UNIVERSITY OF SHERBROOKE

POUR UNE PARTICIPATION ACCRUE DES FEMMES DANS LA FORMATION EN TECHNOLOGIE ELECTRIQUE

STRIVING TOWARDS GREATER GENDER EQUITY IN ELECTRICAL TECHNOLOGY TRAINING

par

Allan Insleay

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A été évalué par un jury composé des personnes suivantes:

_____ Directrice de l'essai

Silke Lach

_____ Évaluatrice de l'essai

Ann Beer

SUMMARY

This research project explored barriers presented to female students, and analyzed the female friendliness of the pedagogy in an effort to understand and address the underrepresentation of females in the current Electrical Technology program at Vanier College.

The researcher, a teacher at Vanier College since 1999, has taken notice of the consistent gender disparity in the Electrical Technologies. The Electrical Technology program is a three-year career program. There are currently three female and forty-four male students enrolled in the three year program, and there are five teachers in the department of which only one is female. The first research question was, "Does the current Electrical Technology program at Vanier College present barriers to women?" The second was, "To what extent is the current Electrical Technology program's pedagogy at Vanier College female friendly?"

A questionnaire was developed to explore these questions using a semi-structured interview format. The interview questions arose from the literature review on barriers to females in non-traditional fields, and on female friendly pedagogy. The questionnaire included general questions forming the basis for more specific follow-up questions to be created during the interview. This flexible approach allowed the interviewer to touch on specific details or discuss issues more deeply.

The participants were selected from a convenience sample of female students in the Vanier College Electrical technology program. There were six participants consisting of the three currently enrolled students and three alumni. These interviews explored the barriers perceived by female students and indicators of female friendly pedagogy.

The first part of the project explored barriers, as perceived by females to the Electrical Technology program. The barriers mentioned by the females in the Electrical Technology program were gender stereotyping, fears about entering a non-

traditional field, ineffective recruitment and the lack of socially relevant, trendy topics in the curriculum. The findings indicated that although these barriers were perceived, the female students in Electrical Technology were strongly encouraged and supported in their choice of field and persisted in their choice of Electrical Technology.

The second part of the project explored the female friendliness of the pedagogy of the Electrical Technology program. One the whole, the Electrical Technology program's pedagogy was perceived by the participants to be female friendly, thanks largely to the extensive amount of group work students encountered. However, several participants complained about the absence of certain trendy subjects in the curriculum. The findings also indicated the need for more current technologies, more theory, more programming, newer sensors, and student driven projects to be included as part of the learning activities.

The study indicated that female students like Electrical Technology, are good at it and are rewarded in their career path. Although they perceived barriers, they were not overwhelmed by them and in general found the program to be female friendly. Several of the participants took great pride in the fact that they are succeeding in a non-traditional field.

The researcher feels that the Electrical Technology program at Vanier College should strive for a greater gender balance. It is his belief that a change in recruitment strategies may be part of the solution to the underrepresentation of females in the technologies. Attracting more female students to the field means opening up interesting career paths for individual women, helping to break down gender stereotypes, and enriching the field of Electrical Technology by bringing a wider set of perspectives to future design problems and solutions.

SOMMAIRE

Ce projet de recherche explore la sous représentation des étudiantes par rapport aux étudiant dans la formation en Technologie Électrique au Collège Vanier, et analyse les méthodes pédagogiques pour savoir si elles répondent à la clientèle féminine.

Le chercheur, un professeur au collège Vanier depuis 1999, a remarqué une disparité des sexes en Technologie Électrique. Le programme en Technologie Électrique est un programme de trois ans. Il y a présentement 3 femmes et quarante quatre hommes inscrit dans ce programme. Il y a 5 professeurs, dont une femme seulement. La première question du projet de recherche, "Est-ce que le programme de Technologie Électrique au Collège Vanier présente des barrières aux femmes?" La deuxième question, "Jusqu'à quel point le programme Technologie Électrique au Collège Vanier est adapté à la clientèle féminine?"

Un questionnaire a été développé afin d'explorer ces questions en utilisant un format d'entrevue semi-structuré. Les questions de l'entrevue font référence à la littérature sur les domaines non traditionnels pour les femmes, et sur la pédagogie adaptée aux femmes. Le questionnaire est composé de questions générales afin de permettre à développer des questions plus spécifiques durant l'entrevue. Cette approche flexible permet d'aborder des détails spécifiques et d'en discuter en profondeur.

Les participantes ont été sélectionnées à partir d'un échantillonnage d'étudiantes au Collège Vanier en Technologie Électrique. Il y avait six participantes, les trois étudiantes présentement inscrites dans le programme de Technologie Électrique et trois anciens diplômés. Ces entrevues explorent les barrières perçues par les étudiantes et les indices pédagogiques adaptées pour la clientèle féminine.

La première partie du projet explore les barrières perçues par les étudiantes dans le programme de Technologie Électrique. Les barrières mentionnées par les étudiantes sont principalement reliées à la peur de participer dans un métier non traditionnel, inefficacité au niveau du recrutement, et une manque de sujets pertinents dans le curriculum. Les résultats de l'étude démontrent que même si ces barrières sont perçues, les étudiantes au programme de Technologie Électrique sont fortement encouragées et supportées dans leurs choix de carrière.

La deuxième partie du projet explore l'aspect pédagogique du programme de Technologie Électrique par rapport à la clientèle féminine. Un aspect apprécie des étudiantes est que le programme requiert beaucoup de travaux d'équipe. Par contre, quelque participantes déplorent le manque d'attention à la nouvelle technologie dans le curriculum. Les résultats indiquent aussi un besoin de plus d'enseignement en technologie courante, plus de théorie, plus de programmation et d'apprendre la théorie en faisant plus de projets crées par elles mêmes.

L'étude indique que les étudiantes aiment le programme de Technologie Électrique, elles performent bien et elles sont récompensées dans leur progression de carrière. Malgré le fait qu'elles voient des barrières, elles ne sont pas découragées par ces obstacles et en général le programme est assez bien adapte à sa clientèle féminine. Plusieurs participantes ont une certaine fierté de performer dans un métier non traditionnel.

Le chercheur croit que le programme de Technologie Électrique au Collège Vanier s'aligner pour devenir plus adapté à la clientèle féminine. Il croit qu'un changement dans la stratégie de recrutement fait probablement partie de la solution au problème de la sous représentation des femmes en Technologie Électrique. Attirer plus de femmes vers ces champs peut ouvrir un développement de carrière intéressante pour les femmes, briser les stéréotypes et enrichir la Technologie Électrique par une plus grande perspective de design et de solutions pour de futures problèmes.

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CHAPTER 1: Statement of the Problem

1. Introduction

The question of underrepresentation of females in Electrical Technology has always challenged the researcher, who graduated from the Electrical Technology program at Dawson College and went on to obtain undergraduate and graduate degrees in Electrical Engineering. As a student, the researcher noticed consistently uneven gender enrolment in the technology and engineering programs. Females always made up a much smaller proportion of the student body than did males.

Years later, as professor in the Department of Electrical Technology at Vanier College, the researcher observed the same pattern in his classroom. There have usually been only one or two female students registered in each class of this three year career technology program. These enrolment numbers indicate that Electrical Technology remains a non-traditional career for females. A non-traditional career is usually defined as one where more than seventy-five (75) percent of the workforce is of the opposite gender. There is a plethora of occupations considered non-traditional for women including welder, mechanic, engineer and electrical technologist.

The underrepresentation of females in the Pure and Applied sciences at Vanier College was investigated by Davis and Steiger (1996). They found that the proportion of females and males who did not persist in their Cegep program and go on to university studies was nearly equal. They found that 72% of the females who entered Cegep in the health sciences obtained DEC's and continued at university in the same area. However, they found that the 35% of females who started in Pure and Applied sciences switched into the Health and biological sciences. There was evidence of gender socialization patterns where frequently, women expressed the desire to enter caring professions and wanted to make human connections in their professional lives. Furthermore, women tend to be more vulnerable to undesirable academic experiences and flourish with good, encouraging ones. Steiger and Davis noted that the underlying reasons for the underrepresentation of females in the Pure

and Applied sciences were related to a complex set of gender differences in attitudes towards science learning as well as a gender bias held by the instructors. They found that instructor gender biases influenced the level of student commitment to the subject and persistence in their studies.

The literature shows that girls do not take higher science, math, and computer science classes as often as boys, and girls do not go into science, math, and technology careers as often as boys (Acker and Oatley 1993; Silverman and Pritchard 1996; Jensen and Owen 2001; Nelson 2004). The SRAM (2010) data for Vanier College indicates that the enrolments in the technologies, specifically Electrical Technology, Digital Systems Technology and Computer Science Technology, show significant gender differences as compared to those for the sciences. Current enrolment in the sciences at Vanier shows a fairly even gender balance. For example in 2007 there was a total of 419 students of which 200 were female and 219 male, in 2008, a total of 405 students of which 189 were female and 216 male, and in 2009 a total of 382 with 191 female and 191 male. The Technology programs together paint a different picture: in 2007 there were a total of 69 students of which 4 were female and 65 male, in 2008, a total of 68 students of which 9 were female and 59 male, and in 2009 a total of 74 students of which 5 were female and 69 male.

Gender inequity creates barriers for girls and may diminish their continuing interest in science, math, and technology, both in school and as a career choice. Furthermore, traditional teaching practices, classroom organization and performance testing may not acknowledge the importance of connecting what is taught to the lives and interests of students. While such interconnectedness is important for all students, women respond better to teaching which relates to their own lives and gives them encouragement about their own abilities.

There is considerable literature in support of "female friendly pedagogy" as a way to improve the educational environments for not only female students, but all students. For instance, Zuga (1999) argued that simply the addition of more women

into the current system was not an appropriate solution in itself. She proposed five different avenues to reform the technology education environment in a female friendly way. The first avenue was to address women's ways of knowing as different from their male counterparts'. The second avenue was the restructuring of the subject matter, suggesting alternatives to the traditional male models of power and dominance. The third was the use of language, where she reported that women need to understand the context of an idea and to have a thorough explanation. The fourth was to create a humane classroom to recognize women's ways of knowing and acting. The final avenue was the integration of cognitive and affective learning through the discussion of values related to technology.

Although women are no strangers to technology, their voices have been missing in the definitions of technology, which are male centered and often exclude women's areas of expertise as reported by Nelson (2004). Kasi and Dugger (2000) found that there was also a serious gender underrepresentation in teachers of Electrical Technology. The authors examined the relationship between gender roles and characteristics perceived as necessary for faculty success in Electrical Technology tenure track positions. The researcher feels that technology must be seen as a women's domain also. Moreover, recruitment of women both as students and faculty should become a priority for Electrical Technology programs.

Scholarly teaching is the process whereby knowledge is communicated in such a way as to enhance student learning and to foster a lifelong learning attitude. Smith (2001) cites Glassic, Huber and Maeroff as having defined six standards by which to characterize scholarly teaching. There should be clear goals, adequate preparation, appropriate methods, significant results, effective presentation and reflective critique. Scholarly teaching must go beyond being an expert in one's field or simply knowing the latest technological advancements. There must also be knowledge of teaching and learning styles, pedagogy, instructional design, various approaches to evaluation and the ability to critically analyze and reflect on one's

teaching practice. Moreover, scholarly teaching strives to promote active student learning and critical thinking skills.

In this study, various aspects of the Electrical Technology program were explored to determine whether it presents barriers to females. The researcher speculated that a more female inclusive curriculum may be needed and numerous barriers might be deterring women from entering the field.

2. *The Electrical Technology (Industrial Electronics) Program at Vanier College*

The three-year Electrical Technology program at Vanier College now comprises forty-seven (47) students, and only three of these are female. The program currently admits approximately 16 new students per year. There are five teachers in the department, of which one is female. The program, defined according to Quebec ministerial guidelines, consists of a program core, general education, and complementary courses. The program has an integrated set of objectives tied to activities and abilities that flow in a logical and coherent manner, and are framed as competencies. These competencies are evaluated in a summative manner through a comprehensive assessment of a student's progress. Students advance by successful demonstration of the specific competencies, which are listed in Appendix A. Eventually a student should obtain a complete competency set through mastery of all the specified skills and abilities.

The Electrical Technology program has been organized in a disciplinary manner. The statement of competence for each of the core courses is specified by the education minister. Actual course content is under College and department responsibility.

There are a great many choices to be made when developing course content and pedagogical material in order to attain specific competencies as integral elements forming a curriculum. There are numerous factors influencing the arrangement of curricular items. Among these are technical obsolescence, status concerns, beliefs

about adolescent development, and organizational priorities. A wide variety of stakeholders lay claim to the curriculum. Students, parents, teachers, administrators, and industry professionals (future employers of graduates) make up stakeholder groups. These stakeholders have different concerns related to the curriculum, and to expect an easy harmony among them is perhaps utopian.

The focus of this research project is on female students in the Electrical Technology program and more specifically on:

1. Why they enter the program and
2. Whether the Electrical Technology curriculum, its components, organization, pedagogical styles and materials suit the needs of female students.

The researcher conducted semi-structured personal interviews with a convenience sample of female Electrical Technology students and recently graduated alumni, to see if they perceive barriers, and also to investigate female students' perceptions of the curriculum and teaching styles.

CHAPTER 2: Literature Review

1. Gathering Evidence: Identification of Barriers Facing Female Technology Students

A review of the literature related to science and technology education brings to light the question of gender distribution. There are a great many publications on this subject, and in particular the question of comparative gender performances in education. Do girls outperform boys, or vice-versa? In 2000, the Programme for International Student Assessment (PISA) began analyzing reading skills, mathematics and science to provide international indicators of the skills and knowledge of 15-year-old students. Over the years, results show that girls outperform boys in reading, and in the identification of scientific issues. There is no significant difference between girls' and boys' abilities in the general sciences. Males, however, seem better at mastering particular scientific knowledge and females seem better at seeing the larger picture, thus enabling them to identify scientific questions that arise from a given situation. Males tend to significantly outperform girls in mathematics.

The researcher has always believed that males and females are equally capable of studies in and pursuing a career in the science and technologies. However, there continues to be a significant underrepresentation of females in the technologies. Acker and Oatley (1993) found that girls and women were underrepresented in schools and in the workplace in the fields of Mathematics, and Science and Technology. They found that females study less mathematics, physical sciences, engineering, computer studies and allied fields than males, at every level of education.

The career choices and persistence of women in the science and technology field was analyzed by Bystydzienski (2009). Mathematics achievement acts as a critical filter, perhaps changing educational aspirations of high school students. Girls and boys, for example, show equal interest in science and math in middle school, but

by high school many of the girls no longer express an interest in a scientific career. Females may be at a disadvantage in college, where many science and engineering programs assume a background in high school calculus and physics (courses often bypassed by high school girls in the past, although this is changing). Higher math achievers generally aspire to higher prestige occupations than lower math achievers. Moreover, studies conducted using longitudinal data (6yrs) found that algebra II and calculus were key filters in the determination of a science and technology career. They found a positive correlation between young women taking higher math and choosing a career in science and technology. Moreover, there are also institutional barriers to women's career development, such as gendered organizational structures and environments where an unfriendly climate may contribute to lower interest levels in female students.

Acker and Oatley (1993) found that women are underrepresented in occupations requiring knowledge of or qualifications in science oriented fields. In 1986 women accounted for 29% of the science and technology labour force in Canada compared to their overall labour force participation of 43%. The authors investigated the role of schooling and other influences. They found influences at the individual, schooling and social levels. Moreover, they speculated as to whether math and science ability were seen as congruent with female sex-role identity. Low self confidence in females was correlated to the belief that success is due to luck and failure is due to lack of ability. They found that females often overestimate the difficulty of unfamiliar tasks. Also, females tend to hesitate over risk-taking. School influences included assessment procedures, teacher expectations, peer pressure, stereotyped textbooks and the fact that boys tend to receive disproportionate teacher time and attention. Additionally, cultural stereotyping included industrial and academic workplaces, which strongly reinforce masculinity within the fields of science and technology.

Silverman and Pritchard (1996) wondered why a disproportionate number of girls turn away from math, science and technology. They investigated the wide

gender gap in participation rates in technology education at the high school level. They considered the impact of teaching methods, classroom organization, classroom atmosphere, and teacher interaction. They surveyed both males and females, and conducted a series of focus group interviews as well as classroom observations and interviews with teachers and guidance counsellors. Based on the evidence, girls initially appeared to enjoy technology, and seemed to have confidence. They found that emerging sexism among peers began to affect female participation despite their proven ability in these subjects. These stereotypes about subjects which have traditionally been identified as male dominated areas may be working to discourage girls from pursuing non-traditional careers. They suggested that teachers should consider the importance of emerging sexism among peers, regarding traditional male oriented fields. Teachers should use care when deciding the kind of objects to build in a laboratory setting, ideally highlighting aspects of technology which attract the interest of both boys and girls. The differing interests of boys and girls should be considered, and there are ways to make the subjects attractive to both and show both what they may be doing in a future career path.

Boser, Palmer and Daugherty (1998) looked into students' attitudes and participation in technology education programs. They wondered if there were differences in the attitudes of male and female students as a result of participation in technology education programs. Moreover, they looked at whether the instructional approaches used to deliver technology education affected students' attitudes toward technology. They found that there were indeed gender differences and that female's consistently perceived technology to be less interesting than did males. However, females, more than males, perceived technology to be an activity for both genders. Females also thought that technology was a more difficult subject to understand than males did.

McLaren (2009) argues that the building of interest in and commitment to science and technologies can address the gender differences in enrolment in science, technology, engineering, and mathematics (STEM). The educational experience in

science and technologies can be made more relevant to women. The way to do this is to reform the curriculum through a topic-by-topic analysis, as well as to attract and retain a greater diversity of students through transition programs, mentoring programs, and residential communities for incoming students.

Haynie (2003) delved into the cultural climate surrounding technology education, barriers presented to women, and ways to attract more women into the profession. Personal interviews were conducted with twelve female informants who had worked in technology education from fewer than 5 to more than twenty-five years. Technology was considered a male dominated field. There was a lack of women to serve as role models in industry, as teachers, and a lack of a well established network of females. The females tended to like more trendy topics instead of shop work. Some of the more trendy topics included PCs, communications, biomedical and conceptual design. Positive findings were the trend towards more PC intensive work, a move away from heavy industry topics, and a decrease in sex-role stereotypes. Nevertheless, Haynie noted that women in technology fields felt patronized, minimized and uncomfortable due to the attitudes and actions of men. The importance of an evolving curriculum and the retirement of older men with outdated views were noted as mitigating positive factors.

Weber and Custer (2005) also found that there was a disproportionate lack of involvement of females in technology. They looked into culturally grounded stereotyping, socially relevant topics as more appealing to females, and collaborative activities. They investigated topics and activities related to the study of technology most preferred by females and males. They used a technology activity preference (TAP) and a technology topics and instructional methods preference inventory (TIP) as instruments. They found that females tended to prefer design and communication oriented tasks, whereas males liked more hands on types of tasks. Women were more interested than their male counterparts in activities that support and facilitate communication and that are socially relevant, and tended to be less interested in competitive activities.

Fox, Johnson and Rosser (2006) reported that the few young women who enrol in technology programs encounter a "chilly climate"; unequal treatment, lack of role models, demoralization, lack of respect, isolation - all this, despite the fact that most women reported, in the case study, feeling confident about their own abilities. Essentially, despite the significant increase in participation of females in post-secondary education and the work force, females are still noticeably underrepresented in high-profile, high status fields and careers, particularly those associated with physical science, engineering, and applied mathematics.

The literature suggests that women tend to have less experience with technology than their male counterparts, whether it is computer technology or Electrical Technology. Pilon (2006) reported that over four hundred female potential high school graduates attended an open house at École Polytechnique, and that even though women make up sixty percent of the school population, they continued to choose health sciences as a career path instead of the technologies. This is also indicated in the SRAM (2010) findings as outlined in chapter 1. The obstacles identified thus far in this literature review are summarized as shown in Table 1.

Table 1 Barriers to Female Students Pursuing Electrical Technology Education

Barriers to Female Students Pursuing Electrical Technology Education	
Fears	• Overestimate the difficulty of tasks • Risk taking
Stereotypes	• School influences • Cultural climate • Perception of the field • Emerging sexism among peers • Attitudes and actions of men
Pedagogy	• Instructional approaches • Activities related to the study of technology
Social	• Trendy topics, socially relevant
Recruitment	• Effective recruitment techniques

The identification of barriers may be a good place to begin to understand the continuing underrepresentation of females in some sciences fields. Gilligan (1982) suggested that women have a different value system from men, a system which influences academic, career, and all other life choices, and ultimately plays a primary role in their educational and occupational achievements. She felt that in order to understand women's lives, one must recognize that in comparison to men, women simply have a completely different world view, one that is relational in nature. Women are different from men in their sense of connection and in their need to be related to others, influencing career choices. According to her, Women have their own path to personal satisfaction and fulfillment. The researcher feels that in electrical technology education, a revised curriculum and the implementation of a more female friendly pedagogy may be an avenue to attracting and keeping more women in this field. This would be of benefit to both the women concerned, and to the development of the field.

2. *Gathering Evidence: the Curriculum*

Teaching is more than the design and implementation of activities that promote student learning, and there are essentially two different approaches to curriculum. The first is the traditional behavioural approach, whose definition of curriculum is based on contents and behaviours. Here the concern is with observable indications of learning. This approach views the teacher's job as modifying the behaviour of students by setting up situations to reinforce students when they exhibit desired responses. Behaviourists view learning as a sequence of stimulus and response actions in the learner. They reason that teachers link together responses involving lower-level skills and create a learning "chain" to teach higher-level skills. The teacher determines all of the skills required to lead up to the desired behaviour and ensures students learn them all in a step-by-step manner.

The second approach searches for deeper meaning in the process of education. It is based on Dewey and his progressive constructivist approach to curricular design, development and implementation. The ideas of logical, objective and reflective thought are key elements of this approach. Tardif et al. (1992) recommends a systemic approach requiring an interdisciplinary pedagogy. The active intellectual participation in socially relevant projects linked to scientific theory and practice are key elements to arouse intellectual interests, while academic theoretical subjects would become more practical and related to the learner's experiences.

Learning begins with an introduction into the discipline followed with applications within the discipline and moving towards personal integration of the knowledge and abilities to fulfill the program objectives. The Electrical Technology program is structured based on competencies supplied by the Minister of Education. Geoffroy (2003) illustrates the importance of a unified and integrated set of objectives, activities and abilities that flow in a logical and coherent manner. For example, a class might study a unit called "Nuclear Cooling Tower", using math to calculate pressure at certain depths and models to maintain a steady level in the

tower, and then social studies to understand the impact of this technology on nearby populations and their livelihood.

Sullivan (1995) suggests that a more appropriate approach is to have students' master specific knowledge and skills before moving on to new ones. Moreover, the competency-based approach mirrors a growing trend within educational psychology to link assessment, instruction and application.

Another element of competency-based education is related to the management of the learning process. In this manner each learner has the opportunity to develop at his or her own rate and then be evaluated on the specific competencies. The program approach through competency-based education acknowledges that people learn at different rates and in different ways. Some may learn more quickly than others depending on the kind of task being learned. Competency-based education makes a point of accommodating this wide variation in potential rate and style of learning by providing for the individual development and evaluation of important competencies.

In summary, the curriculum can be viewed as learning which is planned and guided by the College and department, whether it is carried on in groups or individually, inside or outside the school. The specific courses in the program have competencies needed for successful future employment. Noll and Wilkins (2002) call for more soft-skills to be implemented in the development of Electrical Technology professionals. The authors define these skills as teamwork, collaborative efforts, planning and leading projects, and presentation and writing skills.

3. Gathering Evidence: Female friendly Pedagogy

Teamwork, collaboration, communication, creativity and diversity are at the heart of a successful electrical technology program. Perhaps these ideals can be achieved through a more inclusive classroom. Female friendly pedagogy describes teaching practices that can benefit all technology students. It may offer ways to make electrical technology classrooms more inclusive to women, and help to provide a

framework for evaluating and reflecting upon teaching practices. Female friendly pedagogy aims to create a more inclusive environment and friendly atmosphere for all students. Female friendly pedagogy is an approach to teaching that acknowledges women's perspectives and experiences. It proposes that students should tap into their own resources to utilize their own strengths. Furthermore, female friendly pedagogy tries to play down the role of the teacher as instructor and encourages students to become active learners. The material that students are studying should be relevant and connected to their own lives and experiences.

Female friendly pedagogy was developed and is aimed at empowering women and making them equal participants in the classroom. This approach to teaching and learning aims to set the foundation for a more diverse student centered learning environment. Moreover, students' teamwork, and communication skills, and competencies will likely. (Davis, Steiger, Tennenhouse, Sussman and Yssaad, Weber and Custer)

Davis, Steiger and Tennenhouse (1989), investigated a set of teaching strategies aimed to improve female students' self-esteem, increase their interest in a wider range of disciplines, their commitment to continue in the subject, and attitudes and commitment to further education in general. At the time of the study females tended to drop out of college level science programs more often than their male counterparts. The authors sought to understand the phenomenon as related to the failure of the educational process to retain female students. They sought to understand the women's rate of program transfer or drop out from 1983 to 1987. They found that during this period, women's rates were 1.5 to 2 times higher than men's. They found that the initial Cegep level registration of women at about 45% drops to 35% in pure sciences and to 20% in applied science at the university level. They felt that the education process fails to captivate female students, and that traditional pedagogy may not be experienced in the same way by both sexes.

Davis and Steiger (1993) went on to investigate female friendly teaching strategies designed to improve women's confidence and increase their commitment to and engagement with the physical sciences. They studied such strategies as peer-support partnerships, writing about the learning process, and systematic self-disclosure by the teacher. The authors found that feminist pedagogy positively affected students' attitudes toward both the teacher and the subject.

Davis and Nemiroff (1993) proposed to develop a model for gender-fair education in the compulsory courses in English, French, Humanities and Philosophy at the CEGEP level. A model was developed, teachers were trained in gender-fair pedagogical methods, and the model was tested. In the experimental semester, they found significant positive changes in student attitudes regarding female stereotypes. Another element of female friendly pedagogy is exploring how students view particular aspects of technology content, as well as how they perceive technology as a whole. Such approaches help students seek meaning in the nature of technology and define their own perceptions of technology.

Lewis (2005) suggests that creativity should be an important goal of technology education. He proposes that the standard methods of technology education may not be meeting this objective. Moreover, he identifies a need for design and problem solving to be framed so as to provide a chance for students to step outside the box and find solutions not imposed upon them by the current curriculum.

Dawson and Newman (2002) introduce the concept of empowerment and illustrate its relevance to the study of Electrical Technology. The authors were looking at ways to devise a method to help prepare students for continuous changes in their field by developing a range of skills which will promote and encourage "lifelong learning". Their approach is to have students reflect on their learning and thus internalize their experiences.

Beane (1999) recommended an approach requiring students to solve a "realistic" situation that they can relate to, and is seen by them as important and "high tech", increasing their motivation to take an active part in their own learning experience. The essence of empowerment is to provide students with a "real world" challenging situation that forces students to think creatively and reflect on what they have learned.

Myers and Haynes (2002) delved into ways to transform the traditional lecture-based pedagogy into a more inquiry-based interdisciplinary one. The authors propose that teachers take on a new role, which is that of a mentor or guide, or better still a partner in the learning process with students. Teachers should support and build trust with students so as to encourage them to take risks in their progression towards more complex ways of constructing meaning. They argue that students will exhibit a vested deeper approach to their learning when they are engrossed in their own questions throughout a design and experimentation phase. These phases provide opportunities for students to reflect on their learning process.

Grace (2002) suggests that feminist pedagogy opens up new networks of disciplinary relationships and it engages the learner who constructs identity, develops new meaning, contextualizes new concepts and constructs relations between them. Grace suggests that knowledge is not solely available through textbooks; it is developed through the learner's voice and language. Feminist pedagogy raises the question of authority and promotes methods that empower students, allowing them to actively participate and assume more responsibility in their learning process. Students should be engaged in cooperative and collaborative learning activities to respond to the changing workplace where isolated work tasks are increasingly being replaced by team efforts. Teamwork is certainly an integral component in the Electrical Technology field where successful outcomes may often depend on group dynamics. The decision-making in a healthy team should be democratic, where the responsibilities are divided fairly among all members.

The literature review has provided the key indicators of an ideal type of female friendly pedagogy and is summarized below in Table 2.

Table 2 Elements of Ideal Type Female Friendly Pedagogy

IDEAL TYPE FEMALE FRIENDLY PEDAGOGY
Collective and co operative negotiation rather than competitive models of learning
Learning and teaching that is both reflective and active and demonstrates an awareness of the individual within their own social, environmental, historical, or cultural context
Learning and teaching approaches that empower both the learner *and* the teacher
Learning and teaching approaches that engage with social change
Finding links between curriculum and experience, between theory and practice, between thinking and feeling

CHAPTER 3: Research Design

1. Methodology

The research questions were addressed using semi-structured in-depth interviews. Freebody (2003) refers to three types of interviewing approaches, the structured, semi-structured and the open-ended. The semi-structured interview restricts the domains of relevance of the conversation to a predetermined set of questions and thus, by inference, a set of possible answers surrounding the research questions. This instrument of data collection was designed to investigate female perceptions as to the barriers facing women of technology as well as the female friendliness of various aspects of the IE program.

The interviews were held with three currently enrolled students and three recently graduated alumni of Industrial Electronics at Vanier College during the fall of 2009. The semi-structured interview format was selected as its fairly open framework allows for focused, conversational, two-way communication. It can be used both to give and receive information. The interviewer posed general questions which formed the basis for more specific questions which were not prepared in advance. Thus the researcher created follow-up questions throughout the interview process, allowing both the interviewer and the person being interviewed the flexibility to probe for details or discuss issues more deeply. These interviews provided the researcher with an opportunity to obtain a wealth of qualitative information and insights.

These interviews attempted to tease out the barriers perceived and indicators of female friendly pedagogy grounded in the literature review and summarized in table 2. This instrument sought to test the validity of what is presented in the literature and also provide an opportunity for learning. The researcher hoped for rich information indicating not just answers, but the reasons behind the answers.

The literature review in chapter 2 provided the grounds for the identification of the barriers and indicators of an ideal type female friendly pedagogy. The barriers perceived by the women in the technologies were compared with the indicators listed in table1. The elements of female friendly pedagogy were further broken down into variables and indicators. Tables 3 and 4 (on the following 2 pages) depict variables illustrating female friendly pedagogy and indicators of those variables.

Table 3 Rubric to Illustrate Evidence of Ideal Type Female Friendly Pedagogy

VARIABLES OF IDEAL TYPE FEMALE FRIENDLY PEDAGOGY	INDICATORS OF IDEAL TYPE FEMALE FRIENDLY PEDAGOGY
An ethical approach to learning and teaching	• Evidence of moral values • Evidence of judging acts with respect to the values of the group or society • Explain the relationship between personal values and the choices a person makes • Articulate the values that are important to you in making personal choices about conduct and citizenship
An aesthetic approach to learning and teaching	• Evidence of cognition and emotions in relation to beauty and meaning of life. • Evidence of meaning attained through intense perceptual, intellectual and emotional experiences that provided personal insight into the human condition. • Evidence of influence on one's personal values and promote active enquiry and reflection • Explain how aesthetics influences decisions you make in our life • Evaluate an aesthetic experience and how this strengthened or changed your valuing or understanding of the human condition or culture
Collective and co operative negotiation rather than competitive models of learning.	• Evidence of learning conversations • Evidence of personal experience or interaction with peers • Evidence of collaborative learning • Evidence of legitimate self or peer assessment
Learning and teaching that is both reflective and active and demonstrates an awareness of the individual within their own social, environmental, historical, or cultural context etc.	• Learning changes from thinking independently to thinking through problems • Integrating and applying knowledge in context • Evidence of reflective writing • Evidence of connective understanding beneath and beyond course content to provide deeper more meaningful learning
Learning and teaching approaches that empower both the learner and the teacher.	• Course notes and discussion topics were accessible both as printed material and as online tutorials. • Student-led presentations on aspects of the course were included as part of the final assessment.

Table 4 Rubric to Illustrate Evidence of Ideal Type Female Friendly Pedagogy

VARIABLES OF IDEAL TYPE FEMALE FRIENDLY PEDAGOGY	INDICATORS OF IDEAL TYPE FEMALE FRIENDLY PEDAGOGY
Learning and teaching approaches that engage with social change.	• Films relative to each lecture shown outside of class time in an informal setting. • Simulations
Reflection and action:	• Students required to write a log of their learning development throughout the lab course • Students required to write journals • Evidence of reflective discourse • Evidence of dialogue
Finding links between curriculum and experience, between theory and practice, between thinking and feeling:	• Students were allocated into study groups with the aim of developing a discursive approach to the materials and subject matter. • Students required to write journals
Empowerment	• Evidence of emerging voice • Evidence of relocation of authority • Evidence of changing relationship with authority • Evolving relationships with peers • Value of one's own personal experiences or interactions as legitimate knowledge building
Process as learning product	• Process is generally valued over content, content mastery comes through process • Interpersonal and intrapersonal intelligence • Development of relationships that support and encourage the voices of others. • Evidence of creative thinking • demonstrate evidence of learning through self-determined formats and mediums • Evidence of negotiation of performance expectations in advance
Equity in assessment	• Evidence of critical engagement in the ideas of others • Not all students do equally well in written and verbal interaction • Time it takes to develop new learning strategies • Time it takes to become familiar with the technical landscape

These variables and indicators were used as tools to help analyze the interview transcripts assessing the female friendliness of the Industrial Electronics Department at Vanier College.

2. *Data Collection*

The researcher, from a convenience sample asked the female students and alumni to participate in this research project. The interviews were done on an individual basis in the office of the researcher, a coffee shop, and the Electrical Technology laboratory. The confidentiality of the responses of each of the participants was assured by the researcher. The interviews were taped, and each lasted between ten to twenty minutes (10-20 minutes).

3. *Participants*

Interviews took place with three female students who are currently enrolled in the program. Of the currently enrolled students two were in the second year of the three year program and one in third the year. Regarding the three alumni who participated in the study, one graduated in 2005 and is now working in the field. The remaining two graduated in 2004. Both of them continued their studies at the university level (one in mechanical engineering and other in electrical engineering).

4. *Qualitative Data*

The research questions were designed to address the gender inequity within the current electrical technology program. The questions used during the interviews were organized into two categories relating to the main research questions: the identification of barriers perceived by females when choosing electrical technology at Vanier College, and the extent to which the electrical technology program is perceived as female friendly by the participants.

Table 5 Semi Structured Interview Questions Organized by Category

Barriers Perceived by females	
Question number	**QUESTION**
1	Why did you choose Industrial Electronics at Vanier College?
2	Did you find that the program recruitment helped?
5	Are there any topics you wish had been taught that weren't?
7	How did you get along with the male students in the program?
8	Does it matter to you if your teachers are males or females?
13	How does the selection of a non-traditional career make you feel?
Female Friendly Pedagogy	
Question number	**QUESTION**
3	What aspects of the program did you like the most?
4	What were your favourite courses or assignments in the program?
6	What aspects of the program did you like the least?
9	What do you think is more fun, finding and designing a solution to a problem or building and testing an existing design?
10	Did you find that most courses encouraged team efforts for course work?
11	What kind of classes do you get the most out of?
12	How should college level courses be organized and taught?

The researcher, in an effort to further understand the underrepresentation of women in Electrical Technology, began with the questions as organized in table 4. The participants were asked why they chose Industrial Electronics at Vanier College and how they felt about the selection of a non-traditional career. The literature review has indicated obstacles that women face when selecting a non-traditional career path. The researcher wanted to see if the females that selected Electrical

Technology experienced these barriers. The researcher hoped to gain deeper insight into the question of consistent uneven gender enrolment in this program.

Another of the barriers identified in the literature was the link to effective recruitment techniques. In order to investigate the effectiveness of the current program recruitment, the researcher asked the participants if they found that the program recruitment helped. Some of the recruiting practices and strategies used by college enrolment professionals are visits to high schools in primary markets by a member of the admissions office, interaction on the Internet and hosting campus visits with prospective students. There are live presentations by college personnel for prospective students at high schools and on-campus open house visits. All of these practices are considered to be strong influences in choosing a college technical program. The presence of friendly, accessible faculty members, and warm attitude of administrative officials during the campus visits are considered to be effective strategies. The researcher expected to find that the interviews would support that the currently employed recruitment strategies were a contributing factor in these students' choices.

The researcher found from the literature review that females generally appreciate design and communication oriented tasks with current trendy technological topics. Moreover, women are characterized as more interested in activities that support and facilitate communications and activities that are socially relevant and less interested in activities that promote competition. Therefore, the researcher asked the participants if they thought that there were any topics that they wished they had been taught in reference to the program.

Another of the barriers listed in table 1 is stereotypes, and the emerging sexism among peers and the attitudes and actions of men. The researcher asked the participants using questions from table 5, how they got along with the male students in the program and whether it mattered to them if their teachers were male or female.

It was hoped that these responses would provide additional understanding of the reported barriers as perceived by females in the technologies.

The next group of questions from Table 5 were developed to elicit responses indicative of a female friendly pedagogical approach. The first question asked the participants about their favourite courses or assignments in the program. This question was designed to get at the links between curriculum and experience, theory and practice and thinking and feeling. The researcher was expecting the participants to comment on the assignments requiring reflection and action, such as journals, log books or design oriented course work.

Female friendly pedagogy implies a more inclusive curriculum, whose goal is to empower students. The learner has the opportunity to construct identity, develop new meanings and contextualize new concepts while contrasting relationships between them. The authority shift allows the students to interact, to ask questions, all the while creating a less intimidating learning environment. The participants were asked to identify the aspects of the program they like the least. The researcher was expecting the respondents to indicate courses where there was a strong teacher centered and controlled environment with a passive and recipe/cookbook approach towards theory and laboratory learning.

The participants were asked if they preferred to find and design a solution to a problem or to build and test an existing design, and the type of class they get the most from. The goal of this line of questioning was to pick up on the aspects of female friendly pedagogy that require learning and teaching that is both reflective and active, and demonstrate an awareness of the individual within their own social, environmental, or cultural context. Moreover the need for empowerment, process as a learning product and a shared participant approach towards assessment, and learning centered around reflection, where students begin to lead in learning conversations, discussions and presentations.

Finally the participants were asked for their views on the organization of college level courses within the industrial electronics technology program. The researcher expected the participants would support the characteristics of the ideal female friendly pedagogy as defined by the rubric in table 3.

5. Ethical Issues

The participants in the interview process were protected by the guidelines of the Vanier College Ethics Committee. The participants were informed of the purpose of the research project. Participants were also informed they could withdraw from the study at any time without prejudice. In conjunction with the Ethics Committee, a consent form was developed. (See Appendix B). All participants were asked to sign this form prior to participation in the study. All of the participants were over the age of eighteen.

CHAPTER 4: Presentation of Findings

The data analysis for this research project began with the transcription of the interviews and the coding of the responses. This process was facilitated using the groupings for the interview questions shown in table 4. The interview questions were organized into two categories some linked to the identification of obstacles to female students entering industrial electronics technology and some designed to identify the characteristics of a female friendly pedagogy.

The responses to the questions were coded into response types to facilitate analysis. Some of the responses had compounded meanings and therefore could be coded as belonging to more than one of the categories. The categories are established following a preliminary examination of the responses to each question. Qualitative data analysis is not like the analysis that can be accomplished by statistical methods used for quantitative data. Therefore the researcher employed an inductive approach. The coding process required the researcher to think coherently and clearly about the meaning of each response. The coded data was then analyzed in an effort to support or deny the research questions.

The first question was "Why did you choose Industrial Electronics at Vanier College?" The responses were coded into three general categories and presented in table 5. A response such as "I like what my dad is doing and I did not want to do a DEP so I decided to go a bit further,..." was categorized under "family is role model". Whereas, one such as "...because the program was suggested to me from a cousin who did Industrial Electronics" was included under the heading "family member encouraged".

Table 6 Question 1 response coding

CODING		NUMBER OF RESPONSES
1	Family member encouraged	2
2	Liked theory and practical aspects of electrical technology	4
3	Family is role model	3

The second question was "Did you find that the program recruitment helped?" The responses were coded into three general categories and presented in table 6. A response such as "I took Vanier pamphlets as I did from all other schools at a local college fair." was categorized under "Vanier recruitment activities". Whereas, one such as "...But when I did want to check in to the technologies programs I spoke to like the academic advising person she told me which schools offered it..." was included under the heading "academic advising at high school".

Table 7 Question 2 response coding

CODING		NUMBER OF RESPONSES
1	Vanier recruitment activities	1
2	Academic advising at high school	2
3	Not influenced by recruitment	4

The third question was "What aspects of the program did you like the most?" The responses were coded into three general categories and presented in table 7. A response such as "I really liked the hands on approach in the labs." was categorized under "practical hands-on activities". Here the heading "practical hands-on assembly" implies the assembly of the hardware involving perhaps setting parameters but no student designed programming to investigate and verify the functionality of a

particular system. The second heading, programming (design for control) implies that the student must design and develop from a system description, a flowchart for the functionality of the software and then the actual embedded code. Once the development is done the real embedded code is downloaded in to the embedded microcontroller system that must be designed and assembled, and then tested. A response such as "Especially those where we had to build a circuit and then test and program the microcontroller" was included under the first and second headings.

Table 8 Question 3 response coding

CODING		NUMBER OF RESPONSES
1	Practical hands-on activities (assembly)	6
2	Programming (design for control)	2
3	Understanding how things work	2

The fourth question was "What were your favourite courses or assignments in the program?" The responses were coded into four general categories and presented in table 8. A response such as,

"Yah definitely the project I don't know the class where we worked on the microcontroller and were learned how to program it and control stuff and we built the board and soldered it that's for sure is the best class so far I've had"

was included under the first and second headings.

Table 9 Question 4 response coding

CODING		NUMBER OF RESPONSES
1	Motor drives	1
2	Programming, microcontrollers, controls	5
3	Classes where projects were designed and built	3
4	Technical documentation	2

The fifth question was "Are there any topics you wish had been taught that weren't?" The responses were coded into three general categories and presented in table 9. A response such as,

"I wish I had learnt visual basic of C#, or some sort of object oriented programming and not C++." was categorized under advanced programming. Whereas one such as "Yes I think we didn't learn much on circuit analysis, such as nodal, mesh analysis, etc…"

was included under the last heading, more advanced theoretical aspects.

Table 10 Question 5 response coding

CODING		NUMBER OF RESPONSES
1	Advanced programming	2
2	Current technologies (wireless, sensors)	2
3	More advanced theoretical aspects	3
4	Satisfied with current program	1

The sixth question was "What aspects of the program did you like the least?" The responses were coded into five general categories and presented in table 10. A response such as,

"I didn't like the fact that there were classes that were not structured well. Some courses were easy and to predictable there was no challenge. Some courses were spoon fed we had to many practice exams."

was categorized under three separate headings. The three headings were "courses spoon fed", "course that are too easy" and "course work is predictable". Whereas one such as,

"No it was too obvious, it was so basic I didn't like it I liked to do it further you know with the chips and everything because I learned right away right after that I could everything that I did with all the logic gates I could do with one chip so for me it was useless to learn that"

was included under three of the headings, the first, "learning irrelevant content material", "courses spoon fed", and "courses are too easy".

Table 11 Question 6 response coding

CODING		NUMBER OF RESPONSES
1	Learning irrelevant content material	2
2	Courses that spoon feed	2
3	Courses that are too easy and predictable	3
4	Designated Departmental student lab/study area with plenty of access	1
5	Poor and old equipment	1
6	No response	1

The seventh question was "How did you get along with the male students in the program?" The responses were coded into four general categories and presented in table 11. A response such as,

"In general I got along pretty well with the male students. Especially at the end, we all just became one big family and it didn't matter whether I was a female or not. I've always been able to get along better with males than females. It's just in my nature. But, I think you need to be ready for a challenge if you are a women going into a non-traditional field."

was categorized under three of the four headings. The first was "became good friends by the end of the program", the second was, "challenge initially" and the third was "it's like I am one of the guys". Whereas one such as "We got along well in fact I made good friends I still keep in touch with. I had no difficulty integrating myself I think it's important to keep an open mind and be yourself." was included under the heading, "became good friends by the end of the program" and "keep an open mind and be yourself".

Table 12 Question 7 response coding

CODING		NUMBER OF RESPONSES
1	Initially, a challenge	3
2	Became good friends by the end of the program	3
3	It's like I am one of the guys	2
4	Keep an open mind and be yourself	2

The eighth question was "Does it matter to you if your teachers are males or females?" The responses were coded into three general categories and presented in table 12. A response such as,

"As long as the teacher knows what he/she is teaching well and is willing to help, it is Ok by me. I prefer teachers, especially for technologies, that have worked in the field and are not only about theory."

was categorized under all three headings.

Table 13 Question 8 response coding

CODING		NUMBER OF RESPONSES
1	No difference	6
2	The expertise and information is important	2
3	Teacher's willingness to help	1

The ninth question was "What do you think is more fun, finding and designing a solution to a problem or building and testing an existing design?" The responses were coded into two general categories and presented in table 13. A response such as,

"definitely given a like a general something we are supposed to doing and then coming up with our own idea and a going about it our own way when it's all laid out like that it is not necessarily the easiest way and also what I would want to learn I feel that I should be learning. Well also it is good to a degree to if they are going to mark us in a certain way then at least we know how they going to mark us but the other way is definitely I think a lot better because it makes you use your imagination more and I think maybe you learn more because you are doing you own research and you are not just following somebody's outline"

was categorized under the first heading build and test own design.

Table 14 Question 9 response coding

CODING		NUMBER OF RESPONSES
1	Build and test one's own design	4
2	Build and test an existing design	2
3	Provide an opinion/feedback on Build and test an existing design	1

The tenth question was "Did you find that most courses encouraged team efforts for course work?" The follow-up questions elicited rational/opinions about team work, and the responses and were coded into two general categories and presented in table 14. A response such as,

"I remember that almost all lab work was done in groups which encouraged team work. Of course we cannot work in groups during theoretical courses, except for example for group questions. But, of course it is best to not always work in groups since it will always be the same students that do the work and others will wait around and watch. It is good to make students work alone sometimes, to make sure that they actually learn something and are not just counting on their partners."

was categorized under both of the headings.

Table 15 Question 10 response coding

CODING		NUMBER OF RESPONSES
1	Like team work, found team work positive	6
2	Identify issues of inequity in team work	2

The eleventh question was "What kind of classes do you get the most out of?" The responses were coded into three general categories and presented in table 15. A response such as "The classes I got the most out of where the structured classes that had interesting projects and that provided me with designing, analysis techniques and

involved team work." was categorized under two of the three of the headings, "Classes encouraging design/projects and analysis" and "Classes encouraging team work".

Table 16 Question 11 response coding

CODING		NUMBER OF RESPONSES
1	Classes that encourage active participation	1
2	Classes encouraging design and programming and projects including analysis	4
3	Classes encouraging team work	1
4	No response (do not know)	1

The twelfth question was "How should college level courses be organized and taught?" The responses were coded into seven general categories and presented in table 16. A response such as,

"College level classes: should have more hands on approach I find that we are never too prepared to see what's out in the world. Classes should be based on technology that is currently in use. They should be taught by trained professionals who have teaching skills and enough work experience to transfer their knowledge to their students. There should be more industrial visits, working lab equipment and internships. There should be more theory in the courses."

was categorized under all of the headings except, "Separate the program into specializations" and the "courses are too easy".

Table 17 Question 12 response coding

CODING		NUMBER OF RESPONSES
1	Hands on approach	1
2	Current technology	2
3	Teachers should have teaching skills and relevant work experience	1
4	More theory in classes	2
5	Courses were too easy	1
6	Separate the program into specializations	1
7	Stage	2
8	No response (do not know)	2
9	Satisfied with current organization	1

The thirteenth question was "How does the selection of a non-traditional career make you feel?" The responses were coded into three general categories and presented in table 17. A response such as,

"It makes me feel like I can choose what I want to do and choose what I like or not and not think about what others will think. More and more women are going into non-traditional fields. It doesn't make women feel that different anymore and it's not more challenging anymore. I think women and men should have to prove themselves in the work force and it does not matter what sex they are."

was categorized under the first heading, "I have the ability to choose what I want" and the last heading, "self confidence".

Table 18 Question 13 response coding

CODING		NUMBER OF RESPONSES
1	I have the ability to choose what I want	3
2	Wanted to study more	1
3	Self confidence	3

The data presented in the tables above appear to indicate the presence of some barriers and the need for an even more female friendly pedagogy. Electrical Technology in part is about experimenting and trying new ideas, with plenty of room for mistakes and fixing design and programming hypotheses during projects. There is a need for more than the recognition and encouragement of achievement. There is a need to provide students with opportunities to practice skills to build self confidence in their abilities acknowledge students' strengths and build their career aspirations in the technologies. The findings indicate a need for change, in terms of curriculum, barriers and female friendly pedagogy. The next chapter will further analyze and explore these results to address the gender imbalance in Electrical Technology.

CHAPTER 5: Discussion and Conclusion

1. Discussion

This chapter begins by analyzing responses to interview questions as organized in Table 5. Participants were initially asked why they had chosen their field of studies. The researcher hoped to explore potential barriers the female students may have encountered.

Barriers may be considered as events or conditions either intrinsic or external that make a career selection difficult. The barriers identified from the literature review were summarized and presented in Table 1. Barriers may have an impact on an individual's thoughts and actions during the selection phase of an educational program of study and on the choice of career. Moreover, it may be possible that individuals alter their initial choices when confronted with educational and career related barriers.

According to the literature, one underlying barrier to female students considering training in Electrical Technology is the potential to have little or no support from family and friends who may question their motives for entering a more challenging career, or who overestimate the pressures and problems faced in a non-traditional career. In this study, the findings indicate that females who did enter the program received strong encouragement from family members. One respondent stated, "...I chose Industrial Electronics because the program was suggested to me from a cousin who did Industrial Electronics..." Furthermore, having a role model in the family is influential as well. For instance, on participant reported, "...my dad is an electrical technician also so I guess that helps."

The literature review showed that one barrier to the selection of a non-traditional career may be the lack of a mentor. Mentors are people who are in higher positions within the career field and are critical to newcomers' success as they can guide, protect, and encourage others in their career. The absence of a mentor did not

arise in any of the responses. Several of the respondents actually had a mentor in their family. Therefore the findings do not directly support the literature about this barrier. However, if interviews had been carried out with female high school students who did not enter the Electrical Technology program, it is possible the lack of support from family, and the lack of a family role model may be reasons for their having not pursued this option of studies.

The data collected in this study supports the idea that females have a strong interest in science and technology. There were three responses indicating an intrinsic desire to learn both theory and the practical aspects of Electrical Technology. One respondent said, "...I needed something that incorporated both building and programming which is what I liked about the program." The same respondent indicated that she had worked with robotics in high school, "...I was lucky to have worked with electronics and robotics in high school which allowed me to see that it was something I liked and was interested in pursuing."

The researcher feels that working in a non-traditional career will foster an intrinsic benefit of following one's dreams and the satisfaction that comes from the empowerment of a job done well. One of the respondents stated,

> "I'm glad I chose a non-traditional career, I'm currently at the end of my studies in electrical engineering. If I would have never tried out Electrical Technology I would have never made the career choice that has changed my life today. This non-traditional career has provided me with amazing work experience and I'm sure that I made the right decision."

The findings in Table 6 indicate that the respondents' decision to choose electrical technology as a program of study appears to be based on personal choice and genuine interest in the field and not on recruitment activities. Some of the recruiting practices and strategies employed by college enrolment professionals might be visits to high schools in primary markets by a member of the admissions office, interaction on the Internet and even hosting campus visits with prospective students. There are live presentations by college personnel for prospective students at high

schools and on-campus open house visits which are practices considered to be strong influences in choosing a college technical program. The presence of friendly, accessible of faculty members, and welcoming attitudes of administrative officials during the campus visits are considered very effective strategies. The Vanier College Electrical Technology department participates in various recruitment activities, offers "student for a day" visits, and participates in the open house where the lab facilities and equipment can be viewed. One respondent stated, "I took Vanier pamphlets as I did from all other schools at a local college fair..." There were five responses indicating that the Vanier College's current recruitment strategies were ineffective at helping students choose their program of study and career choice. One respondent said, "I didn't attend program recruitment, I just applied and got accepted." Another stated, "I don't remember any recruitment, I went to my high school's academic advisor. She made an appointment for me to meet with a faculty member, tour the college, where the program was explained and my questions were answered."

According to the literature review, female students prefer when topics are socially relevant and trendy. Two of the three interviewed alumni continued their studies in a university level engineering program and one is currently working in the field. Those continuing their studies felt that more in depth theory and detailed engineering analysis and design should be included in the college Electrical Technology program. One stated, "I think we didn't learn much on circuit analysis, such as nodal, mesh analysis, etc..." Another responded, "Having completed my bachelor in Mechanical Engineering, I wish there was more theoretical courses. I had a hard time catching up in physics, Cal 1 and 2 in University." The alumnus working in the field stated,

> "I wish I had learnt visual basic of C#, or some sort of object oriented programming and not C++. I pretty much had to learn this type of programming myself, which I needed in both the job I had after finishing college and the one I have now.
>
> I also wish I would have learned about wireless communication (Bluetooth, wifi etc)

> Looking at what I am doing now, I which I would have learned more about hobby and domestic robots and not only industrial related robots. Domestic robots are the future and not many classes seem to be given informing students of this type of robotics.
>
> I would have also liked to learn more about the different types of sensors. There are some that I did not know existed before I started working...Plus it was an interview question…

The latter response clearly indicates the need to include recent trendier topics as part of the curriculum. This respondent also indicates the need to address computer programming in a more comprehensive manner, and that the language she was exposed to was outdated with respect to current technology and employer needs. Yet another respondent found that the equipment in the labs was old and poor, suggesting that it is often difficult to address current and trendy topics without the proper tools. There does appear to be a desire among female students for trendier and socially relevant topics to be addressed in the Electrical Technology curriculum. For example, wireless communication technologies, and domestic robots would be of interest to these students.

Gender stereotypes were identified in the literature as another influential barrier. Stereotypes encompass school influences, attitudes and actions of men, perceptions of the industry and emerging sexism among peers. The researcher was initially under the impression that the predominantly male science and technology classroom could be an unfriendly environment for female students. This issue was explored in part with the question, "How did you get along with the male students in the program?" Three of the six responses indicated that they experienced a challenge initially. One stated, "There is one that I don't really like because he is very sexist but except him, I just like them all. They are all fine with me, just like I was a guy anyway". Another indicated that "At first it was hard to fit in." The other three respondents reported always having felt comfortable with their male fellow students. For instance, one alumnus stated, "We got along well, in fact I made good friends I still keep in touch with." These responses indicate some sexism may be present. However, the findings appear to be less significant than the researcher's initial belief

that the overwhelmingly male environment posed an imposing barrier to female students.

Teachers provide an essential link between students and their interest in pursuing careers in science and technology. One of underlying issues influencing this link may be the gender of the teachers. The difference in gender can influence communication patterns. The researcher wished to investigate the impact of teacher gender on female students through the exploration of the students' perceptions and experiences in the technology classroom. The participants were asked," Does it matter to you if your teachers are males or females?" All replied that it did not matter. One participant responded, "No it doesn't make a difference; what is important is the information and expertise that they can offer and transfer." Another stated that students should be taught by trained professionals who have teaching skills and enough work experience to transfer their knowledge to their students. The findings indicated no significant correlation between teacher gender and style of communications, no mention was made of gender bias in vocabulary and language, patterns of inequality in conversation or cultural images of men and women. One commented that we have a female teacher in the department and it does not make a difference.

The apparent lack of findings indicating the relevance of teacher gender as a significant barrier may be attributed to the small sample size. As mentioned earlier, if interviews had been carried out with female high school students who did not enter the Electrical Technology program, it is possible that teacher gender may be a reason for their not having considered this option of studies.

The literature review defined certain barriers which females may face when selecting a non-traditional program of study and career pathway. The responses analyzed and presented thus far indicate that the females who do choose Electrical Technology as a program of study at the college level appear to overcome some of these, or take no notice of them as they pursue their studies in this non-traditional

field. However, the expressed need for current, socially relevant topics should be addressed, as well as the ineffectiveness of current recruitment strategies.

The indicators of female friendly pedagogy from the literature review were summarized and presented in Table 2. These indicators were used to evaluate the female friendliness of the Electrical Technology program at Vanier College. The researcher, hoping to explore the female friendliness of the Electrical Technology program, initially asked the interviewees what aspects of the program they liked the most. All the respondents said that they like the practical hands-on activities. An alumnus stated, "I liked the labs most of course, especially those where we had to build a circuit and then test and program the microcontroller that was incorporated." This approach allows the students to develop, design, build and test their solution to a "real world" case that they can relate to. Another respondent stated, "...learning how to use the microcontroller..." and "learning how everything actually works, and being able to actually go home and say ok I know how to do my own projects and start doing them." These kinds of pedagogical activities reinforce students relationship with subject material creating collaborative environments where students incorporate personal reflections. As an alumnus said, "It's nice to actually test what was learned theoretically."

When the participants were asked about their favourite courses or assignments the responses further supported the need for a female friendly pedagogy with cooperative learning and teaching approaches. One alumnus stated, "I liked the final project, it pushed us to work in teams, while developing a product from the beginning to the end." Generally the respondents preferred classes where collaborative projects and programming were present. One response was,

"Building the temperature sensor project was pretty cool. With the LCD display that really caught my interest. The other classes teach the theory on how the electronic components work, but actually implementing and programming it is more my interest, that's why those courses interested me more."

The findings indicated a need to relocate authority and an increased need to value one's own personal experiences or interactions as legitimate knowledge building arose when the participants were asked what aspects of the program they liked the least. One respondent stated, "Some courses were easy and to predictable, there was no challenge. Some courses were spoon fed; we had to many practice exams." Another stated, ".... no it was too obvious, it was so basic I didn't like it I liked to do it further you know with the chips and everything." The ideal type female friendly pedagogy as in Table 2, further supported the need for more creative thinking, encouraging the voices of others, learning through self-determined formats and mediums, where process can be generally valued over content, and content mastery may be achieved through the process.

Four of the respondents indicated that they preferred to find and design a solution to a problem rather than be given a straightforward procedure of what to do and how to do it. One respondent stated, "The classes I got the most out of where the structured classes that had interesting projects and that provided me with designing, analysis techniques and involved team work." This type of guided self-directed learning activity promotes creative thinking and provides evidence of the student's emerging voice while developing relationships that support and encourage the voices of others, as felt from the answer from one respondent, "I think that finding and designing a solution to a problem is more interesting. Problem solving and design techniques are vital when you're trying to become resourceful and knowledgeable in your field."

However, two respondents indicated a preference for building and testing an existing design. One response was, "Yeah but if I find there is an error in the concept I could at least give them some opinion feedback". However, she expressed interest in the conceptual design phase of a project by offering to provide feedback and suggestions for improvements to the design concept. Another respondent stated she preferred existing designs because, "I know it works and try to build it and debug it to make it work." The researcher feels that perhaps these respondents who are current

students, have not yet attained a high level of self confidence in their abilities. Nevertheless, their interest in the design and creation phase of projects still stands out.

When asked if they found that most courses encouraged team efforts all the respondents confirmed the program indeed encourages teamwork. One stated, "Our program is already team oriented." Group projects can be characterized as collaborative or cooperative learning strategies. Moreover, they can be guided self-directed learning activities which promote interpersonal and intrapersonal intelligence, and learning through self-determined formats and mediums. These instructional methods allow for a negotiation of performance expectations in advance, and encourage students to work together in a non-competitive manner as they apply course material to answer questions, solve problems, or create a project. Cooperative learning, rather than competitive learning is one type of active learning that encourages students to develop questions, acquire problem solving skills, and create something. The respondents suggested that for the most part group work is experienced in the laboratory setting. One stated, "I find that we always work together because if you have a problem you can go to each other to find out how someone approached the problem and can explain to each other all the time."

However, at times group work can be problematic. Two of the respondents indicated an inequity within the team. One respondent stated,

"I guess there are certain classes that the teachers encourage teamwork but I don't find it necessarily it the best way to go about it. There are a lot of things that happen, if the other guy is more advanced than you in a certain way he is going to be able to do things you can't. He may even stop doing work and lay back and not learn anything and not try."

Working with stronger willed students may create situations where some of the group members may shy away from the activity, letting others control the direction of the work. Students may not all learn at the same pace or have the same knowledge or high self-confidence levels.

When asked what kind of classes they got the most out of, all the respondents mentioned that elements of the ideal type female friendly pedagogy must be present. Active participation, teamwork, design and programming of projects were the key answers. One respondent preferred classes where she had the opportunity to guide and control her own learning, "The classes where there is a hands-on component, where we are researching stuff, designing and analyzing stuff, putting stuff together, troubleshooting stuff." This indicates a strong desire for her voice to emerge and to find links to the curriculum and experience. Moreover she offers, "where something does not work it is like we have to try and fix it ourselves before somebody maybe like somebody tells us like exactly how it should be or somebody just fixes it for us." An alumnus appreciated, "Interesting projects that provided me with designing, analysis techniques and involved teamwork."

The typical teacher-centered pedagogical model where the teacher is the manager who controls the learning process spoon feeding students was not favoured by the respondents. One stated, "I prefer a class where there is interaction, in this way we don't sleep because if I see slides all the time sliding, I will stop concentrating and I will stop learning from it." A female friendly pedagogy stressing a more inclusive, more student centered approach is supported in the study.

When the participants were asked how they thought college courses should be organized and taught, the responses were varied. One respondent found the courses too easy. Two respondents indicated the need for current technology to be integrated in the curriculum. One respondent felt that teachers should have teaching skills and have relevant work experience, "They should be taught by trained professionals who have teaching skills and enough work experience to transfer their knowledge to their students." Two respondents indicated the need for a stage, and one alumnus stated, "There should be more industrial visits, and internships." Two responses indicated the need for more theory in the classes. One alumnus suggested the idea of allowing students to specialize in subfields of Electrical Technology:

"There should be small introductory classes that show students different subjects. Students will then know what they prefer…robotics, electrical, pneumatics etc. and basically know what career they are headed for. Students could then take specialized courses in what they like and what they want to work with. No losing time and what we learn in the chosen subject."

This response indicates that learning should be relevant to each learner. Classes should have a more hands on approach and topics and equipment should be current. For instance, "Equipment, topics and theory need to be what is currently being used and taught in the field and not courses about things that were used 30 years ago." This further reinforces the idea that trendy topics and applications requiring current equipment and technologies are appreciated by the participants in the study.

When asked how they felt when selecting this non-traditional career, the participants all indicated that the choice was theirs and it was what they wanted to do. One alumnus reflected on a situation and stated,

"I've had people ask me to pass them on to a technician or comment on wanting to speak to a man but, once you show them that you know what you are talking about they only want to talk to you after that. Once you prove yourself you're all set and that's not a bad thing."

The gender imbalance in the current the Electrical Technology program at Vanier College and in the field unfortunately seems fairly constant. One of the respondents stated, "At the beginning I was really scared, it was one of the reason I did not want to go in the program to start with, my dad encouraged me to at least try it at least a year." This response indicated that self confidence played a part in the initial selection. The family encouragement she received made a difference in her choice. The same respondent reinforces her statement with, "definitely I like I get even more than the first year. I liked somewhat in the first year and now I like it much more..."

These respondents all share an intrinsic interest and a strong passion for Electrical Technology. One respondent had the researcher in stitches with the following reflection, "We got really into more details and since that I really like that even I have nightmares when I get too stressed. I last semester I dreamed I was a chip and I was going to burn if did not plug myself in properly like the temperature display project and I was even an LCD screen."

The findings indicate that the current Electrical Technology program at Vanier is on the whole quite female friendly. Moreover, they indicate that Electrical Technology can be a rewarding career path for women.

2. Limitations of the study

There are limitations that need to be acknowledged regarding the present study. The research is based on the reporting of comments by currently enrolled women and alumni of the program. The analysis and observations of the researcher are based on the responses obtained in personal interviews.

One of the most evident limitations is the possibility that there was interviewer effect due to the difference of gender and age of the interviewer and the participants. The researcher is currently a professor of Electrical Technology at Vanier College, is male, older and in a position of authority with respect to some of the participants. Even though the study was clearly explained and responses in no way influenced their academic standings, there may be a source of bias in that the respondents may have felt uncomfortable opening up in their answers and revealing their "true" feelings when discussing gender issues.

Furthermore, the researcher's reactions to responses during the interviews may have influenced the participants. The transcription of the interviews provides evidence of the researcher's surprise to some responses. This type of reaction may have affected subsequent responses.

At times the respondents did not appear to understand the question as stated and the researcher tried to reword a question, to improve its meaning or clarity. For example:

I	How did you get along with the male students in the program?
R	Fine, actually it was it has been fine.
I	Even from the first semester you weren't nervous about being probably the only girl?
R	I guess it is awkward at first maybe since you are the only girl but it is good to at the same time because you are the only girl so the people are going to be nicer I guess.

Such changes can affect the respondent's understanding and can be a source of bias. This interviewer may have pushed to respondent towards describing a gender issue that she may not have felt was present.

Another limitation of this study is the non-generalizability of the findings. The sample size was very small, and all the participants studied in the Electrical Technology program at Vanier College. It is possible that this college is not typical of the field.

Although semi-structured interviews were a very effective technique to obtain qualitative data from the sample population in this study, perhaps there should have been more follow up questions designed to explore pedagogical, work and gender and career choice issues more deeply.

Yet another limitation is its reliance on only one research methodology. As seen in the literature review, students benefit from exposure to a female friendly curriculum. The female friendliness should be reflected in the teaching strategies, learning activities, and printed pedagogical materials where ideally female role

models and scientists should be portrayed. A content analysis could have been performed to determine the female friendliness of the pedagogical materials used in the Electrical Technology program. However, due to time constraints, the researcher did not pursue this avenue.

3. Recommendations for future research

A future study could include students from other colleges with similar programs of study. Furthermore, the research could be expanded to include not only college level students but those in high school and university as well. Such an expansion may provide a wider variety of responses by interviewing students with an interest in science and technology who may not have chosen to study Electrical Technology.

Future research may consider including an equal number of male participants, providing for a more direct comparative analysis. It might also be useful to interview faculty members who teach in Electrical Technology.

Although semi-structured interviews are a very effective technique, they may not be practical for a larger sample. Therefore an instrument more suitable to large groups, like a survey could be developed and implemented.

Finally, a content analysis could be performed to determine the female friendliness of the pedagogical materials used.

4. Conclusion

This research project explored barriers presented to female students, and how female friendly the pedagogy is, in an effort to address the underrepresentation of females in the current Electrical Technology program at Vanier College. The first question research question was, "Does the current Electrical Technology program at Vanier College present barriers to women?" The findings indicate the presence of some barriers.

The barriers perceived by the females in the Electrical Technology program are gender stereotyping, fears and the lack of socially relevant trendy topics. The findings indicated that despite such barriers, the participants were intrinsically interested in the field and strongly encouraged and supported in their choice.

The second research question was, "To what extent is the current Electrical Technology program pedagogy at Vanier College female friendly?" The findings show that in many ways the pedagogy employed in the program is indeed female friendly.

The indicators of female friendliness of the Electrical technology program were group projects, which encourage students to work together in a non-competitive manner as students apply course material to answer questions, solve problems, or create new designs.

It is clear that women like Electrical Technology, and are good at it and are rewarded in their career choice. Moreover, the perceived barriers are not overwhelming and in general the program pedagogy is female friendly. Improvements should, however be made to the curriculum to make it more trendy and socially relevant for the female students. The researcher believes that there is a real need to develop different, recruitment strategies which draw in female students. More creative recruitment may be one of the ways to address the underrepresentation of females in the technologies.

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APPENDICES

Appendix A

Program Competencies

This appendix contains a tabulation of the core concentration courses and competencies for the Industrial Electronics Department at Vanier College.

First Semester Core Concentration Courses

COURSE	STATEMENT OF COMPETENCE
Understanding the Profession of Technologist	To identify a personal choice of career in the Electrical Engineering Technologies and corresponding academic process.
The Computer as an Engineering Tool	To use microcomputer software as an engineering tool in a framework of typical technological tasks.
Electrical technology	To apply fundamental technological concepts related to electricity, using a systems approach.
Mathematical Models 1	To use fundamental mathematical concepts to describe and to solve problems in the electrical engineering technologies.

Second Semester Core Concentration Courses

COURSE	STATEMENT OF COMPETENCE
Creating Control Systems	To apply logic concepts to the creating of control systems using different technologies.
Circuits	To analyze circuits using the laws, theorems and convention of circuit theory.
Mathematical Models 2	To apply mathematical modeling to the solution of problems in electrical engineering technology.

Third Semester Core Concentration Courses

COURSE	STATEMENT OF COMPETENCE
Process Control	To apply fundamental concepts related to process control.
Automation	To automate a system based on sequential logic.
Motor Drives	To analyze different techniques used to control electric motors.
Technical Drafting	To read, interpret, and create plans and technical schematics relating to the electrical engineering technologies.

Fourth Semester Core Concentration Courses

COURSE	STATEMENT OF COMPETENCE
Implementing a Control Loop	To install and tune a control loop
Industrial Metrology	To apply industrial measurement techniques.
Actuators	To use final elements and actuators in industrial applications.
Signal Processing	To implement electronic circuits used in the conditioning of signals.

Fifth Semester Core Concentration Courses

COURSE	STATEMENT OF COMPETENCE
Maintaining Automated Systems	To effect maintenance of automated systems.
Physics: Motion and Heat	To apply the laws of motion and heat to the solution of mechanical and thermal problems in a technological context.
Automation Strategies	To apply an automation strategy involving discrete as well as continuous variables.
Microcomputer Principles	To analyze the functions of a microcomputer within an industrial application.
Pneumatics, Hydraulics and Mechanisms	To utilize pneumatics, hydraulics and the different mechanisms used in automated systems.

Sixth Semester Core Concentration Courses

COURSE	STATEMENT OF COMPETENCE
Designing and Modifying an Automated System	To implement an automated system.
Process Control and Servosystems	To model linear systems found in process control and in servomechanisms.
Computer Automation	To use a computer and program in automating a system.
Robotics	To create an automated system involving a robot.
Control Systems	To use a control system for the control and supervision of subsystems
Project or Stage	To execute an industrial project, To integrate into the workplace with a team of industrial electronic technologists.
Electrical code	To apply the Canadian Electrical Code to the protection of electrical installations.

Appendix B

The Consent Form

Université de Sherbrooke
Faculté d'éducation

STRIVING TOWARDS GREATER GENDER EQUITY IN ELECTRICAL TECHNOLOGY TRAINING

Consent Form

Dear Student,

My name is Allan Insleay, I am a fulltime permanent teacher in the Electrical Technology Department at Vanier College in St. Laurent. I am presently conducting research for a project entitled, "STRIVING TOWARDS GREATER GENDER EQUITY IN ELECTRICAL TECHNOLOGY TRAINING" as partial fulfillment for a Master's Degree in Education.

The objective of the research is to explore and identify the barriers presented to females in the current Electrical Technology program at Vanier College. This study will identify these obstacles and describe the ideal type characteristics of a female friendly pedagogy. The identification of obstacles and the elements of a female friendly pedagogy are used in this project as an approach towards addressing the underrepresentation of females in the technologies. The results of this work will contribute to scientific knowledge as related to a more inclusive curriculum in Electrical Technology.

The data collection methods consist of semi-structured interviews of current students in the Electrical Technology Program. The interview transcripts will be recorded and analyzed.

Your collaboration is requested for one 45 minute interview with the researcher about your opinion and knowledge of the program. Specifically your perception of barriers and female friendly pedagogy that you may have been exposed to as a student.

As researcher, I am committed to upholding the ethical standards of respect of confidentiality, to transcribing the audio record honestly and impartially, to respecting the rules of scientific research and to treating respondents anonymously in the project report. The audio tapes and data will be treated confidentially and be destroyed at the end of the research process.

Thank you for your collaboration,

Allan Insleay

Having been informed of the above, I _____hereby consent to participate in the research. I understand that my comments during the interview will be taped on audio cassette. I retain the right to withdraw fro the research at any time.

Signature:_____ Witness:_____

Parent/Guardian Signature:_____ Date:_____

Appendix C

The Interview Questionnaire

1. Why did you choose Electrical Technology at Vanier College?
2. Did you find that the program recruitment helped?
3. What aspects of the program did you like the most?
4. What were your favourite courses or assignments in the program?
5. Are there any topics you wish had been taught that weren't?
6. What aspects of the program did you like the least?
7. How did you get along with the male students in the program?
8. Does it matter to you if your teachers are males or females?
9. What do you think is more fun, finding and designing a solution to a problem or building and testing an existing design?
10. Did you find that most courses encouraged team efforts for course work?
11. What kind of classes do you get the most out of?
12. How should college level courses be organized and taught?
13. How does the selection of a non-traditional career make you feel?

Appendix D

A Sample Interview Transcript (with current student in her second year)

Symbols used in Transcription

I	Interviewer
R	Respondent

Question 1 Transcription

I	Why did you choose Electrical Technology at Vanier College?
R	At Vanier, because Electrical Technology is offered in English only at Vanier in the whole province of Quebec. Electrical Technology, because I like what my dad is doing and I did not want to do a DEP. I decided to go a bit further. My dad and I talked about my studies and all the different choices I could have. I picked Electrical Technology and that was exactly what I wanted since I was interested in automation.

Question 2 Transcription

I	Did you find that the program recruitment helped?
R	I never went to it so I have no idea.
I	Do you mean that because there weren't any recruitment activities in your area or you were not interested in attending?
R	I have never heard about recruitment activities. I looked on the internet for my information. Therefore I really do not have anything on that.

Question 3 Transcription

I	What aspects of the program did you like the most?
R	I really like the automation. I like the fact that I could program something and it could actually do it. The program I created could do the task always at the same rate. I like the fact that I can control everything without touching it.
I	Do you prefer to work with your hands or to learn from a book?
R	I really prefer to work with my hands a lot more

Question 4 Transcription

I	What were your favourite courses or assignments in the program?
R	For some reason, I don't know why, I really love to prepare the documentation for a project. I had to document the drawings for various parts on an airplane in technical documentation class which was fun. I liked for this semester, the project where we made a microcontroller based temperature detection system with an LCD display. The project included design, building and I had to program the microcontroller to display the real temperature. I loved to see it working all by itself, actually accomplished it all by myself

Question 5 Transcription

I	Are there any topics you wish had been taught that weren't?
R	I want to know more about PLC programming. I think it is coming soon but on the top of my head I don't know.
I	I am wondering if you find that the program has met your initial needs, or was there something you thought you were going to learn and those ideas been challenged or met yet?
R	I don't remember, it is too far away.

Question 6 Transcription

I	What aspects of the program did you like the least?
R	We did logic gates.
I	Really, how come?
R	I liked it but I don't know, I, it was...
I	Not complicated enough, too obvious?
R	No, it was too obvious. It was so basic. I didn't like it. I liked to learn more and do it further, you know with the chips. I learned right away; right after that I could do everything that I did with all the logic gates, I could do with one chip, so for me it was useless to learn that.

Question 7 Transcription

I	How did you get along with the male students in the program?
R	There is one that I don't really like because he is very sexist. Except him, I just like them all. They are all fine with me, just like I was a guy anyway.

Question 8 Transcription

I	Does it matter to you if your teachers are males or females?
R	Not at all. The male or female can be just as good. We have Miss Robinson. She is the only female in the department and it does not make a difference.
I	Do you think you find you learn better from the female teacher than the male teacher?
R	No.

Question 9 Transcription

I	What do you think is more fun, finding and designing a solution to a problem or building and testing an existing design?
R	I prefer an existing one because I know that it is already works from the beginning. This way I am not working and wasting time in anticipation of it not working, kind of.
I	Do you prefer to have someone say, "here this is something that works and just build it?"
R	I know it works and try to build it and debug it to make it work.

Question 10 Transcription

I	Did you find that most courses encouraged team efforts for course work?
R	Our program is already team oriented. I find that we always work together because if you have a problem you go to each other to find out how someone approached the problem and explain to each other all the time
I	So there are not any specific courses that are geared that way?
R	No response.

Question 11 Transcription

I	What kind of classes do you get the most out of?
R	No response
I	I suppose what I am aiming at here as a question to make it more clear, is it group work oriented, lecture oriented where someone clicks on the slides, show and tell kind of thing or a class where you participate mostly in.
R	I have real big trouble participating in classes. I like to listen to the guy and hear others participate. I learn from them. That is how I work. I prefer a class where there is interaction, in this way we don't sleep because if I see slides all the time sliding, I will stop concentrating and I will stop learning from it. I find that if there is interaction, no problem, no interaction I don't like it. Maybe a combination of slides and with interactions

Question 12 Transcription

I	How should college level courses be organized and taught?
R	I have no response.

Question 13 Transcription

I	How does the selection of a non-traditional career make you feel?
R	What do you mean?
I	Perhaps being a female in a male oriented field
R	At the beginning I was really scared, it was one of the reasons I did not want to go in the program to start with, my dad encouraged me to at least try it at least a year. When I tried it, it did not really make a difference if I was a guy or a girl because all the guys around me would react in the good way. I am still a bit worried for when I work in the field because I am a girl and I may probably be left apart a bit more to work more myself. I am a girl. I am different.
I	You will be surprised in the field you will see the same kind of team work that happens in the school happens in the field. So that was your biggest fear, I guess you were worried that being a girl coming into a field that is non-traditional and even choosing that that was pretty different of you to choose what you like and if it was not for your father you probably wouldn't have chosen it?
R	Never, no.
I	Do you find it was a good choice?
R	Yes, definitely. I like I get even more than the first year. I liked somewhat in the first year and now I like it much more since this semester we got into automation and we got into programming. We got really into more details and since that I really like that, even I have nightmares when I get too stressed. Last semester I dreamed I was a chip and I was going to burn if I did not plug myself properly like the temperature display project and I was an LCD screen.
I	Hahah

Question 13 Transcription

I	Do you think that some of the courses given in second year could be offered in first?
R	So I could get more interested, yes obviously.
I	Would they be too advanced?
R	I don't know. Like intro to automation maybe not there was some stuff that required more logic, I don't know.
I	Do you have any advice, I suppose suggestions for me as to making me or helping me to become more aware as to how to encourage females to come in to the program? Let's say if I were to go to recruiting and try to attract young girls to come into the program what can I say or how will I be able to convince them to overcome the same fears that you had?
R	You should tell them exactly what you just said. Tell them that in the field and in the class it is the same thing, teamwork. We all work together and it does not make a difference. If you think logically it is going to work. Be yourself and just think the same as you usually would, I don't know how to explain it.