all levels, and provide flexible and creative benefits for employees that would like to peruse the 2nd and 1st class of power engineering certification. The results of this study suggest that such advances would be valuable in supporting power engineering education at the 2nd and 1st class levels. The working environment could:

- Increase efforts to make power engineers' education affordable and manageable (through release time and financial support).
- Increase employers' awareness of the effort employees must apply when the workload increases (as in shutdown periods) during the time of their study.
- Increase power engineer's perceptions about the efforts employers apply in complimenting power engineers on completing the courses and obtaining the certifications.
- Increase power engineer's perceptions about the efforts employers apply in showing appreciation for hard work engineers do during their formal studies.

Limitations of the Study

This research study is limited in several ways worth mention.

First, since the study relied on participant's stories, recalled based on their long-term memory, questions of reliability inevitably arise (Blasidell, 1995). For example, it is possible that some participants were not able to recall accurately their reasoning to continue with a higher level of power engineering education, or they might not have been certain of the support they received from family members, the workplace or faculty members. However, the alternative to the retrospective data collection used in the present study would have been a much longer-term study that asked students to report their decisions and impressions at the time of occurrence. In this case, results would not have been available for a period of years.

Second, since this study examined the unique experiences of adult distance education power engineering students at BCIT, the findings are not generalizable to other populations of engineering students. However, this research may provide a structure for further study that will include power engineering students from other educational institutions, or perhaps other non-traditional engineering students taking distance education courses.

Finally, it may be argued that the study involved a limited number of participants, whose experiences and views may not be representative of all BCIT Power Engineering students involved in the 2nd and 1st class online courses.

Also, considering that this research work was intended to produce a better understanding of how students are able to persist in the higher level of power engineering courses, rather than why many leave these courses, dropout students were not included in the study. This could raise questions about the validity of the model due to the relatively small set of persistent students which the model was based.

However, the grounded theory approach needs to be understood as a compound that includes the use of concurrent data collection and constant comparative analysis, theoretical sampling and memoing. The quality of the data as well as their saturation, and not simply the quantity of data, are important (Charmaz 2006). Thomson (2011) highlighted in his study related to sample sizes under the grounded theory research approach, that the saturation point is mostly affected by the nature of the research questions, the sensitivity of the phenomena, or by the researcher's experience. After reviewing hundreds research papers from different disciplines in a period of seven years (2002 – 2008), Thompson (2011) found that the average sample size was 25, that in thirty-three studies the sample size was between 20 and 30, in thirty-two studies the sample was between 10 and 19, in twenty-two studies the sample was more than 31, in twelve studies sample number was under 10, and in one study sample number was more than 100. Therefore, samples in the range of 20 participants are fairly common, while sizes much larger or smaller are unusual.

A final limitation that could be articulated is that with a small number of participants, theoretical sampling could affect the broader application of these research findings (Gobo, 2004). Nevertheless, under the grounded theory approach sampling must be guided by theoretically relevant constructs (Strauss & Corbin, 1997).

Suggestions for Further Research

Based on the limitations and findings of this study, several areas appear worthy of further research. Since this study was limited to one institution (BCIT was the only Canadian post-secondary education institutional offering 2^{nd} and 1^{st} class power engineering courses at the time of this research study), in-depth qualitative studies of programs at other institutions, such as SAIT in Alberta or Lambton College in Ontario, should be conducted to determine if there are regional and cultural differences among educational institutions that have bearing on the recommendations offered above.

Considering multiple participants' requests for or recommendation of face-to-face power engineering course delivery, and the fact that the Power Engineering Department at BCIT as well as at SAIT and NAIT offers face-to-face and distance education power engineering courses for the 4^{th} and 3^{rd} class certifications, further research should concentrate on the comparison of power engineering students' persistence studying through different delivery modes.

Conclusion

Despite its limitations, this study highlights the value of a qualitative approach to exploring students' process of persistence in an adult distance education power engineering program, and reveals phenomena that have not been examined in the literature to date. For mature working adults enrolled in programs like BCIT's, persistence in power engineering is a complex phenomenon involving family, individual, environmental, and workplace influences. While there are common elements to the study participants' experiences, no single pattern provides an explanation for students' choice to pursue 2^{nd} and 1^{st} class power engineering courses. Most of the contributors to persistence among the participants in this study appeared to be internal ones; however, some of the impediments to persistence appeared to be internal as well. In other words, even those power engineering students who were persisting in their 2^{nd} and 1^{st} class power engineering courses faced challenges due to their educational backgrounds, lack of support in the workplace, or at the educational institution.

The study produced some findings that were surprising for the author, despite her long experience in the field of power engineering. For example, even among the persistent students were some who did not strongly wish to be 2^{nd} and 1^{st} class power engineers. This fact substantiates the need for a commitment to developmental career counseling models from an earlier stage of power engineers' training. Only once educational institutions and employers help all students to better understand their viable options, and help them to see value in those options, can power engineering students realize their potential and make appropriate personal decisions about occupational choice.

As shown in the analysis section of this study, some of the findings align well with the literature on persistence among other engineering students, while others present stark contrasts. It follows that some findings and recommendations from this study may be generalizable to other engineering programs suffering from low student persistence. Although each engineering program faces its own unique challenges, findings and interventions suggested by this study may provide a good starting point for increased persistence in the field more broadly.

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Appendix A. Interview Guide

Qualitative Research – Developing interview questions (Creswell, 2003)

Qualitative research offers "a means for exploring and understanding the meaning individuals or groups ascribe to a social or human problem" (Creswell, 2003, p. 4).

Developing effective interview questions is crucial for any qualitative research. When questions were developed a number of issues were considered, for example:

- Why I am asking the questions?
- Who are the outcomes for?
- What do I want to observe?

Questions had an open format that would allow respondents to answer without presented or implied choices (What? Where? Who? When? How? Why?)

I also had follow-up questions to deepen a response to a question, but participants did not always respond well to them. Sometimes participants did not answer, and I did not want to "force" their answers. The table below provides a summary of the applied interview and its defining features (Creswell, 2009).

	Structured (open)
Characteristics	Exact wording was pre-determined. Same questions were asked in the same order.
Interview schedule	Highly structured because of need to standardize
Research questions	Clearly specified
Question types	Mostly opened
Prompting questions	Less prompting

Interview Protocol for the Persistence of Second and First Class Power Engineering Distance Education Students at BCIT

Interviewer: Thank you for taking the time to help me with this research.

As you recall, the purpose of this study is to better understand what conditions and supports are most helpful to students in completing the First and Second class Power Engineering programs at BCIT.

Interview Outline

Background Information

First I'd like to know some things about you as a person.

What is your current age?

Are you married, or do you live with a partner?

Do you have children?

(if yes to children) Do any of your children live at home?

Do other members of your family live with you (for example, parents, stepparents, grandparents)?

Are you working right now?

Are you working in the Power Engineering sector, or another sector?

(if a sector besides Power engineering) What sector is that?

What background do you have in Power engineering?

Prior Experience and Decision-Making

Could you please explain the reasons you decided to take the Second/First class power engineering courses?

Did your community or work environment shape your decision to take these courses? If so, how?

Could you please describe any previous experiences you have had of distance or online education?

Could you describe how you decided to take these distance education courses?

What has your experience with the online Power Engineering courses been like so far?

How, if at all, have your thoughts and feelings about taking distance education courses changed since you took them?

After having these experiences with distance education power engineering courses, what advice would you give to someone who has decided to take this path?

Could you please explain what it means to you to take distance education power engineering courses?

Family Support

Could you please describe for me your family's typical daily routine?

Could you describe specifically how family members have supported progress toward completion of your courses?

How have your family members shaped your progress through the courses?

Do you think your family’s support for your studies has been sufficient?

Faculty Support

What is your impression of your relationship with faculty members in the Power Engineering Department?

How, if at all, have specific members of the Power Engineering Department at BCIT influenced your studies

Who has been the most helpful to you during this time? How has he/she been helpful?

Could any member of the Power Engineering Department have been more supportive? How?

Has academic advising been helpful? What did they help you with? How has it been helpful?

Course Environment

Could you please tell me more about your experiences in the Power Engineering courses, particularly ones that you feel were useful in the development of knowledge and skills you need to attain a higher certification?

Could you please describe your experience with the course you had the most difficulty with? What support do you think you might have benefitted from? What could be done better?

Could you please describe an experience with the course that went smoothly for you? What support you had, if any.

Could you please describe your experience with the course course delivery platform? What do you think was effective about it? What support did you benefit from?

Program Benefits

How have you grown as a power engineer since you completed the program? Please tell me about strengths that you discovered or developed through taking these courses.

What do you most value about yourself now that you have completed the program?

What do others most value in you now that you have completed the program?

Anything else?

Is there anything that you'd like to share with me that I haven't asked about?

Is there anything else you think I should know to understand the process of course completion better?

Is there anything you would like to ask me?

Interviewer: Thank you so much for your time. Your contribution to this research is very valuable to me.

Appendix B. Three original transcripts from the Pilot Study

April 15, 2015

Hello and thank you for taking your time and for your participation in this study

S: Could you please share with me few words about yourself and your power engineering background?

Y: I am 49, I live with wife and son. In 2003 I completed 1st class

Y: In 1995 arrived in Canada, and I completed 3rd class, '97 I started working as a power engineer and took one year to complete 2nd, and after 6 years working I completed 1st class. I work in paper mill, also in M……- incinerator. I was in variety of power engineering field as chemical, paper mill, energy. I also worked in an ammonia plant- for about year.

S: Could you please share with me why you took 2nd and 1st class power engineering courses?

Y: I did not need to do 4th class, I am 2nd class marine engineer international and BCSA (British Columbia Safety Authority) recognized my background. They recognized the background and allowed me to do 3rd class. Also my marine engineering would be recognized but back in 1995 employment was difficult to obtain. My friend has to work more as technician and I decided to not go that way.

So back in 1997 I realized how power engineering is good thanks to some people. I was very ambition and I had strong background and not happy with status quo and power engineering program specially distance education one at BCIT was really good and natural set up. It satisfied my personal goal.

S: Could you please explain your working environment?

Y: Working environment, I was working with great people, but they did not understand my goal and industry needs. They did not value education. My power engineering courses were covered by employer. That was great

S: Did you have any previous experience with distance education and why you decided to take it ?

Y: Prior to BCIT I did not take distance education; I took 5 years face-to-face marine academy program. I think for people who are self-motivated, distance education is great. I tested model and worked for me and I am happy that I took it when I needed. I hope that others see the values of this distance education program.

S: Do you prefer face –to-face program?

Y: It would be more challenging, I had to work full time and studying full time would be hard to keep up with

S: Could you please tell me what was your experience taking distance education at BCIT?

Y: The courses that BCIT offered were great, I like variety, I enjoy getting help from instructors, and these distance education courses offered different tools. With my personal situation I did not need interaction with instructors. I followed the structure and achieved my goal. That might not be case with some of my coworkers. They needed more help and BCIT tried to offer that help

S: Would you take face-to-face if you did not need to work?

Y: I still preferred distance education; face –to-face is not my choice because of my background. And I needed my stem time, and it took me 6 years to finish 1st class.

S: What advice would you give to power engineering students?

Y: I would suggest to take what BCIT offers and ask students to follow the structure and if that is followed the rest has to do with knowledge base and that could be done. I followed the structure and I completed the program. I am structured person in order to see the goal to be done.

S: What does it mean to you, how do you feel about completing the program?

Y: I feel in general taking power engineering path is well aligning with my background only instead of being on sea I am stationary engineer. It helped my goals and supplement my income and leaving standard and be in touch with education

S: Did you have any family support?

Y: We came from world were education is appreciated and did not need extra kick to go further. Back to the situation my wife had to study and complete another degree. We study together, it was fun, challenging, no time for family activities, we agreed we have to do it. My son was 7 and he study too. Since we decided to leave O….. we had a plan how to bring ourselves where we are now. We took one year, and we know what we need to do. We had a plan and we fined tunes and move was very drastic and I am not sure I would like to do it again. My family was very supportive

My son went to 2nd grade and I hope he understood what we are doing and hope that he learned that main idea is about him.

I think I am driven person and I like to think I can do on my own but support was value

S: Did you have any support from faculty?

Y: I had great experience, they welcome me, the initial experience was top of the scale, moral support and some members with past experience and it was natural and great. During these years I was thinking to end my career in power engineering education. I am very thankful

S: How did distance education influence your study?

Y: Influence for me was in a way of supporting me what I was doing, they provided structure I needed, I am not sure if I am looking for any extra support. I am not person that needs external support and ask for one. I think I had enough tools

S: Did you look for academic advisers?

Y: I do not recall having these conversations, I had conversation with members from power engineering department and information from program

S: What courses did you find useful?

Y: I found that industry specific course, provided me with clear alignment, equipment, legislated matters and standard operation procedure. I came from different legislation and standards and that was great that I was able to understand what industry needed.

S: Did your background help?

Y: Yes I have a strong background and if I did not have it I think it would be very hard, I was looking my collages and they struggle and many people tend to have problems and 2nd and 1st class choose to bypass academic courses and that is indication for me that they do not have competency to do that. I know some people ending after finishing 6-7 paper and missing 1 or 2

S: Did you experience any difficulties?

Y: No

S: How did you experience the distance education platform?

Y: That did not affect my progression and I was comfortable with system and structure so any platform will work for me. I realized that distance education does offer but I did not use it. Now I would but it took me time to learn the system and use all opportunity that system offered

S: Did you find that your development more successful with distance education program?

Y: Definitely and my employers supported me, financial they supported and that is sign that they do appreciate. I got shift engineering position after completing 2nd class. That helped to accomplish future thing. Power engineering course helped to provide some of those helpful items

S: What other value do you see about you being 1st class power engineer?

Y: That is very heavy question. People in general are great and good and for the most part supports are there when needed. Some people did not see that education is needed and I did not prove anybody wrong or right. One of the employers, employment was great, I was helped financially and I realized quickly that I had to take entry position even though I had 2nd class, because of union structure and people did not have intention to go further educationally or occupationally. I had to leave the position and I go for 2nd class. I realized that structural items and they influence my decisions. Unionized environment has same concepts and after 1st class I was not trap and no logic. Qualification was important and no seniority.

Thank you

May 25, 2015

S: Thank you for your time. Could you please share with me few words about yourself and your background?

F: I am 56. I have a dog. I live with daughter and wife. I work in ……….

F: I graduated in business and work a year and took 4th through distance education. I worked part time in power engineering sector over weekend as power engineer assistant; assist shift engineer do shut down and start-up of boiler.

S: Why did you switch from business to power engineering?

F: I got the job in business and it was a good job in the mining industry in BC and economy in early 80 went down and my dad was power engineer and he suggested and offered the job and assistance to finish 4th class.

S: Could you please explain your reasoning for proceeding with 2nd or 1st class power engineering courses?

F: After obtaining 4th class certification I worked and the plant upgraded and offed opportunity to go for 3rd and I used distance education again while working full time. Later plant increased and I was offered to do 2nd class position and we had a group of people and we took distance education courses and followed the program and again I persuade 1st class I worked full time and study I could not study at work and company did not support the time and they still do not do it.

S: Did your community shape why you decided to go for 1st class?

F: I made it , I was working for chief and learned a lot from and he talked to me and told me I have potential to go for 1st and that was the main one. Yes I can take the plant over and be chief engineer, but that was not in my reasoning, it was more for personal learning. I had him as a mentor; in my normal duties he helped me a lot.

S; Did you have any previous experience in distance education prior to 2nd and what are the reasons to take distance education courses at BCIT?

F: At BCIT they offered face-to-face – 2 year Diploma program and I did not know about 2 year diploma program, if I knew it I would go for that program.

S: So you made decision without looking into different options at the first place ?

F: I think I did not have foundation as 2 year diploma program students and distance education was the one to go so I did have hard time

S: What is your experience with the online courses?

F: Internet was just started and success was not that good, I would say was done with books not so much online and I did not use it . It is done more like correspondence mode. Once I took 1st class courses, I was able to do online research and BCIT material.

S: What are your thoughts, what do you think after taking 1st class courses, did you change your approach toward the distance education mode?

F: For power engineers 2nd and 1st class there are no options than distance education and that is biggest influence. If there is the course face-to-face I would do it. I rather see student-instructor face-to-face relationship. Distance education still follows correspondence model it is translation from correspondence it went online for access. Access is better, no coming to tutorial room, but no interaction, more flexible in time and place

S: What would bean advice to another potential 2nd and 1st students?

F: Do 2 year diploma program where you are exposed to courses so you have good foundation to start 2nd and 1st. For me that was missing and it was more difficult and I am missing some of the foundation

S: Could you please explain it further?

F: I have negative experience – where you are in distance education mode there is not structure , you work on your own pace, you have 1 year, nobody will contact you , and for me structure is important, it has to be mutual between student and instructor,

S: What was a typical day for you when you were studying?

F: Baby was in the house and I worked shift work, 8 hrs and many hrs overtime, study at work 0 hours and study at home 0 hours and I had to go to library to get quiet time, one of the thing was the huge stress as well as pain,

S: Was it common in industry that people taking power engineering courses study at work?

F: Yes , particular in the union environment, I had collages and they had knowledge what is coming on exam, in my plant we straggle no knowledge what is on the exam. People will pass papers and we are not. If you have 20 people they will go challenge the exam and get ideas and get exams out and pass it on to others

S: How was family support?

F: Wife was supportive and she still is, parents supported and encouraged me,

S: Would you mind explaining it?

F: A lots of encouragement, back on the horse and keep writing

S: What relationship did you have with faculty?

F: It was good from the very start, from 4th, some of them are still in my memory. Instructors then had different approach – 4th, 3rd , 2nd and 1st it was more like part time study. People will come from other places from BC and stay in the hotel or friends. The group will defend the dynamic of the tutorial it was live tutorial.

S: So you are saying that it was different between today and in the past?

F: Yes. I was new into field and once I wanted to do 2nd the things were different. I did not use onsite even though it was offered. They change the dynamics and it was you work on your own pace and if you need help you can go and ask. The difference was in number of students. It was many people in the class so you can have almost face-to- face tutorial. If that can be organized students will come to get help and be in the class. They do not know how to ask for help. People are afraid I am afraid to get into

S: Did BCIT influence your study in any way?

F: Instructors are very helpful and patient

S: Could BCIT do more?

F: Follow up is missing. Assignment is marked and no comments or explanations. No follow up or no one "cares" about if student complete or not. Should ask and I do have the reason but no one asked.

S: Would call make any difference?

F: Yes I felt alone and not connected to community

S: Other supports, program advisory?

F: I did not know, I am figuring now at the 1st class, and yes I would use it, academic part would be very useful, the only help I knew was from tutorial. It would be helpful to have a list of resources at the Department website.

S: What was useful in power engineering courses and do you think additional courses will help?

F: The BCSA outlined and I study matirai and most of them helped me in the process of completing. I think additional coursess are needed in the academic area and has to be related to what we doing. Like math or thermo has to be related to what we do. Missing points from math in the high school can be critical and I think it has to be added to the program. Information came out of books without explanation. I need info from department and making me aware that things are exsiting.

S: Do you think that info session would help or video?

F: It would help but it has to be more specific, like mechanics and the explanation what is covered and how to get help, ruther the process of paper but more specific

S: What do you tink about delivering platform D2L?

F: Not helpful at all and no information available , I had to do on my own

S: Did your knowladge grow up with taking power engineering distance education courses?

F: Higher class force you to learn. I have to learn and I still have to learn it

My technical knowlage increses and I question my sefl what I should learn at highre level that I do not know. Sense of accomplitment is the one I value when I finished. Other people looked up to me and want to complet it too. Experience was positive, but the problems in the courses should not stop me. I chandge my attitude towords the obsticals in the process of learning. I am not sure that I am different than others.

We should have courses dedicated to the subject material for the particular paper.

Thank you.

August 7 2015

S: Thank you very much for the participation and if you have any questions please do not hesitate to ask. Could you please share a few words about yourself?

B: I am 51 and I have daughter and son and wife and no pats

B: My last job was in C….. I took to 2 year diploma way back in 1994, no work experience, right out of school I start in production environment more maintenance and running the process and production equipment. First and second job were more the same. First was temporary position and more operation hours as a junior engineer. Over 10 years I developed the plan to go for 2nd from 3rd. During 10 years working as 3rd I started working on my 2nd class certification.

S: So it took you 10 years. How were you introduced to power engineering?

B: My father was power engineer and by default my journey was defined. I spent some time at my father's work place and I sow how it works and got familiar with environment.

S: Why did you take the courses and getting the 2nd class?

B: Initially I was targeting toward the electronics. After high school and did not know how to progress to the next step and father asked me to take power engineering diploma program. He has influence on me and told me that program is very extensive. I took the math and science to prepare and it took me three years to get ready for the program. It was waiting period. My father was aware that courses were not easy.

S: Could I ask was it yours or father decision?

B: It was mutual; during that time I was working with father and advise me 2nd class certificate is the best certificate. I did the research and I could work as a shift engineer. I want to be operator I want to obtain 2nd class but not the 1st one. I set the goal where I wanted to go

S: How did you reach your goal?

B: After 2 years I passed all courses and I was out of the school and I did not want to study anymore. I was 21 and I wanted to work. Others advised me that it is best to go for 2nd class. I basically put any notion of study on side and get experience. I figured I would know when it is the right time to go for 2nd class. And after 10 years I felt I was ready

S: How did you start? Did you know about courses?

B: Distance education I did not know well. I kept my notes from my diploma program and all I need is to take the course to get more information about the material. I think the program/ courses were more correspondence. At work I got some information and got some worksheets and material so I signed for the course. It was 6 papers and I set it as a job – 8hrs a day studying. I was more auditing than being in the program.

S: If you do not mind to clarify for me, you had 6 papers, you needed to finish 4 because 2 were are granted from diploma program.

B: Yes that was the path. I did not ask for help, I was on my own and if I got into problem I was digging. Whole preparation was to register for 2 papers and go to BCSA, and challenged one exam in the morning and one in the afternoon. Failed couple of exams and then asked for help.

S Do you remember what paper was the first one?

B: I did do it in order. First two were the hardest ones, thermos and apply and at that point I did not look at the book and it was big inertia and hardest part was to start . Commitment was there and it was very painful to start .After month it got easier. Initially it was hard and eventually all material from diploma program got back.

S: Would you take courses earlier than 10 years?

B: I would not change anything. I was ready to do it. I know when I am ready and I will not push it. I have to personally be ready

S: How did you know you were ready what was the “aha” moment?

B: I was learning how it works and cementing practical with theoretical. I was moving through different department and each time I realized that I worked from bottom to the top and I master. Once I got bored and voice inside told me move on. When hear the voice I move and make changes.

S: What was your experience with distance education courses?

B: Overall positive initial was painful, physically I had headache and after one month I made it

S: What was the driving force: target?

B:I set the goal and stubborn determination

S: Did you experience any obstacles at work?

B: Yes, no ability to study at work and did not work for me I could not work anything at work, day off will used for study separating study and work and recognizing what work is and what is not

S: Did you have any support at work?

B: Nothing and I did not tell anyone, treated very privately, I wanted to do on my own, I did not want to be subject of gasp

S: Do you think people will talk?

B: Yes and I did not want to be part of any talk. I was junior and keep head low and do not piss anybody, I want to learn practical from them

S: Did company, under union offer support?

B: No, not time not financial support, nothing in the agreement, they were indifferent, that was chief approach. I asked for the letter for the steam time and I need the endorsement for my time and as soon as I get I would like to be trained no problem but no help no success nobody will know and at the end I was happy to say I did it. I had all holidays and with 2nd I lost all benefits. I was at the top of 3rd but it was personal choice. Lots of people will say what I do not want to lose everything for nothing, that was the conversation but I think that was just the excuse.

S: Did you have any family support?

B: Family was supportive. Great family, no children at that time, leaving on our own, and wife will give all support, quite place

S: Did you study at home?

B: Yes at home

S: Did 2 year program help to develop studying skills?

B: Yes without that I would not be able to do it

S? Any help from others?

B: Yes from friends, share the difficulties of the courses. My parent always were supporting me and it was part of my motivation to make parent proud of me

S: What was the hardest moment?

B: It was at the very first days and I opened the book and even now I remember the pain like it was yesterday. I was looking the book and nothing initial pain is that one where most people will stop and not get back.

S: Did assignments help the studying, did they structure you?

B: I used my old notes and books from my diploma program and I was studying to connect the dots and did not get to instructor. Repetition is the one that was working for me. I did not understand some things during the 2 year diploma program but I did ‘bang my head on the wall”.

S: Did you ask your instructors for help?

B: No,

S: Could you please tell me why?

B: I knew I could do it but I was stupidly stubborn. I put thing on the side and built the momentum and get back and do it again. I shelf the problem and I go back. People at the work helped me and they would help and some discussion was very helpful

S: Any thoughts about the course environment?

B: Building the house on the full time program

S: How long did it take?

B: One year , 4 months , I work 2 days 2 nights and 5 off and I did it every week, I took it as a job. Dedicate it all my time, and no kids

Joyful moment was when I felt I am in I know that this is the right and studying was easier and enjoy every moment and it felt great and easy after that

S: Would you like to add anything?

B: You know more than anybody

I did not want to go for the first and I did not have that goal and I did not want to be manager and I want to be great operator and it was not comfortable, I was not sure how to do it. My comfort level. Personal thing. I thought about it, but I do not want to start the pain and I know I would be happy. I would use resources if I go now. I find it comes down to personal motivation, focus back on the planning where I want to go where I want to be. The whole process has to be personally driven. You have to have a goal and that is the key for me and how to go for 2nd and 1st.

Thank you.

Appendix C. List of Initial Codes

List of all codes produced during the Initial Coding Process (232)

Initial Code	References within Code
More money	13
Family member in PE	12
Additional courses needed	12
In the same time helpful and painful	10
Prefer face-to-face	10
No contacts	10
Control time	10
More jobs	9
Too much of material	9
Face-to-face works better	9
Get certificate	9
Encourage by family to take the course	8
Did not have experience with de	8
Positive experience	8
It was beneficial	8
No interaction in de	8
Is it beneficial for the effort	8
To many assignments	8
Great help	8
PE as craft	8
It was challenge	8
Help available	8
High number of assignment questions of questions	8
Students are on their own	8
Quite place	8
No distractions	8
Study at work	8
Study on days off	8
Asking coworkers for help	8

Good material	8
Hard very hard	8
Using d2l only for assignments	8
No experience with DE	8
Helped me obtain certificate	8
With support to get easier	8
Classroom better	8
Organized time	8
Family influenced	7
Previous education helped	7
Force to go through	7
Waste of time taking courses	7
Co-workers help	7
Money	7
Studying on your own	7
Time off for studying	7
Helped pass the exam	7
They are all hard	7
My decision	7
Do not need	7
More comfortable in the class	7
Not too comfortable	7
It is good opportunity	7
Family support important	7
Carrier stability	6
Working on my own paste	6
Great passion	6
More than needed but good	6
Good improvement overall	6
Not asking for help too much	6
More examples of questions with solutions	6
Assignments are helpful	6
Does not offer much	6
Better position	6
Expand knowledge	6

More f2f,	6
Painful	6
Overwhelming	6
Prefer f2f	6
Practical problems	6
Helps for exams	6
Not friendly at work	6
Not using tutorial	6
Better working hrs	6
F2f not available	6
With tutors help	6
Completed 2 year f2f PE program	5
Knew d2l	5
De works for me	5
Solid foundation in PP	5
More contacts from faculty	5
Better in person	5
Job security	5
Lot of opportunity	5
Tutorial for thermos, refrigeration, drafting	5
Just for the exams	5
Course is paid	5
At night	5
Do not care at work	5
To better myself	5
Hard to get through material	5
Assignment are good	5
Help is available	5
Financial support	5
Like flexibility in DE	5
DE source of learning material	5
Grow more from work	5
Good money	5
Could not do it on his own	5
Having hard time to use DE	5
No destructions	5

It is hard	5
Coworkers not supportive	5
Course is paid	5
Money lost	5
I am in control	5
More f2f time	5
Degree	4
Structure well de	4
More time, less condensed	4
No problem with further studying	4
Not special family support	4
It is good faculty support	4
They are all hard	4
Opportunity for positions	4
Tutorial helpful	4
Good support	4
Math skills	4
Interesting	4
Feel more confident	4
Increase knowledge	4
DE works too	4
Only assignments	4
Do not have a choice	4
They are positive	4
Preparation for exams	4
Moral support from family	4
Teacher helps available all the time	4
Managing the time	4
Boss is supportive	4
Like tutorials	4
Use it a lot	4
Better prior preparation	4
Have responsibility	4
Personal decision	3
Not completed process of delivering	3
Success stories of PE	3

Manage time	3
Ask questions	3
Increase skills	3
Clear instructions	3
Practical questions with answers	3
Provide help when asked	3
Better job opportunity	3
Better working environment	3
I want it	3
Get answer when it is asked	3
Very helpful	3
My decision	3
Do prepare me for exams	3
It is up to students	3
Have to do my work	3
Tutor help important	3
Live tutorials needed	3
Job security	3
No family support	3
Ask questions	3
Not close to instructors	3
Have to do it	3
Needed support	3
Moral support	3
Prioritizing the tasks	3
More connection	3
Realize strengths and weaknesses	3
Willing to listen	3
Interest in process and plant operation	2
Late , not at the work	2
Encouragement	2
No influence of family on the progress	2
More simulator time	2
Good structure	2
No problem	2
I had good base	2

The knowledge	2
Additional skills that program offers	2
10-20 hrs of study	2
Faculty help	2
Degree in science	2
Skills come from work	2
Do not pay attention on my progress	2
Not good material	2
It has to be done	2
Not worth doing	2
Better have overtime to get more money	2
Good if you do not have better	2
Get expert for answering the questions	2
Faculty at BCIT do not influence me	2
Skills come from work	2
Promotions	2
Little experience	2
Job stability	2
Further the carrier	2
Boss as a mentor	2
Have to remind that assignments have to be done	2
Faculty should contact students	2
I like it	2
Like to learn	2
To continue education	2
Only if it is paid	2
More examples with solutions	2
Assignments are good	2
Desire to complete all pe programs staring with 4th	2
Both trade and academic	2
Great support	2
Consider how your peer group affects your actions.	2
Used vacation to study	2
Understand and appreciate the help	2
Excellent encouragement and discussions of career path.	2
Faculty inspired me	2

They shaped my academic path.	2
Helpful	2
I feel accomplishment, dignity, and without fear of advancement or challenge.	2
My capacity to understand challenges, whether academic, practical, or personal.	2
In the coffee shop	1
Had power to continue	1
No choice	1
Mother pushes	1
Not good connection between material and job	1
Hard to study after 12 hrs of work	1
Family is optimistic	1
Faculty supportive	1
Should start with easier course	1
Improve myself	1
Proper instruction needed	1
Better resume	1
Different position in PE	1
Job driven decision	1
Had fear to contact instructors	1
Create schedule	1
Not good at the beginning	1
Did not believe in PE	1
Power Engineering gave me confidence in both academics and real-world application	1
Post-secondary education	

Appendix D. List of Revised Initial Codes

As stated in section of Main Study in the Chapter 4 as coding progressed a number of initial codes (listed in Appendix C) which were deemed very similar to each other were merged. This resulted in a revised list of initial codes, totalling 24 codes. This list of Revised Codes is shown below.

Revised Initial Codes	References within Code
Financial benefit	13
Family heritage	12
Better jobs	9
Family support - yes	7
Family support - no	4
Job support-yes	8
Job support-no	9
No DE experience	10
Face-to-face better	13
Instructor support	8
Overwhelmed with material	9
No need for education -all from workplace	8
Painful experience	15
No use of D2L	9
Coworkers support	7
Better jobs	8
Postsecondary education	16
D2L for examination preparation	8
Educational benefits	7
Asked to do it	5
Time management	12
Is it beneficial for the effort	7
More courses needed	12
Better support better results	8
Limited Math and science skills	12