Factors Perceived to Contribute to Mathematics Avoidance or Mathematics Confidence
in Non-Traditional Age Women Attending a Community College

by

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A dissertation submitted in partial fulfillment
of the requirements for the degree of
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Date of Approval:
April 6, 2007

Keywords: anxiety, self-efficacy, teacher behaviors, parental support, motivation

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Acknowledgements

Completing this research study would not have been accomplished without the support of the members of my doctoral committee, who were patient with my progress, which seemed to be imperceptible at times, and who provided me with helpful advice and guidance through my move to Pennsylvania and the years that followed. Dr. Arthur Shapiro was there to inject his unfailing sense of humor even in the darkest times when I felt hopelessly overwhelmed. Dr. Jan Ignash was always available to help me locate the right paperwork and the ins and outs of maneuvering through the maze leading to graduation. She was my long-distance connection to the Tampa campus and I will always be grateful for her advice and encouragement. I would also like to thank Dr. Steve Permuth, Dr. Denisse Thompson and Dr. Robert Dedrick, all of whom made important contributions to my journey through the doctoral program. I feel blessed to have had the opportunity to work with such talented individuals.

I would also like to thank the administrators at Reading Area Community College for allowing me to conduct my research on the campus and for granting me the freedom to access student records and use their facilities to interview participants. Dr. John DeVere and Dr. Fred Indenbaum welcomed me and my proposed research, and although I was a newcomer to the college, trusted and believed in me. Without their help, this research could never have been conducted.
Next, I would like to thank two special individuals who served as co-researchers with me in reading transcripts and offering their perspective on the stories the participants shared. Dr. Sandra Kern and Tomma Lee Furst were invaluable in their support and expertise. Without their unselfishness and dedication to providing the best possible educational experience for students, my work on this study would have been far less productive. Thank you both for your time and encouragement.

Thank you to my children for never giving up believing that their mother would finish this research, even though it took many years to accomplish. Thank you, Jon, Melodie, Dan, David, Norah, Justin, and Morgan.

Finally, my thanks to the fifteen women who agreed to participate in this study and who granted me the honor and privilege of witnessing their memories and feelings. Through their stories, I became a better educator and a closer friend.
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Theme 6: Feelings of powerlessness may impede learning mathematics

Theme 7: Self-esteem can survive in spite of past failure

Theme 8: Motivation to understand mathematical concepts remained high

Summary

Chapter Five: Summary, Discussion and Implications

Problem

Purpose

Summary of the Findings

Discussion

Theme 1: Acquiring a college education is a personal goal

Theme 2: Adequate study time is necessary to understand and to retain mathematical concepts

Theme 3: Experiences with mathematics at an early age remain in one’s memory

Sub-Theme 3a: Poor experience with mathematics at an early age tended to make participants believe they could not learn mathematics

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Theme 5: Teacher behaviors and teaching methods matter

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Factors Perceived to Contribute to Mathematics Avoidance or Mathematics Confidence in Non-Traditional Age Women Attending a Community College

Jo Ann K. Rawley

ABSTRACT

Over the past decade, the number of students entering postsecondary institutions immediately after high school has been decreasing, while the number of non-traditional aged students, defined as adults over 25, has substantially increased, with women making up the majority of this adult student group. Mathematics education is an area where non-traditional age women tend to have difficulty.

Fifteen individual interviews were conducted with non-traditional age women enrolled in a community college, 10 identifying mathematics as the subject they would least enjoy and 5 identifying mathematics as the subject they would most enjoy. Data were analyzed by comparing the women’s stories and drawing out common themes. Eight major themes and six sub-themes emerged: (1) Acquiring a college education is a personal goal; (2) Adequate study time is necessary to understand and to retain mathematical concepts; (3) Experiences with mathematics at an early age remain in one’s memory, (3a) Poor experience with mathematics at an early age tended to make participants believe they could not learn mathematics, (3b) Positive experience with mathematics at an early age tended to provide participants a higher degree of self-efficacy in succeeding in mathematics courses; (4) Parental behavior and expectations play a role in children’s self-perception, (4a) Absence of parental/family support tended to...
to discourage participants from pursuing further education, (4b) Presence of parental/family support tended to encourage participants in pursuing further education; (5) Teacher behaviors and teaching methods matter, (5a) Negative teacher behaviors tended to cause some to develop poor mathematics self-concept, (5b) Positive teacher behaviors tended to encourage some to persevere in understanding mathematics; (6) Feelings of powerlessness may impede learning mathematics; (7) Self-esteem can survive in spite of past failure; (8) Motivation to understand mathematical concepts remained high.

Seventeen implications for both faculty and students were drawn from the responses of the participants. Both metacognitive and affective factors present in learning mathematics were expressed and meanings attached to experiences were reported in participants’ own words. Suggestions are offered explaining what teachers might do to reinforce positive metacognitions and reduce those that are negative. Recommendations for further research are provided and personal reflections are shared.
Chapter One

Introduction

For women preparing to move ahead in the 21st century, education offers one of the best opportunities for advancement and for improving quality of life. Although education brings no guarantee of monetary or professional success, it can help open doors that are closed to the uneducated. Lack of education can be an overwhelming obstacle to women in America’s competitive technological society. Because of the increasing demand for technological skills, mathematics education, in particular, has taken on heightened importance and is in the national spotlight. Successful completion of mathematics courses for women in undergraduate education is critical, not only to those individuals whose lives are affected, but to the economy of the nation as well. An awareness of factors perceived to contribute to mathematics avoidance or mathematics confidence in non-traditional age women attending a community college may be key to addressing issues of retention and persistence in America’s educational institutions.

Enrollment Trends

Over the past decade, the number of students entering postsecondary institutions immediately after high school has progressively decreased. Conversely, the registration of non-traditional age students, defined as the “mature,” “reentry,” or “adult” learner over the age of 25, has substantially increased (Klein, 1990; Krager, Wrenn, & Hirt, 1990; Padula, 1994; Scott, Burns, & Cooney, 1996). The majority of this group is female and is
becoming the fastest growing population now entering postsecondary education (Clayton & Smith, 1987; Donaldson & Graham, 1999). Continued success of postsecondary institutions may well depend on their ability “to understand and accommodate the unique dispositional, situational, and institutional needs of non-traditional female students” (Carney-Crompton & Tan, 2002, p. 140).

Statistics gathered by the U. S. Department of Education, National Center for Education Statistics, show that women accounted for about 96% of the increase in college and university fall enrollment from 1976 to 1984. Recent data indicate this trend continuing with 66% of the increase in enrollment from 1994 to 2004 attributable to women. Between 1994 and 2004, the number of men enrolled rose 16% while the number of women increased by 25% (see Table 1).

The numbers speak for themselves. By 1996, women were a majority of both part-time and full-time enrollees (Bae, Choy, Geddes, Sable, & Snyder, 2000). More than half of undergraduates were women in 1999-2000 (56%) (NCES, 2003). Data collected during 1999 and 2000, reported that female students comprised 61% of the student body on community college campuses in the United States (VanDerLinden, 2002).

The Non-traditional Age Student

Although female students of all ages who are seeking higher education predominate, those who are considered of non-traditional age are the focus of this research. Non-traditional age has generally been recognized as being over the age of 25 years (Chickering, 1981; Cohen & Brawer, 1996; Horn, MPR Associates & Carroll, 1996; Lyons & Pawlas, 1998; Winter & Harris, 1999). Some believe that this population,
Table 1.

*Total fall enrollment in degree-granting institutions, by attendance status, sex of student, and control of institution: 1947 to 2004*

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Enrollment</th>
<th>Attendance status</th>
<th>Sex of student</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Full-time</td>
<td>Part-time</td>
</tr>
<tr>
<td>1947</td>
<td>2,338,226</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>1957</td>
<td>3,323,783</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>1967</td>
<td>6,911,748</td>
<td>4,793,128</td>
<td>2,118,620</td>
</tr>
<tr>
<td>1976</td>
<td>11,012,137</td>
<td>6,717,058</td>
<td>4,295,079</td>
</tr>
<tr>
<td>1980</td>
<td>12,096,895</td>
<td>7,097,958</td>
<td>4,998,937</td>
</tr>
<tr>
<td>1984</td>
<td>12,241,940</td>
<td>7,098,388</td>
<td>5,143,552</td>
</tr>
<tr>
<td>1990</td>
<td>13,818,637</td>
<td>7,820,985</td>
<td>5,997,652</td>
</tr>
<tr>
<td>1994</td>
<td>14,278,790</td>
<td>8,137,776</td>
<td>6,141,014</td>
</tr>
<tr>
<td>1998</td>
<td>14,506,967</td>
<td>8,563,338</td>
<td>5,943,629</td>
</tr>
<tr>
<td>2000</td>
<td>15,312,289</td>
<td>9,009,600</td>
<td>6,302,689</td>
</tr>
<tr>
<td>2001</td>
<td>15,927,987</td>
<td>9,447,502</td>
<td>6,480,485</td>
</tr>
<tr>
<td>2002</td>
<td>16,611,711</td>
<td>9,946,359</td>
<td>6,665,352</td>
</tr>
<tr>
<td>2003</td>
<td>16,900,471</td>
<td>10,311,814</td>
<td>6,588,657</td>
</tr>
<tr>
<td>2004</td>
<td>17,272,044</td>
<td>10,610,177</td>
<td>6,661,867</td>
</tr>
</tbody>
</table>

which includes disproportionate numbers of women and members of ethnic minorities, “are subjected to an interactive web of entrenched values from long-standing elitist systems” (Richardson & King, 1998, p. 68). Although there are pressures to bring change and opportunities for wider access to higher education, many educators agree that this population has been overlooked (Richardson & King, 1998; Schatzkamer, 1986; Smith, 1994; Winefield, 1993).

Non-traditional students report different concerns than traditional students (Bean & Metzner, 1985). They often share characteristics such as working full-time while enrolled in classes part-time, having family responsibilities, desiring to upgrade skills and advance their careers, and having been out of academic life for a period of time. Many have undergone a major life change, such as divorce or loss of a job, and seek to develop self-confidence to cope with future uncertainty.

Non-traditional age students, male and female, comprise nearly half the population in America’s community colleges. The National Center for Education Statistics reports, in National Profile of Community Colleges: Trends & Statistics, that 46% of community college students are 25 years or older (see Figure 1).

In reference to gender, NCES data show that more women than men pursue postsecondary education after the age of 30, perhaps coinciding with average post-childbearing years (Phillippe, 2000) (see Table 2).

Table 3, showing statistics gathered by the U. S. Department of Education, National Center for Education Statistics, projects student enrollment figures in degree-granting institutions to 2014, separated according to age and gender. These data indicate that in 2000, women between the ages of 25 and 34 years, who registered for a full-time
Figure 1.

Community College Enrollment by Age: 1997


course load, represented 53% of fall enrollments in that age category; by 2014 that figure is projected to reach 61%. In the 35-years-old-and-over category, women enrolled full-time represented 57% of 2000 fall enrollments; projections for 2014 rise to 67%. In addition to full-time attendees, part-time enrollments of non-traditional age women are growing as well. In 2000, women between the ages of 25 and 34 years represented 60% of fall enrollments in that age group, with the 35-years-old-and-over group of women reaching 65%. Projections for 2014 for part-time women enrollees show 60% for the 25-to-34-years-old group and 63% for the 35-years-old-and-over category.

Many non-traditional age women seeking higher education have special needs that go beyond those of the traditional, 18-21-year-old female coming to college right out of high school, who is single and depending on her parents for financial support. One of
Table 2.

*Community College Fall Headcount Enrollment by Age and Gender: 1997*

<table>
<thead>
<tr>
<th>Age</th>
<th>Male</th>
<th>Female</th>
<th>Percent Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 18</td>
<td>86,209</td>
<td>129,523</td>
<td>60%</td>
</tr>
<tr>
<td>20 to 21</td>
<td>409,823</td>
<td>457,211</td>
<td>53%</td>
</tr>
<tr>
<td>22 to 24</td>
<td>333,067</td>
<td>391,630</td>
<td>54%</td>
</tr>
<tr>
<td>25 to 29</td>
<td>327,589</td>
<td>439,205</td>
<td>57%</td>
</tr>
<tr>
<td>30 to 34</td>
<td>200,582</td>
<td>319,889</td>
<td>61%</td>
</tr>
<tr>
<td>35 to 39</td>
<td>156,621</td>
<td>285,270</td>
<td>65%</td>
</tr>
<tr>
<td>40 to 49</td>
<td>198,156</td>
<td>381,813</td>
<td>66%</td>
</tr>
<tr>
<td>50 to 64</td>
<td>78,430</td>
<td>140,041</td>
<td>64%</td>
</tr>
<tr>
<td>65 or older</td>
<td>23,838</td>
<td>35,713</td>
<td>60%</td>
</tr>
<tr>
<td>Age unknown</td>
<td>20,452</td>
<td>23,388</td>
<td>53%</td>
</tr>
</tbody>
</table>

Note. From National Profile of Community Colleges, American Association of Community Colleges.

the most potentially problematic of these needs is requiring childcare while attending college classes. Survey data collected during 1999 and 2000 reveal that 45% of single mothers who enrolled in community colleges because of a major life change indicated that the cost of childcare or dependent care was a problem while taking courses (VanDerLinden, 2002).
Table 3.

Total fall enrollment in degree-granting institutions, by attendance status, age, and sex:
1980 through 2014 [in thousands]

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Full-time</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 to 29 years</td>
<td>577</td>
<td>770</td>
<td>908</td>
<td>878</td>
<td>1509</td>
</tr>
<tr>
<td>30 to 34 years</td>
<td>251</td>
<td>387</td>
<td>430</td>
<td>422</td>
<td>584</td>
</tr>
<tr>
<td>35+ years</td>
<td>182</td>
<td>471</td>
<td>653</td>
<td>599</td>
<td>748</td>
</tr>
<tr>
<td><strong>Men</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 to 29 years</td>
<td>360</td>
<td>401</td>
<td>454</td>
<td>415</td>
<td>596</td>
</tr>
<tr>
<td>30 to 34 years</td>
<td>124</td>
<td>156</td>
<td>183</td>
<td>195</td>
<td>213</td>
</tr>
<tr>
<td>35+ years</td>
<td>74</td>
<td>152</td>
<td>238</td>
<td>256</td>
<td>251</td>
</tr>
<tr>
<td><strong>Women</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 to 29 years</td>
<td>217</td>
<td>369</td>
<td>455</td>
<td>463</td>
<td>913</td>
</tr>
<tr>
<td>30 to 34 years</td>
<td>127</td>
<td>231</td>
<td>247</td>
<td>227</td>
<td>371</td>
</tr>
<tr>
<td>35+ years</td>
<td>108</td>
<td>319</td>
<td>415</td>
<td>343</td>
<td>498</td>
</tr>
<tr>
<td><strong>Part-time</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 to 29 years</td>
<td>1209</td>
<td>1213</td>
<td>1212</td>
<td>1083</td>
<td>1404</td>
</tr>
<tr>
<td>30 to 34 years</td>
<td>905</td>
<td>935</td>
<td>805</td>
<td>843</td>
<td>989</td>
</tr>
<tr>
<td>35+ years</td>
<td>1145</td>
<td>2012</td>
<td>2093</td>
<td>2150</td>
<td>2539</td>
</tr>
<tr>
<td>------------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>----------------</td>
</tr>
<tr>
<td><strong>Men</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 to 29 years</td>
<td>594</td>
<td>539</td>
<td>508</td>
<td>447</td>
<td>538</td>
</tr>
<tr>
<td>30 to 34 years</td>
<td>397</td>
<td>381</td>
<td>378</td>
<td>332</td>
<td>423</td>
</tr>
<tr>
<td>35+ years</td>
<td>382</td>
<td>672</td>
<td>748</td>
<td>757</td>
<td>935</td>
</tr>
<tr>
<td><strong>Women</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 to 29 years</td>
<td>616</td>
<td>674</td>
<td>704</td>
<td>636</td>
<td>866</td>
</tr>
<tr>
<td>30 to 34 years</td>
<td>507</td>
<td>554</td>
<td>427</td>
<td>511</td>
<td>566</td>
</tr>
<tr>
<td>35+ years</td>
<td>762</td>
<td>1340</td>
<td>1345</td>
<td>1393</td>
<td>1604</td>
</tr>
</tbody>
</table>


In addition to the complexities of childcare, many women have been away from a classroom atmosphere and the rigors of academic life for several years and often enroll as part-time students while holding a full-time job. The coexistence of family responsibilities and commitments with the demands of academia can create additional challenges and barriers to academic success for non-traditional age women (Padula, 1994). All of these responsibilities, with which non-traditional age women must cope, have been identified as risk factors and may result in lower rates of persistence. The number of risk factors is directly related to the likelihood of leaving postsecondary education without completing a program (Berkner, Horn, Clune, & Carroll, 2000). The data in Table 4 reflect numbers of students affected by the following risk factors:
Table 4.

Percentage of 1999-2000 Undergraduates with Various Risk Factors, by Age

<table>
<thead>
<tr>
<th>Age categories</th>
<th>Delayed enrollment</th>
<th>Part-time attendance</th>
<th>Have dependents or children</th>
<th>Work full-time while enrolled</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 or younger</td>
<td>9.6</td>
<td>26.3</td>
<td>5.6</td>
<td>16.1</td>
</tr>
<tr>
<td>19-23 years</td>
<td>31.2</td>
<td>34.0</td>
<td>11.1</td>
<td>24.2</td>
</tr>
<tr>
<td>24-29 years</td>
<td>62.5</td>
<td>61.6</td>
<td>35.4</td>
<td>52.1</td>
</tr>
<tr>
<td>30-39 years</td>
<td>72.9</td>
<td>73.1</td>
<td>61.0</td>
<td>60.8</td>
</tr>
<tr>
<td>40+ years</td>
<td>74.7</td>
<td>82.0</td>
<td>55.0</td>
<td>62.7</td>
</tr>
</tbody>
</table>


(a) delayed postsecondary enrollment; (b) part-time attendance; (c) responsibility for dependents; and (d) full-time workload while enrolled.

One of the more serious risk factors is having been out of school for anywhere from five to twenty years. Although communication and verbal skills tend to operate as part of normal life activity, mathematical skills are often forgotten. Not surprisingly, a lack of confidence in successfully performing calculations and solving problems in mathematics may develop (Ramus, 1997). Furthermore, if these students had negative experiences in the mathematics courses they had growing up, this lack of confidence may escalate as they think about taking a mathematics course for the first time in several years.
Many women enrolled in postsecondary education have three, four, or more of these risk factors present. These students know their chances are limited and, as a consequence, they are more serious now about school than they were when they were in their teens or early twenties (Cox, 1993; Miglietti, 1994; Schatzkamer, 1986). According to Schatzkamer, older students do better work and have a different classroom attitude than most younger students. Consequently, they are actually more likely than younger students to exhibit a deep approach or a meaning orientation toward their academic studies, and they are conversely less likely than younger students to adopt a surface approach or a reproducing orientation to their academic work (Richardson, 1995). They want to learn and to change their lives (Cox, 1993; VanDerLinden, 2002). We cannot afford to overlook this important age group (Mullinix, 1995).

Much of an adult’s self-identity, whether male or female, is derived from his or her life experience. To ignore or reject such experience is to devalue that individual (Crawford, 1980). Rarely are adults’ prior experiences formally integrated into the process of learning, and rarely are socialization issues addressed in the curriculum. The focus tends to be on cognitive learning alone. Consequently, there is a neglect of the affective issues adults are facing as they return to the classroom. Feminist writers insist that learning should be regarded as a holistic process (Belenky, Clinchy, Goldberger, & Tarule, 1986), and yet most of the mainstream literature on learning neither reflects the experiences of learners nor acknowledges that ideas cannot be separated from experience (Richardson & King, 1998). Because feelings and personal interests play a vital role in learning, adult students are often capable of more effective and elaborative learning than younger students precisely because they are likely to be more adept at examining and
exploiting their prior experience in order to make sense of new information and new situations (Merriam & Caffarella, 1991).

Researchers studying adult development challenge mathematics teachers to create environments that are warm and accepting, cooperative, adventuresome, and challenging (Bean & Metzner, 1985; Donohue & Wong, 1997; Fiore, 1999; Jackson & Leffingwell, 1999; Koelling, 1995). When adult learners return to school after being out of the academic world for a considerable period of time, they tend to be unsure of themselves and unclear about the expectations of the academic environment. They may be in the middle of major transitions in their personal or professional lives and are being forced to look in new directions. They may be asking fundamental questions about their identity and self-esteem (Grood, 1985; Ham, 1998; Lehmann, 1985; Menson, 1982; Miglietti, 1994).

Many studies support an optimistic profile of the non-traditional age student as a very capable and resilient participant in the academic world, despite the number of challenges and stressors that differ from those experienced by more traditional age students. Carney-Crompton and Tan (2002) suggest a number of ways that postsecondary institutions can enhance the potential success of these students.

First, because the transition to the role of student realistically entails a significant degree of adjustment to an already full repertoire of commitments and responsibilities, postsecondary institutions should offer orientation programs targeted specifically to these students and their life situations. Such programs should be offered prior to and in the initial particularly stressful stages of enrollment. These students should be informed about the real demands of higher
education, including course expectations and requirements, as well as the extent of time and personal energy required to succeed. Although most students are aware of the actual class time involved in a particular program, many are unaware of the amount of time that is frequently required for out-of-class reading, written assignments, and other course activities. Non-traditional female students who have successfully completed some or all of their studies could provide realistic accounts of the demands as well as rewards of further education (p. 146).

Study skills often must be developed or refreshed as the women assume their new role as students. Counselors and academic support staff may help here to give advice, guidance, and support. Life experiences, although receiving no academic credit, should be recognized and respected. For non-traditional age students, emotions may have more influence on learning than intellectual ability (Fiore, 1999). Anxieties about academic performance and test taking, especially in mathematics, often surface (Mullinix, 1995; Parker, 1997; Richardson & King, 1998). This is sometimes due to a low mathematics self-concept (Zachai, 1999; Zopp, 1999), which is discussed in Chapter Two. Because of low self-concept and low confidence, many non-traditional age students require more individual attention and support than may be necessary for the traditional, straight-from-high-school student (Lehmann, 1985; Richardson & King, 1998; Zachai, 1999).

Although older students may be effective problem solvers for many life demands, they may exhibit fewer skills for coping with an academic environment, particularly mathematics. From data gathered in British universities, Woodley (1984) found that adult students tended to obtain better degrees (i.e., first-class honors) than younger students in the arts and the social sciences, but the reverse was true in science disciplines.
Woodley concluded that in the former subjects the extra life experience of adult students could be translated into greater academic success, whereas the break in their full-time education had resulted in a decline in their mathematical and scientific skills. These data add support to the researcher’s hypothesis that mathematics courses create unique challenges to non-traditional age students.

It appears that non-traditional age students will continue to make up a substantial percentage of the higher education student body. Because this is a relatively new phenomenon, it is necessary to develop a greater understanding of their unique goals and needs in an educational system that was originally established to facilitate the growth, training, and education of young adults (Donohue & Wong, 1997). Because women have been traditionally more open about expressing their feelings about mathematics, they provide an excellent resource for collection of data about the nature of their experience (Fiore, 1999).

Challenges for the Community College

Many people think of mathematics as one of the most logical, most impersonal branches of knowledge, yet it inspires more emotion than any other school subject (Marderness, 2000; Smith, 1994). “In the United States most people would be ashamed to admit that they never could learn to read, yet it is perfectly respectable to confess that one can’t do math” (Zaslavsky, 1994, p. 5).

The researcher has witnessed the emotional drama surrounding mathematics first hand, having worked for over a decade in a community college setting. It is a common occurrence to encounter a sizeable number of women who have been kept from achieving a degree due to an inability to pass the required mathematics. They may attempt the
mathematics early in their programs and find it to be a disappointing, failing experience. Instead of persevering, they bypass the mathematics requirement until they finish all of the other required courses, then return to mathematics at the end of their programs. By this time, mathematics has become, in their minds at least, a formidable and foreboding challenge, one that may add a year or more on to degree completion. Furthermore, it is not an uncommon occurrence to find women who are counseled to change their original degree choice and career aspirations in order to avoid the required mathematics. Saddest of all are those who give up entirely after investing their time and money in an education that proved to be a disappointment and unfulfilled dream.

Community colleges, in accordance with their mission to democratize American higher education, hold out the promise of providing education in, among other areas, mathematics, to a wide range of students, many of whom had not previously been successful in this subject. “Ironically, the very fact that community colleges exist to give students a ‘second chance’ may contribute indirectly to the complex factors that lead to the lack of success some students have had in mathematics...” (Seidman, 1985, p. 133). Knowing that community colleges will admit them regardless of prior experience with or previous success in mathematics, some may persuade themselves that there is always the hope that if absolutely necessary, they will contend with mathematics and pass the course somehow. The problem is that mathematics, perhaps most of all subjects, is cumulatively organized. Progress in mathematics at one level rests on having achieved a solid foundation at earlier levels. The further one goes up the hierarchically arranged mathematics curriculum, the firmer the foundation of basic understanding must be (Seidman, 1985).
All students are forced to deal with mathematics in a way that affects their futures. The first hurdle, often a barrier when entering postsecondary undergraduate education, is maximal performance on a standardized test. For acceptance to most four-year universities, a minimum score on the SAT or ACT is required. For entrance into a community college, a college placement test is given to every student, regardless of previous high school grades. Performance on these standardized tests greatly affects student motivation and self-concept (Zachai, 1999). Smith (1994) states that doing poorly on these tests makes most people feel dumb. “And I don’t just mean dumb in mathematics, I mean dumb in everything” (p. 93). Most frequently, scores on the verbal portion of the test are adequate; however, low performance on the mathematics portion of the test places students into remedial courses—prealgebra or beginning algebra. These courses are meant to be “refresher” courses and move quickly over a lot of material in a very short period of time. When students have been away from using mathematics for years, it often is a formidable prospect to master all of the mathematical concepts needed to establish a foundation for further learning.

Often introductory mathematics courses are structured in the form of labs, where academic software is introduced and several levels of developmental mathematics are combined into one class. The instructor acts as a facilitator and tutor while the student is working in a self-paced fashion. In this scenario, students are not only required to learn the mathematics but must also become familiar with software and quickly learn computer skills, causing additional frustration and anxiety. With the way the curriculum is organized, coverage of material is essential; therefore, coverage has taken priority over
comprehension. Students are not given the opportunity to understand what has taken place with any degree of depth (Berkman, 1995).

The first few mathematics courses offered in college should be carefully structured and taught by the school’s best instructors (Arriola, 1993; Schatzkamer, 1986), which might include full-time instructors trained in methodology for both mathematics and education. These courses should be entertaining, interesting, and practical, with only the essentials that students are going to need to succeed in a technical career (Smith, 1994). Colleges would need to get help from businesses in order to decide what those essentials might consist of and tie the material to some practical applications and interests of their students.

It has been the researcher’s experience that teachers assigned to introductory mathematics courses are generally part-time, retired, or persons coming from business or technical fields who want to try their hand at teaching. Full-time faculty often prefer to teach the higher-level mathematics courses where they can be assured of a class of students who do not have the unique struggles and anxieties that beginning mathematics students exhibit. As a result, teachers may lack a commitment to and understanding of the teaching and learning styles required for underprepared or returning, non-traditional students to succeed. Good college remedial mathematics teachers are non-threatening and use a student-centered, active learning approach (Arriola, 1993; Cook, 1997; Mullinix, 1995).

A typical introductory course in mathematics may not be viewed as welcoming, meaningful and appealing (Ramus, 1997). *An Exploration of the Nature and Quality of Undergraduate Education in Science, Math, and Engineering*, dated January 1989,
reported that, “Introductory courses remain unapologetically competitive, selective, and intimidating, designed to winnow out all but the ‘top tier’” (cited in Tobias, 1990, p. 9). Students often see themselves as outsiders in a world that they cannot penetrate. Poor performance and repeated failure does not instill confidence and hope. Motivations and interests are affected by performance rather than the other way around (Parker, 1997; Scherer, 1990; Tobias, 1990). Tobias recommends extending comfort zones [italics added] for women who are struggling with mathematical concepts (Tobias, 1994, p. 12). She believes that the failure of women and girls to conquer the world of mathematics represents not a failure of intellect, but rather a failure of nerve. Students enjoy learning and perform well within established comfort zones; therefore, it is a valuable teacher who is committed to identifying ways to help students get comfortable with mathematics.

Interest in finding strategies for teaching entry-level mathematics courses was demonstrated by a call for manuscripts in the October 2001 issue of Mathematics Teacher. These manuscripts were sought for the purpose of providing material for articles on the following topics: examples of lessons that motivate beginning, hesitant, or uninterested students; ideas for making algebra and geometry accessible to all students; uses of manipulatives, multimedia, and technology to make mathematics a hands-on, interactive, real-life experience for students; innovative ways to teach seemingly simple concepts; and classroom ideas that lead students to take mathematics courses beyond the minimum required for graduation. Although this magazine is geared for high school mathematics educators, the principles and techniques are applicable for postsecondary introductory mathematics courses as well.
My investigation has been inspired to a large degree by Marderness, whose research was conducted at a public high school, involving ten 11th-grade girls enrolled in an on-level (not the most or least challenging) mathematics class. Marderness (2000) investigated the thoughts and emotions experienced by young women engaged in various mathematical situations, especially those particular experiences where feelings of confidence were lowered. An existential phenomenological method was used which depends on acquiring articulate, expressive individuals who have experienced the phenomenon under investigation. Unlike other methods that are researcher-controlled, the existential phenomenological method depends on detailed descriptions of participants to provide the raw material [italics added] for the data analysis (Marderness, 2000). The study revealed common themes of experience, including five structural themes and two interactional themes within one framing theme. The framing theme was Perceptions of Self and Others. Structural themes included Concern about Grades, Disappointment, Frustration, Giving Up, and Math Just Isn’t Me. Pressure from Self and Others and Influences of Teacher Behaviors were revealed as interactional themes (Marderness, 2000).

Marderness’ research underscores the importance of teacher responsibility, not only to help students learn content, but also to prepare them for their roles as critical thinkers in today’s information age. When students, especially females, suffer from a lack of confidence to do mathematics and do not take any more than the minimum number of mathematics classes required, their future success is inhibited in a society that is increasingly dependent on mathematical literacy (Steele & Arth, 1998). Marderness’ research has contributed greatly to the body of literature on women’s mathematics
experience and this study builds on her findings with a population of older women in a community college atmosphere.

**Purpose**

The first purpose of this study was to examine metacognitive and affective factors that are perceived to contribute to mathematics avoidance or mathematics confidence in non-traditional age women attending a community college. The research setting is described in detail in Chapter Three.

Stories of participants illuminate realities for other non-traditional age women who are struggling with mathematics and also provide new insights and connections for women who are considering a return to school and a career change. It is hoped that this exploration and description of factors that are perceived to contribute to mathematics avoidance or mathematics confidence will add to the literature available to educators and prove to be beneficial in curriculum and pedagogical initiatives augmentation.

The investigation was done using a phenomenological approach to in-depth interviewing. The appropriateness of this research design has been eloquently proposed by Seidman (1998). "At the very heart of what it means to be human is the ability of people to symbolize their experience through language" (p. 2). Recent research studies using this approach, description, and theoretical background of phenomenology are discussed in Chapter Two. Listening to and studying the stories and details of women’s lives are ways of knowing and understanding. By developing profiles of these women and making thematic connections among their stories, this study focuses on factors in the educational experience that are perceived to contribute to mathematics avoidance or mathematics confidence.
The second purpose of this study was to explore and to describe the meaning non-traditional age women attach to their experience with mathematics. The question of meaning [italics added] addresses the intellectual and emotional connections between the participants’ feelings about mathematics and their lives.

The third purpose of this study was to determine the relationship, if any, between metacognitive and affective experience in learning mathematics. What is true in any given situation has rarely been investigated (Bloom, Krathwohl, & Masia, 1964) and therefore was one of the unique pursuits of this study.

The methodology of in-depth interviewing was chosen because it is a powerful way to gain insight into educational issues by describing and attempting to understand the experience of women whose lives may depend on and are enhanced through education (Seidman, 1998). “Older women returning to college are part of the continuing movement toward education for all” (Schatzkamer, 1986, p. 322).

This study investigated the following three research questions:

1. What metacognitive and affective factors are perceived to contribute to mathematics avoidance or mathematics confidence in non-traditional age women attending a community college?

2. What meanings do participating non-traditional age women attending a community college attach to their experience with mathematics?

3. What is the relationship, if any, between metacognitive and affective experiences of participating non-traditional age women attending a community college in learning mathematics?
Definition of Terms

For the purposes of this study, the following definitions are provided for clarification.

*Affect/affective.* The term *affect* has generally been used to refer to mental aspects of human nature that are differentiated from reason. Those aspects include feelings or emotions like anger, fear, love, and others that were thought to arise from stimuli without reasoned analysis (Beane, 1990). Modern research in psychology and philosophy, however, has demonstrated that thought and feeling occur simultaneously. Emotional responses are based on past experiences. “Feelings and emotions are not empty occurrences; rather they are feelings about or emotions tied to something. That ‘something’ is the content of problematic situations that call for some sort of reaction or resolution. …no matter how irrational a reaction or proposed resolution may seem, it is based on some degree of belief that it is appropriate in the given situation” (Beane, 1990, p. 4). Consequently, affect refers to a broad range of dimensions such as emotion, preference, choice, and feeling. These dimensions are based on beliefs, aspirations, and attitudes regarding what is desirable in personal development and social relationships. Furthermore, these dimensions are connected to thinking or cognition because they are informed by what has been learned from past experiences (Beane, 1990). It is important to recognize the interrelationship between cognition and affect (Bloom et al., 1964; Goleman, 1995).

Affective development is regarded as important by many institutions. This includes the development of such characteristics as emotional maturity, tolerance, empathy, and leadership ability (Astin, 1985). For the purpose of this paper, the affective
dimension refers to the operative emotional component when dealing with mathematics, at times consisting of *positive* [italics added] affective aspects such as confidence and exhilaration, and sometimes consisting of the *negative* [italics added] affective aspects such as anxiety, feelings of nervousness, tension, dread, fear, and unpleasant physiological reactions to stressful situations (Oxford, 1997; Sarason, 1986).

*Mathematics avoidance.* Closely related to the construct of mathematics anxiety, mathematics avoidance is behavior that seeks to evade confrontation with mathematics. Such behavior would include attempting to circumvent the mathematics sequence of courses, *get around* [italics added] the mathematics requirements, keep one’s distance from the instructor by sitting in the rear of the classroom, and staying detached from any discussion or contemplation that relates to mathematics. Parents, peers, significant role models, and environmental, social, and psychological factors contribute to mathematics avoidance (Campbell & Beaudry, 1998).

*Mathematics confidence.* Confidence in mathematics is a belief in one’s ability to complete the work successfully. It is the “I think I can” mentality, a conviction that one can handle the task and handle it well. Participation in mathematics at all levels beyond elementary school revolves around the confidence factor (Armstrong & Price, 1982).

*Metacognition.* Metacognition, or awareness of the process of learning, is a critical ingredient to successful learning. Metacognition is an important concept in cognitive theory and consists of two basic processes occurring simultaneously. Individuals (1) monitor their progress as they learn and (2) make changes and adapt their strategies if it is perceived they are not doing so well (Winn & Snyder, 1996). Blakey
and Spence (1990) define metacognition as thinking about thinking, knowing *what we know* and *what we don’t know* [italics added].

“Metacognitive skills include taking conscious control of learning, planning and selecting strategies, monitoring the progress of learning, correcting errors, analyzing the effectiveness of learning strategies, and changing learning behaviors and strategies when necessary” (Ridley, D. S., Schutz, P. A., Glanz, R. S. & Weinstein, C. E., 1992). Learning how to learn, developing a repertoire of thinking processes which can be applied to solve problems, is a major goal of education.

*Non-traditional age student.* According to the NCES, the term “non-traditional student” is not a precise one, although age and part-time status are common defining characteristics (Bean & Metzner, 1985). Non-traditional students, described by Cohen and Brawer (1996), are individuals who do not conform to the profile of the traditional 18-year-old student who enrolls full-time at a community college, completes the freshman and sophomore years, and transfers to a four-year college to earn a baccalaureate degree. In searching through the vast amount of literature relating to college student populations, most authors, as well as the U. S. Department of Education, have concurred that a non-traditional student means he or she is 25 years or older and has any one or more of the following characteristics: delays enrollment; attends part-time while working full-time (35 hours or more per week); has dependents other than a spouse (usually dependent children); reenters a two-year college after being previously enrolled at a four-year institution; is considered financially independent for purposes of determining eligibility for financial aid (Bean & Metzner, 1985; Horn et al., 1996; Klein, 1990; Krager et al., 1990; Padula, 1994; Scott et al., 1996).
Perception. In psychology, perception is mental organization and interpretation of sensory information or stimuli. An individual’s perception is influenced by the intensity of the stimulus, effects of previous stimulation, past experience, and his or her motivation and emotional state. Sometimes emotional disturbance can prevent perception completely (Smith, 2004). We receive information through our senses, then our mind selectively focuses on some of the information, ignoring what is considered less important. Evidence points to the conclusion that early experience, learning, emotion, and motivation are important in defining what and how we perceive (Heil, 1983).

Phenomenological method. This model of in-depth, phenomenological interviewing (Seidman, 1998) allows the interviewer and participant to plumb the experience and place it in context. Phenomenology encourages a close relationship between the experiences of real life and the ideas that guide our actions in practice (Boeree, 2007). This process of putting experience into language is a meaning-making process (Vygotsky, 1987).

Self-efficacy. Albert Bandura defined self-efficacy as the conviction that one can successfully execute the behavior required to produce the desired outcome (1977, p. 193). Expectations of what one can do determine how much effort will be expended and how long this effort will be sustained in the face of obstacles and aversive experiences. Perceptions of efficacy influence thought patterns, actions, and emotions. What a person believes that he or she can do is derived from four sources: performance accomplishments, vicarious experiences, verbal persuasion, and physiological states. Application of the concept of self-efficacy expectations to the realm of mathematics could help to understand and treat mathematics avoidance and anxiety (Betz & Hackett, 1983).
Assumptions

There are a number of assumptions that were made at the beginning of this study. Some of these follow:

1. Individuals construct knowledge in a social context, through individual cognitive processes and the social context and interactions in the home and in the classroom.

2. Participants would welcome the opportunity to talk about their experiences in their early education, recall teachers who they perceived as making a difference in their lives, and describe their feelings about learning mathematics currently in the community college atmosphere.

3. As the researcher, I would be able to listen intently, withhold judgment, and focus on what the participant is truly saying, rather than what I might think they’re saying, and to establish sufficient rapport and confidence to encourage participants to trust me and share their stories.

4. Participants would be able to recall and clearly share their memories and feelings about their educational experience.

5. Despite many differences, I am similar enough to the participants that if I calmly, non-defensively listen to them, I would be able to clearly understand their lived experience and be able to report their stories in a manner that accurately reflects that experience.

6. Knowing the factors perceived to contribute to mathematics avoidance or mathematics confidence—as shared by the participants—would be valuable in serving the needs of other non-traditional age women enrolled in a community college.
Limitations and Delimitations

Limitations

Some of the limitations of this study include the following:

1. This study was limited to non-traditional age women attending a community college.

2. This qualitative research study is not meant to be generalizable since the findings are based on a small purposeful sample; nevertheless, the study does provide an in-depth examination of the phenomenon. Community college teachers and students can determine whether or not the study applies to their situations.

3. Since the researchers are the main instruments in the collection and analysis of data in qualitative research, as the primary researcher, my beliefs and experiences teaching in a community college have informed this study. As an individual who has lived out many of the same experiences as the participants in this study, I have a particular viewpoint that has an effect on how I interpret the data. Therefore, the involvement of two co-researchers to read and develop themes from the data was instituted to assure me of the accuracy of my analysis of the participants’ stories and to increase the credibility of the findings.

4. Participants’ responses may have been limited by the capacity of their memories. In addition, the interview process may have colored their recollections of people and past events. They may have discovered new meanings in the process of retelling their stories.

Delimitations

No delimitations.
Organization of the Study

Chapter One introduces and emphasizes the need for exploring factors that are perceived to contribute to mathematics avoidance or mathematics confidence in non-traditional age women attending a community college. The importance of understanding the experience many non-traditional age women have in attempting to pass the required mathematics courses they need to move into technological or scientific fields is presented. Current trends in postsecondary institutional enrollment of non-traditional age students are discussed along with the current challenges facing community colleges. The purpose of the study, research questions, definition of terms, assumptions, limitations, and delimitations of the study are presented.

Chapter Two is dedicated to a review of the literature relevant to this study.

Chapter Three examines the value of a phenomenological approach to in-depth interviewing and the study design, which was the informal conversational interview. The research setting is described and a brief history of the researcher is reviewed. Selection of participants, procedures involved in deciding on interview questions and the process of transcribing, compiling and analyzing the data are explained in detail. The chapter concludes with a discussion of trustworthiness and credibility issues.

Chapter Four is comprised of the findings of this study. Eight major themes and six sub-themes emerged from a constant comparative analysis of the transcribed data. Brief profiles of each participant are presented as well as their stories, expressed in their own words.
Chapter Five includes a summary of the findings, a review and discussion of the major themes in connection with the literature, implications for practice, suggestions for further research, and personal reflections.
This chapter will address research findings from studies of academic self-concept, social conditioning and stereotyping of women, mathematics anxiety, teacher influence on students’ attitudes about mathematics, constructivist approaches to learning, and mathematics education initiatives designed to improve mathematics performance. The first section of this chapter provides a historical backdrop including women’s role in the American labor force and the need for information-age skills in our society. The final section will examine the fundamental principles of phenomenological research approaches and explore the appropriateness of such methodological approaches for this study.

Historical Background

Concerns about mathematics performance by U. S. students came to the forefront of national concern following the successful Russian launching of Sputnik in October of 1957. America’s presumed scientific and technological superiority was called into question (Mayhew, Ford, & Hubbard, 1990). The immediate response was to concentrate on increasing the robustness of mathematics and science education in the nation’s schools. Along with an increased rigor in mathematics courses and mathematics testing, concern arose in the mid 1970s over mathematics anxiety, which came to the attention of educators first as a feminist issue. Young women were not taking the high school
mathematics courses they needed for many college majors, and, as a consequence, were excluding themselves from promising and well-paying careers (Zaslavsky, 1994). Three decades later, President George H. Bush, in the 1990 State of the Union address, “proclaimed as one of his educational reform goals that American students, by the year 2000, should rank first in the world in math and science” (Smith, 1994, p. 123).

According to Reyes and Stanic (1988), knowledge of mathematics is essential for all members of our society. “To participate fully in our democratic processes and to be unrestricted in career choice and advancement, people must be able to understand and apply mathematical ideas. Unfortunately, certain groups are underrepresented in mathematics courses and do not achieve up to their potential” (p. 26). Women are among these groups (Reyes & Stanic, 1988). Today’s women are less likely than men to earn mathematics degrees in postsecondary education, earning a smaller and smaller proportion of these degrees at advancing levels of education, in other words, from the associate through doctoral degree levels (Foster, Squyres, & Jacobs, 1996). High school senior girls are more likely than boys to say that they did not take mathematics courses because they were advised that they did not need them (32% and 26%, respectively) or because they disliked the subject matter (35% and 22%, respectively). Females were more likely than their male peers to say poor performance in the subject kept them from taking additional mathematics classes (Foster et al., 1996).

It was found that, initially, boys and girls are alike in their perceived mathematical capabilities, but girls begin to lose confidence in their mathematics ability and differ increasingly in this regard as they move into high school. Partly to blame are parents’ beliefs about their children’s capabilities, which stem from the cultural
stereotype that girls are less talented in mathematics than boys (Eccles, 1989; Phillips & Zimmerman, 1990). Outside the home, studies found gender bias alive and well in classrooms as well and, not surprisingly, also in career guidance functions (Betz & Fitzgerald, 1987).

More students are going on to college than ever before, but nearly a third of them find it necessary to take remedial courses in reading, writing, or mathematics (Ravitch, 2000). Presently, there are a significant number of non-traditional age women entering the nation’s community colleges who are unable to pass the mathematics requirement (i.e., 22% of non-traditional female students tested into remedial mathematics courses at the researcher’s community college in the spring of 2003). This situation points to the important role of social-support systems for females at all levels of education.

Women in the Labor Force. Non-traditional age women enter or reenter the world of academia for a variety of reasons, many of which are job-related. Most of the women are working wives and mothers; they work because they need the money. A solid majority of women in the labor force in 1991 were either single (25%), divorced (12%), widowed (4%), separated (4%), or had husbands who earned less than $15,000 the previous year (13.5%) (Begun, 2000).

A little more than a century ago, few women completed high school, and the fortunate few who did attended sex-segregated seminaries that emphasized social graces, not academics. Most women who went beyond high school could only prepare for teaching, social work, and nursing. Business schools prepared them for clerical duties, never for management (Begun, 2000). While many women still train for these traditionally female occupations, others, as a result of growing educational and
occupational opportunities, explore other fields. According to the findings in Table 5, during the past 20 years, female participation in such traditionally male occupations as medicine, law, engineering, law enforcement, computer science, financial management, and college and university teaching has increased significantly.

For women to continue to move into professional and technological jobs, a strong background in mathematics is critical. The problem lies in the fact that when these women were in high school, they may not have taken the mathematics necessary to allow them to succeed in college level courses. Many academically capable students prematurely restrict their educational and career options by discontinuing their mathematical training early in high school (Fotoples, 2000; Hall, Davis, & Bolen, 1999; Horn et al., 1996).

*Mathematics Course Selection and Affective Issues in High School*

The National Center for Education Statistics’ primary assessment of what American elementary and secondary students know and can do in academic subjects is the National Assessment of Educational Progress. Often called the “Nation’s Report Card,” the NAEP has been taking academic snapshots of America’s students since 1969. Funded by the federal government, the NAEP tests 4th, 8th, and 12th graders in several different subjects. Unlike the SAT exam, which develops academic pictures of only the college-bound, the NAEP offers information on a sample of all students. It is through this and other national tests that we learn how well girls begin their school careers and what happens with each year’s promotion to a new grade. In the 1980s, when the non-traditional age women in postsecondary education today were most likely junior or senior
<table>
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high school students, data indicate that only half of all high school graduates chose to enroll in mathematics courses beyond the 10th grade. These reports also indicate that fewer women than men enrolled in the more advanced courses in high school mathematics. Furthermore, women, in particular, did not appear to have attained a high level of mathematical competency, even if they completed four years of high school math (NAEP, 1988; NCES, 1984).

Other research conducted during the 1980s supports the findings of the national data. Eccles (Parsons), Adler, and Meece (1984) found that self-concepts of mathematics ability were predictive of junior and senior high school students’ course enrollment plans and performance in mathematics. They also document significant gender-related differences in junior high school students’ mathematics related expectancies, values, and self-concepts of mathematics ability. In 1990, Meece, Wigfield, and Eccles studied predictors of mathematics anxiety and its influence on young adolescents’ course enrollment intentions and performance in mathematics. This study confirms predictions regarding the critical role (especially for girls) that perceptions regarding the value of mathematics play in determining students’ intentions to enroll in advanced mathematics courses.

NAEP 2000 assessment results indicate that, at the 8th and 12th grade levels, boys continue to outperform girls in mathematics, although the gap is decreasing. This increase in mathematics achievement for girls is reflected in National Science Foundation statistics which show that the percentage of bachelor’s degrees in science and engineering awarded to women has been steadily increasing; in the mid 1980s, women earned about 38% of bachelor’s degrees in science and engineering; in 1995, they earned 46%, in
1998, the number reached 49%. (Begun, 2000). This is an encouraging report, however gender differences in college majors persist, with women still concentrated in fields like education and men more likely than women to earn degrees in engineering, physics, and computer science (Bae et al., 2000).

According to a National Science Foundation study, *Women, Minorities and Persons with Disabilities in Science and Engineering: 2002*, one of the factors related to course taking and achievement in high school is a student’s attitude toward mathematics and science.

Differing attitudes toward science and mathematics and different perceptions about their performance in these subjects are evidenced by members of both sexes….One factor in the differences between male and female students in science and mathematics achievement may be these differences in attitude. Females generally have less positive attitudes toward science and math than do males. In 2000, female 4th and 12th graders were less likely than their male counterparts to agree with the statement “I like mathematics” (an indicator of their attitudes about mathematics). In grades 4, 8, and 12, females were less likely than males to agree with the statement “I like science.” And among students in all three grades, females were less positive than males regarding their mathematics and science performance: specifically, they were less likely than males to agree with the statements “I am good at mathematics” and “I am good at science” (NSF, 2002).

When reading these results, it is important to keep in mind that there is no simple, causal relationship between membership in a subgroup, such as female, and mathematics
achievement. A complex mix of educational and socioeconomic factors may interact to affect student performance (NAEP, 2000).

Teachers can help students appreciate the value of mathematics by explicitly relating mathematics to students’ everyday lives and by counseling students about the importance of mathematics for various careers. “Unfortunately, in over 400 hours of classroom observation, Eccles and her colleagues observed fewer than a dozen instances of these instructional behaviors” (Meece et al., 1990, p. 69). In addition to the critical role that students’ perceptions of the value of mathematics and their own mathematics ability play, evidence further suggests that affective factors may also play an important role in achievement patterns, especially in females (Meyer & Fennema, 1986; Rounds & Hendel, 1980) and have strong relationships with course and career selections (Armstrong & Price, 1982; Ethington & Wolfe, 1988; Tocci & Engelhard, Jr., 1991).

Affect permeates the entire school and the experiences of young people who attend. “A theory of learning or schooling that ignores or denies affect is incomplete and inhuman” (Beane, 1990, p. 7). When young people come to school, they bring with them their whole selves, including the affective aspects. One of these aspects is a belief system of attitudes about themselves. Each day adds new experiences that may confirm, change, refine, or otherwise alter their existing belief systems, preferences, or attitudes toward themselves and others. Because these aspects are part of the makeup of the individual, they cannot be left at the school door or set aside. The student who is afraid or lacking in confidence is not likely to barge into new experiences as if those feelings did not exist (Beane, 1990).
Beliefs shape behavior and can create a chilly climate in the classroom, according to Sadker and Sadker (1994). Teachers’ beliefs that boys are smarter in mathematics and science begin in the earliest school years. Many adults think that boys possess innate mathematical and scientific ability. Girls can also achieve, they believe, but they have to try harder. Sometimes it is counselors who harm when they mean to help. Feeling sorry for girls who find their mathematics and science courses difficult, they excuse them, a dismissal less likely to be offered to male students (Sadker & Sadker, 1994). When girls select out of mathematics, they are making decisions that will affect the rest of their lives. Without the right high school courses, college courses are out of reach. Without college courses, females are filtered out of careers that remain overwhelmingly and solidly male (NSF, 1990).

Scenes experienced by a student in the classroom, whether positive or negative, have a permanent effect on the quality of his or her life (Tomkins, 1991), depending on how many times the scene is rehearsed. “The effect of any set of scenes is indeterminate until the future either further magnifies or attenuates such experience…The consequence of any experience is not singular but plural. There is no single effect, but rather there are many effects…”(Tomkins, 1991, p. 87). Any scene which is sufficiently similar to bring about the same type of response is thereby made more similar and increases the degree of connectedness of the whole family of scenes (Tomkins, 1991).

Consider a scene in which a student is bombarded with demands for rapid responses at the same time being threatened with humiliation. Such threats increase the perceived difficulty of the demanded performance sufficiently to slow the student down
while simultaneously increasing the demand for more competence and more speed (Tomkins, 1991).

When students internalize success and externalize failure, an approach that Sadker and Sadker refer to as, “the male approach,” they are able to tackle new and challenging tasks and persevere in the face of difficulty. Students who attribute success to effort and failure to lack of ability (the female approach) exhibit “learned helplessness.” When confronted with difficult academic material, they do not persist but rather say, “I think I can’t,” and give up (Sadker & Sadker, 1994).

Need for Information Age Skills in Today’s Labor Force

How large a role do women play in the labor force today and what is to be expected in the next decade? According to the November, 2001, issue of Monthly Labor Review, the rate of growth for women in the labor force between 2001 and 2010 will increase at a faster rate than that of men (Fullerton & Toossi, 2001). In 2008, women will make up about 48% of the labor force and men 52%. In 1988, the respective shares were 45% and 55% (Monthly Labor Review, February 14, 2000). The workforce of the future will be shaped by several emerging trends: an aging workforce; increased numbers of women, minorities, and immigrants; a declining pool of youth from whom to draw; a continuing movement toward the service-producing sector; and a demand for highly skilled workers (Begun, 2000). In 2010, women will account for 48% of the labor force compared to 47% in 2000. This 1% may seem small, however it represents an increase of 9,884,000 women (Fullerton & Toossi, 2001).

In addition to the aging of the future workforce, there is a continuing demand for workers who have acquired computational skills. Our world is becoming increasingly
more quantitative due to technological advances through the rise of computers and a more global job market. Therefore, occupations in the United States are becoming increasingly dependent on knowledge of computers and quantitative expertise. “As we enter the 21st century, three critical challenges face the nation: competing in a global economy, reversing the growth of a permanent and disenfranchised underclass, and developing a workforce with Information Age skills. Without doubt, meeting these challenges will depend on the achievement of our educational system” (McCabe, 1999, p. 23).

Dr. Susan Sclafani, advisor to United States Secretary of Education Rod Paige, in a speech delivered at the 2002 annual meeting of the National Council of Teachers of Mathematics (NCTM), stressed the importance of a highly skilled workforce. In 1950, the job mix in the United States was 20% professional, 20% skilled, and 60% unskilled. Comparing those figures to the year 2000: the job mix was 20% professional, 65% skilled and only 15% unskilled. Sclafani projected that by the year 2020, there would exist 15 million more jobs requiring education and skills than people to fill them. Saying, “I was never good in math,” won’t work in this new economy (Sclafani, 2002).

Quantitative literacy is important through a variety of job fields, not just in mathematics, as many people previously believed. As evidence of this fact, NCTM offers, in its 2001-2002 catalog, the book, *Why Numbers Count—Quantitative Literacy for Tomorrow’s America*, which shows ways in which mathematics plays a critical role in everyday life. Women who desire to move into new fields of opportunity are finding that undergraduate degrees that prepare them for such fields require a significant number of mathematics courses. Careers in nursing, veterinary technology, engineering,
architecture, and criminal justice, just to name a few, are examples of careers that require college-level mathematics.

Understanding the Role of Academic Self-Perception

Perception, the way people experience, process, define, and interpret the world around them (Lewis, Goodman, & Fandt, 2001), influences the way individuals communicate and become aware of sensations and stimuli that exist around them. Acting as a filter, perception helps individuals take in or see only certain elements in a particular situation (Lewis et al., 2001). There is not only a constant interaction with one’s world but also a continuous contact with one’s inner reality; it is a personal choice of a point of view (Bach, 1965). The way that we perceive and react to an event is largely responsible for the ultimate effect of that event upon us. If we can understand and make sense out of an event and draw some objective, meaningful conclusion, the impact of that event will be less dreadful. Meaninglessness, on the other hand, can be very disturbing (Ghadirian, 1983).

An individual becomes slowly both the beneficiary and the victim of the world he or she has most often experienced and remembered. One is the beneficiary when stored scenes have been positive and suffers as the victim when the scenes have been negative. One feels free [italics added] when good scenes are retrieved and feels victimized when bad scenes are remembered (Tomkins, 1992).

Many elements may affect a person’s perception in any given situation. These include an individual’s age, sociocultural orientation, personal skill and capability in problem-solving and decision-making processes, memory capacity, quality of vision and hearing, energy level, or amount of stress at a given time (Badger, 1996). In addition,
personal beliefs and expectations play a major role in a person’s perception of his or her capacity to learn and achieve (Ghadirian, 1983). Several studies have shown that the beliefs that learners hold about their capabilities have a strong influence on task engagement and achievement (Bandura, 1982; Richardson & King, 1998; Schunk, 1989). “It is students’ interpretations of their achievement outcomes and not the outcomes themselves that have the strongest effects on students’ affective reactions of achievement” (Meece et al., 1990, p. 68). Each student may perceive the college experience differently. Studies have shown that these perceptions have both negative and positive effects on student attrition and persistence (Hatcher, Kryter, Prus & Fitzgerald, 1992; Klein, 1990; Lamport, 1993).

A vivid illustration of how sensory perception may lead to misinterpretation is dramatized in the poem entitled, “Blind Men and An Elephant.” The poem, written by American poet John Godfrey Saxe (1816-1887), is based on a fable told in India many years ago, and describes the experience of six blind men who went to see the Elephant. Each “saw” the Elephant as something different: a wall (touching the Elephant’s side), a spear (touching the Elephant’s tusk), a snake (touching the Elephant’s trunk), a tree (touching the Elephant’s knee), a fan (touching the Elephant’s ear), and a rope (touching the Elephant’s tail). “Each was partly in the right, but all were in the wrong.”

Likewise, on a college campus or in the classroom, students’ perceptions of a remark, a gesture, or a situation, may not be alike. For example, a competitive classroom atmosphere may be perceived as exciting and motivating to one student yet may appear threatening and intimidating to another. Research indicates that, while competition is motivating for many traditional age students, for non-traditional students, a cooperative
orientation rather than a competitive orientation enhances the student’s success in college (Donohue & Wong, 1997). Perceptions of the amount of effort expended to achieve a goal may differ. One student may view extensive hours of studying as a sign of dedication and tenacity, where another student may perceive the effort as a sign of low ability (Harju & Eppler, 1997). Of particular interest to this researcher is an understanding of the perceptions students may have of their own ability, teacher behaviors, and the college experience that affect mathematics confidence either positively or negatively.

Mathematics Self-Concept and Gender

“The self is not something with which individuals are born but something they create out of their experiences and interpersonal relationships” (Hamachek, 2000, p. 230). Each person has a self (a sense of personal existence), a self-concept (an idea of personal identity), and a certain level of self-esteem (feelings of personal worth). The self grows, develops, and understands itself in a social context. The interactions students experience and the feedback they receive are each important components in the development of a sense of self-concept (Hamachek, 2000).

More specifically, academic self-concept refers to students’ perceptions of their academic abilities (House, 1992). A positive self-concept is an important mediating variable that may promote academic achievement and other valuable educational outcomes (Marsh & Yeung, 1996). Marsh, Craven, and Debus (1991) show that enhancement of self-concept can improve academic performance and is strongly related to subsequent course selection (Marsh & Yeung, 1997).
Self-concept has been shown to be intimately involved in the cultivation of cognitive competencies (Bandura, 1997). Furthermore, perceived beliefs of one’s ability (self-efficacy) contribute independently to intellectual performance rather than simply reflecting cognitive skills. “Perceived efficacy exerts a more substantial impact on academic performance, both directly by affecting quality of thinking, and good use of acquired cognitive skills and indirectly by heightening persistence in the search for solutions” (Bandura, 1997, p. 216). Individuals of high efficacy persist while those of low efficacy are more apt to quit (Bandura, 1982; Bandura & Schunk, 1981). The higher the students’ efficacy beliefs, the higher the academic challenges they set for themselves (Pintrich & DeGroot, 1990).

Students gain knowledge about themselves by comparing how they measure up with those around them. When students are uncertain about any aspect of the self that seems important to them—abilities, competency, personal worth—they do not compare themselves with just anyone, but only with similar others (Gilbert, Gieser, & Morris, 1995). Comparison of self with others is useful in two ways: it allows individuals to gain knowledge about themselves (cognitive information) and to assess how they feel about themselves (affective information) (Hamachek, 2000).

According to Donohue and Wong (1997), self perceptions of traditional and non-traditional students may differ significantly, suggesting that age is a variable affecting one’s self-perception. In addition to age, gender may also be a defining factor in self-perception. Mathematics self-concept in women is believed to be related to issues of power, justice, and oppression, not aptitude. Psychosocial theorists propose that factors such as gender-role orientation and/or attitude toward mathematics play critical and
complementary roles. Many such theorists believe that the traditional feminine gender-role orientation and associated gender stereotyping interfere with women’s successful mathematics achievement and discourage involvement in mathematics-related careers (Landerman, 1987; Swindell, 1988). Women may attribute good performance in the classroom to effort rather than ability; they can achieve when they put forth great effort but, at heart, they may not believe that they have a true ability for mathematics (Eccles (Parsons) et al., 1984; Richardson & King, 1998; Seegers & Boekaerts, 1996; Smith, 1994; Stipek, 1984). Studies conducted in 1977 and 1978 by Fennema and Sherman show that males consistently exhibit higher levels of confidence in their ability to learn mathematics than females. These gender differences were also found when there were no differences in achievement (Meyer & Koehler, 1990). Successful performances do not necessarily enhance efficacy-related perceptions; the impact of this information depends on how it is cognitively appraised and interpreted (Schunk, 1984). Although a self-derogating bias in attributions has been found in skill areas other than mathematics, gender differences are most consistent in the mathematics domain (Ryckman & Peckham, 1987).

Does the same self-concept seem to hold true in women when the subject under discussion is not mathematics? Mythology about mathematics includes the idea that if one is good [italics added] at language arts, one is, inevitably, not good [italics added] at mathematics (Tobias, 1991, p. 92). In this researcher’s experience, it is not uncommon to be informed by a female student that she is getting A’s in English but is “no good at math.” Marsh (1990) studied how mathematics and English self-concepts are formed and what may influence them in their formation. The study found that mathematics self-
concept was dependent on whether a student had an external or internal frame of reference. An external frame of reference compares one’s self-perception of skill to the perceived skills of other students, whereas an internal frame of reference will make a comparison between one’s ability in mathematics as compared to one’s performance in English. The Big Fish-Little Pond Effect was also described where an average-ability student is placed in a high-ability group of classmates, causing self-concept to suffer. The implication is that average ability students may see themselves as doing poorly when placed in a group of high-ability students. Likewise, when students’ English skills are high, this may concurrently affect their perceptions of their mathematics skills as being low. The results of the study imply that if a student’s frame of reference can be determined, such an insight may help to explain self-concept. Marsh’s findings also indicated that when mathematics achievement was strong there was an accompanying positive relationship to mathematics self-concept (1990).

Unger and Crawford (1996) have linked a low self-concept to feelings of not belonging in the mathematical arena. Students, especially girls, often begin elementary school with positive feelings about their ability to perform well in mathematics. By adolescence, however, many girls have concluded that they are “not good at math” (Silver & Kenney, 2000). Sax (1992) conducted a study of college-age women who, in spite of performing slightly better than men on tests of mathematics ability, scored lower than men on tests of mathematics self-confidence. Using data from 192 colleges and universities, representing a total of over 15,000 students, Sax discovered that women rated themselves significantly lower on mathematics ability than men.
In-depth interviews have the potential to explore and clarify this complex phenomenon of lower mathematics confidence in women of equal or greater ability than men. The discrepancy may be due to the fact that females are often reluctant to express confidence in an area that has historically been labeled a male domain (Sherman & Fennema, 1977; Tocci & Engelhard, Jr., 1991). As a result, women are more likely to attribute success in mathematics to great effort or luck. Although over the last two decades achievement levels of females has increased, the myth of male superiority and dominance in the field of mathematics remains virtually unchanged (Caporrimo, 1990).

For many women, the belief that they are outsiders to the world of mathematics becomes ingrained in their belief system during adolescent years and remains intact throughout their adult lives (Crawford, 1980; Marderness, 2000). Teacher attitudes and encouragement (or lack of) have a significant influence on a student’s choice of major/career fields. Students’ attitudes about the subjects they study are often tied to performance. Such attitudes can affect enthusiasm for learning a subject and the effort devoted to studying it (Eccles, 1994). Women’s attitudinal differences toward mathematics begin early in elementary school, and are reinforced by subject area encouragement from teachers. In fact, research suggests teachers, more than family or peers, influence women’s decisions to continue/discontinue high school mathematics (Scherer, 1990). A negative mathematics self-concept involves perceptions of mathematical incompetence and low mathematics self-esteem which may result in a perpetual lack of mathematical success (Sax, 1994; Wadlington, 1992). There is evidence that a lack of encouragement to study mathematics goes hand in hand with the experience of individuals who lack power in our society (Drew, 1996).
Social Conditioning and Stereotyping

Social conditioning cannot be overlooked when discussing self-concept and self-confidence of women. Studies have shown that women speak frequently of problems and gaps in their learning and so often doubt their intellectual competence. For many women, the real [italics added] and valued lessons did not necessarily grow out of their academic work but in relationships with friends and teachers, life crises, and community involvements (Belinky et al., 1986). Boys and girls differ with respect to attitudes, self-confidence, values, career aspirations, and expectations regarding mathematics performance. These differences are learned behaviors (Fox, Tobin, & Brody, 1979). Socialization agents are parents, teachers, counselors, peers, the school environment, the media, and books (Fox et al., 1979).

Parental Support. Studies have shown parents, to a greater extent than teachers, hold gender-differentiated beliefs about their sons’ and daughters’ mathematics achievement (Eccles-Parsons, Adler, & Kaczala, 1982; Tocci, 1991). Furthermore, children’s self-concept of ability and their confidence in mathematics are more directly related to their parents’ beliefs about their mathematics aptitude and potential than to their own past achievement in mathematics (Eccles-Parsons et al., 1982). Parents in the Eccles-Parsons et al. (1982) study thought that mathematics was more difficult for their daughters, that their daughters had to work harder in order to do well in mathematics, and that enrollment in advanced level mathematics courses was less important for daughters than for sons. To the extent that parents convey the expectations inherent in these beliefs to their children, parents may help socialize the gender differences in students’ attitudes toward mathematics (Dickens, 1990; Yee & Eccles, 1988).
Yee and Eccles (1988) found a consistent pattern emerging from their data indicating that although girls and boys were doing equally well in mathematics, both mothers and fathers credited boys with talent and girls with effort. Parents may inadvertently encourage boys to develop higher estimates of their mathematical ability while undermining both their own and their daughters’ estimates of the daughters’ mathematical talent. When parents do this, it may cause boys to develop greater confidence in their continued future success, while girls begin to doubt their continued success in an activity that they presume gets increasingly difficult (Eccles, Adler, Futterman, Goff, Kaczala, Meece, & Midgley, 1983).

Tocci and Engelhard, Jr. (1991) conducted a study using nationally representative samples of 13-year-old students in the United States and Thailand. The study indicated that, for students in both countries, there was a positive relationship between parental support and student attitudes toward mathematics. Adolescents’ perceptions of their parents’ reactions to mathematics, along with the amount of encouragement they receive to study and do well at it, may affect the students’ attitudes toward mathematics. Researchers of adolescent behavior frequently underestimate the power of the home environment (Tocci & Engelhard, Jr., 1991), especially in the area of mathematics achievement, which appears to be particularly susceptible to the influence of parental beliefs (Chipman, Brush, & Wilson, 1985).

Stereotyping. Women generally have lower status than men, as is evidenced by findings that stereotypical feminine traits are evaluated less favorably than stereotypical masculine traits (Broverman, Vogel, Broverman, Clarkson, & Rosenkrantz, 1972). Consequently, in mixed-gender discussions of gender neutral topics, men display a
greater amount of verbal and nonverbal power. This suggests that in mixed-gender groups, women are given fewer opportunities to make contributions, receive less support for their contributions, and are less influential than men (Carli, 1990).

Stereotypes influence perceptions and performance in school and are often cited as contributing to girls’ shortcomings in schools (Fennema, Peterson, Carpenter, & Lubinski, 1990). In an analysis of the role of teacher beliefs on mathematics performance, Fennema et al. (1990) found that teachers attributed boys’ mathematical success to ability 58% of the time, and attributed girls’ mathematical success to ability only 33% of the time. Female successes were due to effort 37% of the time, while males’ successes were due to effort only 12% of the time (p. 178). In the same study, teachers attributed characteristics such as volunteering answers, enjoyment of mathematics, and independence to males.

Silence of women. Gilligan (1982) asserted that women who have been taught to accept the judgments of the men in their lives rather than make decisions for themselves, lack the opportunity to develop confidence-building experiences. As a result, many women fall silent. This pattern of silence is evidenced by the results of a study conducted by Norman (1997) that indicated that girls do not ask questions in class and therefore tend to have higher levels of mathematics anxiety. Belenky et al. (1986) learned, through intensive interviews with women, that, in general, they often felt alienated in academic settings and experienced formal education as either peripheral or irrelevant to their central interests and development.

Differing socialization processes of males and females are primarily responsible for the fact that many women speak “in a different voice” (Carli, 1990; Gilligan, 1982;
Tannen, 1990). In *Women’s Ways of Knowing* (Belenky et al., 1986), a five-category model served as a framework for the different ways women expressed themselves: silence, received knowledge, subjective knowledge, procedural knowledge, and constructed knowledge. The 135 participants in this study, although representing different ages and backgrounds, shared common perspectives. These perspectives emerged from the telling of their lived experiences.

If participating in classroom discussion is a necessary part of successful performance, then males have an edge (Sandler, Silverberg & Hall, 1996; Tannen, 1990). Speaking in a classroom is more in harmony with boys’ language experience than girls’ since it involves putting oneself forward in front of a large group of people, some of whom are strangers and at least one of whom (the teacher) will be judging the speakers’ knowledge and intelligence by their verbal eloquence (Tannen, 1990). Debate-like formats as a learning tool tend to be more preferred by men than by most women. Adversativeness, the act of expressing opposition, is fundamental to the way most males approach any activity, however, this is contrary to the way most females learn and like to interact (Kenschaft, 1991; Ong, 1981). “In the interactions between teacher and students, girls are silenced; they become spectators, wallpaper flowers, listeners of the boys who, given more time and attention, form the dominant valued core and command the action of the classroom” (Martel & Peterat, 1994, p. 159).

Mardeness (2000) cites several related studies conducted with women and specifically their mathematical experiences. One such study by Erchick (1996) dealt with capable, female elementary teachers who generally did not assume the role of the silent
learner in other areas of their lives but revealed feelings of being unable to speak and unable to hear when faced with mathematical situations:

The women spoke of how they “just never got it,” no matter the particular content or instructor or level. One woman described her feeling that mathematics was like building blocks, and she had missed the very first one. These women asked no questions, and few asked the teacher for help. They felt voiceless, fell silent, and stayed silent regarding mathematics well into adulthood (p. 112).

From the findings of Erchick and others it would appear that many women believe that their voices are silent and have no weight when decisions regarding mathematics curriculum, scheduling, course content, and instructor attitudes are concerned.

Mathematics Anxiety

In the mid 1970s the problem of mathematics anxiety came to the fore as a feminist issue. Young women were not taking the high school mathematics courses they needed for many college majors, and, as a consequence, they were excluding themselves from promising and well-paying careers (Zaslavsky, 1994). Interviews were conducted with such women who were now adults. They felt they could not cope with mathematics. Their experiences were often inspiring, but more frequently devastating. Zaslavsky suggests that pinpointing the problem is a first step in overcoming negative feelings about mathematics. Research on memories, attitudes and beliefs (Martin, 1994) has helped identify individuals who report feelings of mathematics anxiety. There are factors in society— inadequate schools, poor teaching, inappropriate mathematics programs,
stereotypes about who can and cannot do mathematics—that indicate the problem of mathematics anxiety is a complex construct.

Mathematics anxiety does not appear to have a single cause. Research has shown that it is the result of different factors, such as an inability to handle frustration, excessive school absences, poor self-concept (Hall et al., 1999; Norwood, 1994; Wadlington, 1992), parental attitudes toward mathematics (Dahmer, 2001; Eccles, 1994), teacher attitudes toward mathematics, and emphasis on learning mathematics through drill without understanding (Norwood, 1994). In addition, mathematics anxiety has been shown to be related to weak skills in mathematics. Lasher (1981) believed that reducing mathematics anxiety and building skills in mathematics were processes that must be done simultaneously. Although there are different theories about the causes of and cures for mathematics anxiety, there is little disagreement in the literature about the fact that it exists. Indeed, noteworthy research on mathematics anxiety has shown the phenomenon to be real, widespread, and seriously to interfere with learning, severely impacting people’s perceptions of themselves and of their career choices (Norman, 1997; Probert, 1983; Smith, 1994).

The prevalence of mathematics anxiety in the college population is discussed by Betz (1978), who reports that 68% of the students enrolled in college mathematics classes experience high levels of mathematics anxiety. Women suffer from mathematics anxiety to a greater degree than men (Atkinson, 1988; Douglas, 2000; Fischer, 2000; Furner, 1996; Ho, Senturk & Lam, 2000; Hopko, 2000; Rabalais, 1998; Skiba, 1990; Spanias, 1996; Tobias, 1991). Furthermore, a relationship between age and mathematics anxiety
exists such that the higher the student’s age, the higher the student’s mathematics anxiety (Springer, 1994).

Greenwood (1984) argues that mathematics anxiety is a problem whose solution lies almost entirely within the domain of mathematics education. Steele and Arth (1998) support this view and assert that the major source of mathematics anxiety lies in the impersonal teaching approach characterized by the explain-practice-memorize paradigm. When mathematics is taught without meaning, students are forced to memorize unconnected bits of information. As a result, mathematics doesn’t make sense to them. Because it doesn’t make sense, students rely on memorization. When students become convinced they will never understand mathematics and can learn only through memorization, “they may begin to fear math and may even become mathematics avoiders” (Steele & Arth, 1998, p. 19).

Tobias (1991) expresses her belief that mathematics anxiety is a political issue with millions of adults “blocked from professional and technical job opportunities because they fear or perform poorly in mathematics” (p. 91). Hers is a political conviction that mathematics is being used to channel students into job classifications and to lower their achievement and career goals. She feels that there is a cure but it will involve a change in both students’ and teachers’ attitudes. Instead of teaching students the steps to take when they remember [italics added] how to solve problems, teach them how to cope when they forget [italics added]. Coping skills such as taking problems apart, relaxation techniques to combat panic, and positive self-talk are vital in the teaching of mathematics (Peskoff, 1997), yet feelings, attitudes, and anxieties about mathematics are not discussed in many mathematics classrooms (Furner, 1996).
Mathematics anxiety feeds on helplessness, the burden of being out of control and alone (Fischer, 1993; Tobias, 1991). It is defined in terms of three components (Ohman, 1993): a subjective experience consisting of a feeling of foreboding; perceptions of bodily responses, such as sweating, palpitations, shortness of breath; behaviors associated with escape and avoidance. Furthermore, inability to influence events that significantly affect one’s life may also give rise to feelings of futility and despondency as well as anxiety (Bandura, 1982). The emotion is unpleasant, is directed toward the future, and is out of all proportion to the threat (Hembree, 1990). Students magnify the formidableness of the task and their personal weaknesses, think over their past failures, worry about the consequences of failing, imagine disconcerting scenarios of things to come, and otherwise think themselves into emotional distress and inadequate performance (Sarrason, 1975; Wine, 1982).

Mathematics anxiety has been identified as a factor limiting educational and career choices of college students, particularly women (Betz, 1978; Zettle & Raines, 2000). Why such emotional responses to mathematics? It is spoken of as “the worst curricular villain” (Smith, 1994, p. 135), associated with terrible anxiety, bad grades and test scores, avoidance, power, mysteriousness, hostility, and pressure. For many, it is a devastating experience (Tobias & Weissbrod, 1980; Garcia, 1998; Ma, 1999).

Some individuals consider learning mathematics to be useless in the context of their lives and work; yet there is a sense that knowing mathematics gives one a powerful feeling of being more knowledgeable than other people. There is a mystique surrounding mathematics that is hard to overcome (Segeler, 1986). People who can solve problems
we can’t or who can solve problems more quickly than we might, seem to be more intelligent and swifter of mind (Smith, 1994).

Fascination and curiosity in studying mathematics anxiety can be demonstrated by the considerable number of studies conducted and the resulting articles and books that have been written on the subject (Hanson, 1988; Miller, 1999; Norwood, 1994; Voit, 1983). Some of these materials are self-help guides that provide hints and creative suggestions for people who find they are in trouble with mathematics. Examples include, *Math, A Four Letter Word!* (Sembera & Hovis, 1996), *Mastering Mathematics: How to Be a Great Math Student* (Smith, 1998), *Winning at Math, Your Guide to Learning Mathematics through Successful Study Skills* (Nolting, 1997), *Math Study Skills Workbook: Your Guide to Reducing Test Anxiety and Improving Study Strategies* (Nolting, 2000), *Succeed With Math: Every Student’s Guide to Conquering Math Anxiety* (Tobias, 1987), *Overcoming Math Anxiety* (Tobias, 1995), *Conquering Math Anxiety: A Self-help Workbook* (Arem, 2003), and *Math: Facing an American Phobia* (Burns, 1998), just to name a few. These publications begin by validating the existence of mathematics anxiety and assure the reader that he or she is among a vast number of others who feel the same way. Next are ideas that may help to alleviate nervousness, test-taking hints, study suggestions, and the like. Most materials of this type focus solely on what the student can do to overcome the anxiety. A variety of *cures* [italics added] are suggested ranging from mental imaging to hypnosis. Although past research has revealed many interesting facets of mathematics anxiety, there is no current study underway, of which the researcher is aware, that focuses solely on women of non-traditional age who are enrolled in postsecondary institutions. Research is needed that uncovers and
describes feelings and stories coming from the learner. These stories may serve to unveil new strategies and stimulate understanding for educators to use in developing educational programs and processes which will speak to the problem from a pedagogical, curricular, and institutional perspective (Marderness, 2000). Indeed, mathematics anxiety is an affective issue that must be addressed not only by students but also by educators (Koelling, 1995).

McLeod (1992) contends that affective issues play a central role in mathematics learning and instruction. Moreover, the National Council of Teachers of Mathematics expresses the importance of affective issues by including two goals related to affect in their 1989 Curriculum and Evaluation Standards for School Mathematics: (1) students should learn to value mathematics; and (2) students should become confident in their ability to do mathematics (NCTM, 1989). Likewise, the Principles and Standards for School Mathematics, released in 2000, builds on and consolidates messages from previous NCTM documents by stating that knowing mathematics can be personally satisfying and empowering. “…those who understand and can do mathematics will have significantly enhanced opportunities and options for shaping their futures.” In this document, standards for grades preK through 12 include (a) providing environments where thinking is encouraged, uniqueness is valued, and exploration is supported (p. 73); (b) providing instruction that is active and intellectually stimulating (p. 142); (c) seeing to it that mistakes are seen not as dead ends but rather as potential avenues for learning (p. 145); (d) providing rewards for sustained effort and progress, not the number of problems completed (p. 145); (e) recognizing sensitivity of individuals to peer-group perceptions (p. 210); and (f) encouraging confidence in each student’s own mental and physical
capacities (p. 287). The *Principles* emphasize that, when mathematics is made interesting and relevant, “many apparently uninterested students can become quite engaged” (p. 371).

Tobias (1990) calls for more individual attention and support, more meaningful and appealing introductory mathematics courses, and greater guarantees of welcome and success by colleges and universities. The intimidating, competitive and selective characteristic of most mathematics courses is seemingly designed to winnow out all but the *top tier* [italics added] of students. Tobias calls this an outsider-insider problem where an individual can only join the insider group by demonstrating mathematical prowess, something perceived to be unattainable by many non-traditional age students.

Educators have the power to affect mathematics anxiety (Fiore, 1999; Forbes, 1988; Marable, 1994). A change must take place and it has to start with the mathematicians and the teachers of mathematics (Smith, 1994; Stodolsky, 1988). Anxiety in any subject area hinges on a student’s belief in his or her ability to master the concepts. On the average, students like mathematics in the elementary grades but when the content and level of abstractness increases in junior high and high school, they lose interest and perceive mathematics as a negative entity. As their dislike increases, so does their judgment of the subject’s difficulty. A concomitant belief that ability plays a critical role in learning mathematics is also a part of this picture (Stodolsky, 1988). Studies have shown, however, that aptitude, i.e., intelligence, is hindered by emotional factors. Intrusive worries about mathematics temporarily disrupt mental processes needed for doing arithmetic and drag down mathematics competence. Students find it difficult to hold new information in their minds while simultaneously manipulating it.
This capacity, known as working memory, is crucial for dealing with numbers (Bower, 2001).

The theory that there is a relationship among working memory, mathematics anxiety, and performance is supported by recent studies conducted by Ashcraft and Kirk (2001) on college students. In this study, 66 participants were administered mathematics anxiety and working memory tests. It was found that there is a reduction in the available working-memory capacity of high-mathematics-anxiety individuals when their anxiety is aroused.

This reduction should depress levels of performance in any math or math-related task that relies substantially on working memory, including not only addition with carrying, but presumably any counting-based task. It specifically includes math in which procedural knowledge is essential, for example, situations requiring carrying, borrowing, or sequencing and keeping track in a multistep problem….The anxiety reaction is one of attention to or even preoccupation with intrusive thoughts and worry. Because such thoughts and worry are attended, they therefore consume a portion of the limited resources of working memory. This reduces the available pool of resources to be deployed for task-relevant processing….Math anxiety, when aroused, functions exactly like a dual-task procedure; that is, performance to the primary task is degraded because the secondary task, the anxiety reaction, compromises the capacity of working memory. The draining of resources implies continued, inappropriate (and self-defeating) attention to the cognitive components of the math-anxiety reaction and to intrusive thoughts, worry, preoccupation with performance evaluation, and the
like….The effect may be the result of an inability to inhibit attention to intrusive thoughts or distracting information or, perhaps equivalently, a failure to focus attention and effort on the task at hand. In either case, the available processing capacity of working memory is compromised, with transitory but important effects on cognitive performance (Ashcraft & Kirk, 2001, p. 236).

Students who have a low sense of efficacy to manage academic demands are especially vulnerable to achievement anxiety (Bandura, 1997).

Academic activities are often infused with perturbing elements. Many parents impose on their children stringent academic demands that are difficult to fulfill. Accomplishments that fall short of those standards are devalued and lead to unpleasantness at home. A similar drama is played out in schools, where academic deficiencies displease teachers and lower status and evaluation by one’s peers. To add further to the stress, students who adopt stringent standards for themselves, as indeed many do, must contend with self-censuring reactions to their own substandard performances as well as with the reactions of others….The stakes become considerably higher at upper levels of schooling where performance grades determine entry to future pursuits that affect life courses….Academic deficiencies foreclose many life paths and erect barriers to others that are difficult to surmount (Bandura, 1997, p. 235).

The influence of efficacy beliefs on anxiety over scholastic activities has been examined most closely in relation to mathematics, where a low sense of mathematical efficacy is accompanied by high mathematics anxiety (Betz & Hackett, 1983).
Individuals experience high anticipatory and performance distress on tasks in which they are inadequate, but as their self-efficacy increases, their fear declines (Bandura, 1982).

A final perspective offered for mathematics anxiety is the idea that much of mathematics anxiety is due to test anxiety (Bandura, 1997; Furner, 1996). There is evidence that males and females differ in their responses to evaluative pressure and performance outcomes. When confronted with actual or potential failure in important achievement situations, boys have been found to engage in behavior indicative of increased achievement, while girls often display the opposite tendency (Dweck & Gilliard, 1975).

Hembree (1990) did a meta-analysis on the nature, effects, and relief of mathematics anxiety, integrating the results of 151 studies. Under the general heading of anxiety, two subconstructs specifically relating to academics were identified: mathematics [italics added] anxiety and test [italics added] anxiety. Test anxiety, according to research conducted by Liebert and Morris (1967), consists of two components: emotionality [italics added], behavioral in nature, and conscious worry [italics added] or concern, a cognitive element. This theory conceptualizes an “interference model of test anxiety, in which test anxiety disturbs the recall of prior learning, thereby degrading performance” (Hembree, 1990, p. 34).

An alternative deficits [italics added] model was proposed by Tobias (1985) that points to poor study habits and test-taking skills as the culprits causing low test scores. Within this model, test anxiety does not cause poor performance; the reverse is true. An awareness of doing poorly in the past causes test anxiety.
Hembree came to the following conclusions after doing the meta-analysis: (a) mathematics anxiety depresses performance; (b) mathematics anxiety is related directly to debilitating test anxiety and inversely to the anxiety drive that facilitates performance during testing; (c) females displayed higher levels of mathematics anxiety than males, especially in college (the highest levels occurred for students preparing to teach in elementary school); (d) higher achievement consistently accompanies reduction in mathematics anxiety; and (e) treatment can restore the performance of formerly high-anxious students to the performance level associated with low mathematics anxiety (Hembree, 1990).

*Teacher Influence on Students’ Attitudes*

One cannot go very far in reviewing the literature on mathematics education before being confronted with issues regarding teacher behaviors that produce anxiety responses in students. Teachers are considered to be a major force in contributing to student achievement, more important than either the method or curriculum (Greenwood, 1984; Swetman, Munday, & Windham, 1993). Certain personality traits of teachers are related to mathematics anxiety in their students (Norwood, 1989; Spanias, 1996). Jackson and Leffingwell (1999) investigated types of teacher behaviors that created or exacerbated anxiety and found that anxiety-producing problems occurred in three primary clusters of grade levels: elementary level, especially grades 3 and 4; high school level, especially grades 9-11, and college level, especially freshman year. Teaching behaviors that caused students to have anxiety in mathematics classes were classified as either overt or covert. Although the behaviors at all three levels were fascinating and thought-provoking, concentration will be directed to responses at the college level.
In the Jackson and Leffingwell (1999) study, 27% of 146 students indicated that their freshman year was the starting point of mathematics-related stress. Students could not understand some teachers because of their poor pronunciation. In some cases, English was not the teacher’s first language. The speed at which lectures were delivered was too rapid for some students. Students were told to leave class if they did not understand the material. Teachers belittled students for not having the prerequisite knowledge. When seeking assistance, students were often told that the teacher did not have enough time to help them. One teacher said, “If you don’t like math, get out.” Students were told to go to the mathematics lab if they were that “dumb” (Jackson & Leffingwell, 1999, p. 3). Teachers gave poor explanations or rushed through explanations. Relying on assumed prerequisite knowledge, teachers told students that they should know the material. If they did not, then the teacher did not have time to waste on them. Teachers did not explain material sequentially or at an instructional pace that was understandable. One college teacher wrote equations with one hand and erased them with the other hand as he proceeded, without concern for students’ needs. Students saw long and complex tests as punishment and as a vindictive form of retaliation against students who asked questions. Some teachers were offended at having to teach entry-level mathematics classes and vented their frustrations on students. Teachers told female students that girls should not take mathematics classes. Teachers used a condescending and demeaning manner to tell female students that because they did not understand the lesson in class, the teacher would explain it after the lecture. Teachers showed insensitivity to students who were older than the traditional 18-to-22-year-old bracket when these students expressed anxiety about returning to school after many years.
Overt, or observable, behaviors can be either verbal or nonverbal; for example, a teacher might scowl, use belittling humor, interrupt or allow peers to interrupt, attribute success to luck, beauty, or relationships rather than talent, or make a derogatory comment. Covert behaviors, although veiled, can have the same detrimental effects as the overt behaviors. These include failure to respond to a student’s question, relying heavily on worksheets without explaining content, asking easier questions, making seemingly helpful [italics added] comments, doubting accomplishments, expecting less, giving less feedback, less criticism, less help, less praise, avoiding eye contact with students or sighing in a demeaning manner (Jackson & Leffingwell, 1999). Because mathematics requires sequential-thinking skills, any stress in the mathematics classroom will have even more adverse effects because of the nature of the subject (Zaslavsky, 1994).

The results of Jackson and Leffingwell’s study have significant implications for mathematics instructors. Students tend to internalize their teachers’ interest in, and enthusiasm for, teaching mathematics. Conversely, if students think that the teacher is not happy teaching and does not enjoy being with them in the classroom, they will be less motivated to learn. The survey of student responses showed that the negative memories were so profound that mathematics anxiety could persist for 20 or more years (Ernest, 1976; Hanson & Gentry, 2001; Jackson, 1999). Teachers can help enhance students’ valuing of mathematics in several ways, including explicitly relating the value of mathematics to students’ everyday lives, making mathematics personally meaningful, and counseling students about the importance of mathematics for various careers (Eccles,
Female mathematicians frequently cite inspirational teachers as being a major factor in their choice of career and significant role models (Leroux & Ho, 1994).

In a qualitative study of female mathematics majors at a very competitive college, Gavin (1996) found that almost half attributed their decision to major in mathematics to the influence of a high school teacher. They needed someone outside of their family to tell them that they had mathematical talent and should continue to pursue it. Students mentioned female mathematics professors who served as mentors and role models in college. In addition to encouraging students, their styles of teaching also provided a nurturing environment where students felt free to ask questions (Gavin, 1996).

Because teacher attitudes toward mathematics, positive or negative, can affect students in a similar manner, it is important to note the extent of literature on the anxiety of mathematics teachers at the elementary level (Allen, 2001; Richardson, 1980; Sachs, 1994; Swetman et al., 1993; Trice & Ogden, 1987; Williams, 1988). Allen (2001) concluded that although mathematics anxiety is prevalent among citizens of our country, nowhere is it more prominent than in America’s elementary-level classrooms. By examining 43 mathematics autobiographies of female elementary school pre-service teachers, Allen’s results identified experiences with mathematical content as a significant predictor of mathematics anxiety for both mathematics specialization participants and those who selected a specialization other than mathematics. In addition, the study showed that mathematics anxiety and participants’ experiences with mathematics content were significant predictors of mathematics avoidance behaviors. Sachs (1994) investigated the degree of mathematics anxiety in a group of elementary education students (pre-service teachers) and found that two-thirds of the group had moderate to
high anxiety, blamed their instructors for it, were low in confidence, and rarely took part in class discussions.

It appears that correction needs to be made in the training and preparation of elementary education teachers; however, changing the long-standing attitude of someone who has maintained and fostered a negative attitude for years is a difficult task. As far back as the 1960s, research directed toward improving attitudes toward mathematics in elementary school teachers was conducted (Dutton, 1962) with discouraging results, suggesting that attitudes developed early and maintained over many years can be difficult to change.

Research conducted in the 1980s (Kelly & Tomhave, 1985; Larson, 1983; Martinez, 1987; Trice & Ogden, 1987; Widmer & Chavez, 1982) reveals mathematics anxiety was “rampant among elementary teachers” (Swetman et al., 1993, p. 422). Current research on mathematics anxiety indicates that females suffer more than males, and because many elementary teachers are female, it is not surprising that a high degree of mathematics anxiety is found among elementary teachers (Swetman et al., 1993).

Even more alarming is the fact that mathematics anxiety usually results in mathematics avoidance. “The tragedy of this situation is that prospective teachers who avoid taking mathematics courses are not as well-prepared to teach it as they could be” (Swetman et al., 1993, p. 422). Trice and Ogden (1987) found that teachers who were most intimidated by mathematics planned less time for mathematics instruction and were observed teaching non-mathematics content during the time allocated for mathematics. The researchers also discovered that this avoidance of mathematics conveys a negative attitude toward mathematics to the students. The scenario becomes a vicious circle:
mathematics-anxious teachers communicate a negative attitude toward mathematics to the students, who in turn take fewer mathematics courses and then proceed to become ill-prepared mathematics-anxious teachers who create more students who are mathematics-anxious (Swetman et al, 1993).

Most educators recognize the importance of affective variables in the learning process; there is an emotional side to learning as well as cognitive (Hodges, 1983). Teachers who provide supportive, encouraging environments attempt to increase student confidence levels and improve achievement and interest in the subject matter. Providing the right [italics added] environment, however, can be complicated, because students respond to stimuli in varying ways. Competition may provide motivation for some students, whereas for others, competition may appear personally threatening. Individual attention, while considered a plus to many students, may cause others to be embarrassed and feel “on the spot” (Marderness, 2000).

Quality in Mathematics Education

Mayhew et al. (1990) share a perplexing dilemma that concerns the importance of intellectual dexterity with numbers and other abstract symbols. They correctly recognize that in a society dominated by science and technology and likely to be highly dependent in the future on computers, the need for mathematical ability is obvious. They also correctly identify a pervading fear and dread of mathematics, not only in high school dropouts, but also in the general population:

It has been urged that all students should have four years of mathematics in secondary school followed by more mathematics in college. Unfortunately, such
a recommendation runs counter to the rather deep-seated fears and feelings of antagonism regarding mathematics that exist in the larger society (p. 86).

Quality in mathematics education may be taking a new turn, as evidenced by articles such as the one by Berkman (1995), suggesting that the mathematics curriculum be centered on cooperation rather than competition. Competition implies that learning mathematics is being able to come to a solution quickly. This error in thinking denies learners a deeper understanding of the subject. Berkman says too often instructors are driven by coverage of material rather than comprehension/mastery. If mathematics is boring, monotonous, routine, and uncreative, by all means, get it over with as fast as possible. But, if mathematics is interesting, useful, entertaining, and pertinent to our lives, then teach it at a pace that allows students to enjoy the process and achieve confidence and mastery. Most curriculums pack too much information into too little time, at a significant cost to the learner (Brooks, 1999). Students must be given problems to explore rather than tasks to complete, which produces understanding of content rather than mere memorization (Schroeder, 1998).

Teachers’ beliefs shape the way in which they teach mathematics (Carter & Norwood, 1997; Reyes, 1980). Teachers communicate expectations in their interactions with students during classroom instruction, through their comments on students’ papers, when assigning students to instructional groups, through the presence or absence of consistent support, and in their contacts with significant adults in a student’s life. These actions also influence students’ beliefs about their own abilities to succeed in mathematics (NCTM, 2000). Students learn mathematics through the experiences that
teachers provide. The teaching they encounter in school shapes their understanding of mathematics, their disposition toward mathematics, and their confidence in mathematics.

NCTM’s vision for mathematics education, strongly influenced by constructivist views (Oxford, 1997) and described in *Principles and Standards for School Mathematics* (2000), is quite ambitious and brings with it a commitment to both equity and excellence. NCTM shares with students, school leaders, and parents the responsibility to ensure that all students receive a high-quality mathematics education, in environments that are equitable, challenging, supportive, and technologically equipped for the twenty-first century (NCTM, 2000). The *Principles and Standards (PSSM)* describes the mathematical content and processes that students should learn. The six principles for school mathematics address the following themes: (a) equity; (b) curriculum; (c) teaching; (d) learning; (e) assessment; and (f) technology.

*PSSM’s* equity principle states that all students, regardless of their personal characteristics, backgrounds, or physical challenges, must have opportunities to learn mathematics, and receive the support necessary to achieve success. This principle challenges a pervasive societal belief in North America that only some students are capable of learning mathematics. This belief leads to low expectations for many students, including females (NCTM, 2000). To accommodate students effectively and sensitively, teachers need to understand and confront their own beliefs and biases.

*PSSM’s* assessment principle focuses on more than just using tests to certify students’ attainment. Assessment should be an integral part of instruction that informs and guides teachers as they make instructional decisions. Assessment should not merely be done *to* [italics added] students; rather, it should also be done *for* [italics added] and
with [italics added] students to guide and enhance their learning (NCTM, 2000).
Assessment and instruction must be integrated so that assessment becomes a routine part of the ongoing classroom activity rather than an interruption. Such integration provides information teachers need to make appropriate instructional decisions (NCTM, 2000).
Teachers should be gathering information continually about students’ progress by asking questions during the course of a lesson; in fact, a type of evaluation might include dialogues between teacher and student in order to assess thinking. Research indicates traditional testing may not always provide a true picture of student learning. Teachers can use a variety of testing techniques: asking oral questions, observing student demonstrations, having students keep a mathematics portfolio or journal. Assessment is more than a test that is given at the end of a chapter (Steele & Arth, 1998).

As the NCTM Principles and Standards are implemented across the United States, the way in which they are accepted and put into practice will depend largely on the beliefs that teachers have about mathematics and the teaching of mathematics.

For example, the view of learning mathematics from a constructivist approach, that is, having children construct their own knowledge about mathematics may precipitate a large gap between teachers’ beliefs and their cognitive understanding of the recommendations of the Standards (Carter & Norwood, 1997).

Although an instructor may be in concurrence with the goals of a new way of teaching, he or she may not be willing to change the strategies that have been used for years, and may have no problem ignoring methodologies listed in the reform material. Routine operations become highly ritualized; a lesson plan is in place that is repetitive, predictable, and hence highly resistant to change. Faculty members value their autonomy
highly and guard vigilantly against attempts to limit it. Sometimes this attitude takes the form of blind resistance to almost any change (Astin, 1985). At the root of much resistance are issues of power, control, and vulnerability (Lucas, 2000). Furthermore, one could argue that the hierarchical organization of American higher education is resistant to change. “Intellectuals who have achieved power and influence in the larger society have a stake in accepting and perpetuating the status quo, no matter how much in need of reform or renewal it may be” (Astin, 1985, p. 192). Most colleges still maintain considerable control over their most vital functions, two of which are course content and teaching techniques (Astin, 1985).

Cohen and Ball (1990) agree that strategies, philosophies and content recommendations in the NCTM *Principles and Standards* are not simply excised and inserted into the classroom experience. Sometimes the changes made may be superficial or incomplete. For example, some of the pedagogical ideas may be enacted without sufficient attention to students’ understanding of mathematics content (NCTM, 2000). Teachers continue to behave and teach in accordance with their existing beliefs built by their own personal experiences unless there is a powerful reason to change. The recognition for the need to change is a mandatory first step (Carter & Norwood, 1997).

*Constructivist Approaches to Learning*

Constructivism is an educational theory which argues that students are motivated to learn only if they are active learners, constructing their own knowledge through their own discoveries. All learning is digested by the learner and understood in relation to what the learner already knows (Oxford, 1997; Ravitch, 2000). What students *know*
[italics added] consists of internally constructed understandings of how their worlds function. New information either transforms their old beliefs or fails to do so.

Belenky et al. (1986) emphasize the potency of connections in learning. Linking topics to students’ lives is a prerequisite for the most efficient learning of abstractions. Mathematics becomes exciting when it is not divorced from other subject areas and when it is linked to the real world. This type of curriculum honors the learning style of females (Karp, Brown, Allen, & Allen, 1998).

Constructivists would agree that the dynamic nature of learning makes it difficult to capture on assessment instruments that limit the boundaries of knowledge and expression (Brooks, 1999). Emphasis on performance usually results in little recall of concepts over time, while emphasis on learning generates long-term understanding.

Some formal knowledge is also involved. For instance, in mathematics, students must be engaged in active problem solving which requires that they master the basic skills of adding, subtracting, multiplying, and dividing. In other subject areas, such as the social sciences, helping students search for personal understanding and valuing different, often contrasting, points of view is reasonable (Brooks, 1999). However in mathematics, in many cases, there is only one correct answer, with multiple avenues leading to its discovery. Acknowledging that there exists only one correct answer is what makes following constructivist approaches in mathematics classrooms a challenge. It is up to the teacher to ensure that the truths [italics added] arrived at in the classroom are consistent with disciplinary knowledge (Prawat, 1992). Boeree (2007) believes that rote learning, i.e. the memorization of facts, will always be with us. However, it is not
entirely devoid of meaning. “The trick is to encourage students by making the necessity of the rote learning meaningful.”

There is a difference between talking at and talking with students, both in “giving students opportunities to invent mathematics and in encouraging positive beliefs about learning mathematics. Students should see their job not as finishing assigned tasks but as making sense of, and communicating about, mathematics” (Clements, 1997, p. 200). The classroom environment should be perceived as one in which students are free to explore ideas, ask questions, and make mistakes (Cobb, 1988).

Yager (1991) asserts that constructivism requires a dramatic change in beliefs about education. Putting the students’ efforts to understand ahead of the traditional telling-listening relationship is paramount. Most agree that this involves a decisive change in the focus of teaching and the role of the teacher (Prawat, 1992). The traditional telling-listening relationship between teacher and student is replaced by one that is more complex and interactive. “Teachers who take this path must work harder, concentrate more, and embrace larger pedagogical responsibilities than if they only assigned text chapters and seatwork” (Cohen, 1988, p. 255).

As previously stated, in order for teachers to accept such significant change, their beliefs about teaching and learning must change dramatically. First, there is the tendency to think of both learning and content as fixed entities, rather than dynamic and continually undergoing change and revision (Prawat, 1992). Second, there is the tendency to equate activity with learning instead of seeing that student engagement is not the best measure of educational value. Third, there is the popular view of curriculum as a fixed agenda with certain material to cover at all costs. Constructivists favor a more
interactive and dynamic approach to curriculum, believing that it should be viewed more as a matrix of ideas to be explored over a period of time than as a road map (Prawat, 1992).

A constructivist approach enabling students to understand may be accomplished by (a) seeking out and using student questions to guide lessons, (b) accepting and encouraging student initiation of ideas, (c) promoting student self-regulation and action, (d) using students’ experiences and interests to drive lessons, (e) encouraging uses of alternative sources of information, (f) using open-ended questions and encouraging student elaboration when possible, (g) encouraging students to suggest causes for events and situations and to predict consequences, (h) seeking out student ideas before presenting ideas from the text, (i) allowing time for reflection and analysis, (j) facilitating reformulation of ideas in light of new experiences and evidence, and (k) encouraging social interaction (Clements, 1997; Yager, 1991).

Some would caution that constructivism is not an instructional approach; it is a theory about how learners come to know (Airasian & Walsh, 1997; Clements, 1997). Since knowledge is constructed by the learner, constructivism makes the assumption that all students can and will learn. The vision of the constructivist student is one of activity, involvement, creativity, and the building of personal knowledge and understanding (Airasian & Walsh, 1997). “In the constructivist approach, we look not for what students can repeat, but for what they can generate, demonstrate, and exhibit” (Brooks, 1999, p. 16).
Mathematics Education Initiatives

Failure in mathematics can be the limiting factor in an undergraduate’s choice of major (Berenson, Carter, & Norwood, 1992). Because many people perceive mathematics as a barrier that needs to be hurdled in order to gain entrance to their selected careers, programs have been developed and some are just beginning to help show the relevance, utility, and criticality of mathematics. These truths must be demonstrated to students, parents, advisors, faculty in other disciplines besides mathematics, and to administrators. Sensitivity to gender and age are imperative (Hovis, Kimball, & Peterson, 2003). The following are current mathematics education initiatives, some still in experimental stages, that are tackling long-standing perceptions about mathematics as a barrier.

National Council of Teachers of Mathematics. With the release of Curriculum and Evaluation Standards for School Mathematics in 1989, the National Council of Teachers of Mathematics (NCTM) moved to the forefront of efforts to improve mathematics education in the United States and Canada. The Standards were the result of three years of planning, writing, and consensus-building among the membership of NCTM and the broader mathematics, science, engineering, and education communities, the business community, parents, and school administrators (NCTM, 2000). In 1991, NCTM published the Professional Standards for Teaching Mathematics (PSTM), which was produced as a companion to the Curriculum and Evaluation Standards and whose goal was to provide guidance to those involved in changing mathematics teaching. The Assessment Standards for School Mathematics, released in 1995, established objectives against which assessment practices could be measured. These documents are based on
the assumption that all students are capable of learning mathematics. In 2000, NCTM released *Principles and Standards for School Mathematics*, which is a compilation of the lessons learned and experiences gained since the first document was written. It delineates six Principles that should guide school mathematics programs and ten Standards that propose content and process goals. The newest innovation from NCTM are the E-Standards, an electronic edition of *Principles and Standards*, with interactive applets, short videos, and links to other resources. NCTM’s efforts in addressing reform in mathematics education have been making a difference, influencing state standards and curriculum frameworks, teacher education and classroom practice. *Principles and Standards* has provided a catalyst for the continued improvement of mathematics education.

*American Mathematical Association of Two-Year Colleges—Crossroads in Mathematics.* In 1995, seeking to bridge a gap in mathematics programs between high school mathematics and college calculus, the American Mathematical Association of Two-Year Colleges developed standards known as *Crossroads in Mathematics*. Educators became aware of the fact that each year greater numbers of students were entering college mathematics starting below the level of calculus, yet very few were persisting to higher levels. This situation is still occurring and the failure of many of these students to persist in mathematics not only prevents them from pursuing their chosen careers, but it also has a negative impact on our nation’s economy as fewer members of the workforce are prepared for jobs in technical fields. A second standards document, *Beyond Crossroads*, was developed in 2006 to renew and extend the goals of the first document which were to address the special circumstances of students who are enrolled
in introductory college mathematics. The particular type of students addressed in this
document may be described as non-traditional, meaning they “are older, work a full-time
or part-time job while attending college, are returning to college after an interruption in
their education of several years, need formal developmental work in a variety of
disciplines and in study skills…” American Mathematical Association of Two-Year
Colleges [AMATYC], 2007).

The major goals of Beyond Crossroads include improving mathematics education
in two-year colleges and encouraging more students to study more mathematics. One of
the principles of Beyond Crossroads is that there would be increased participation by all
students, specifically referring to women and others who have traditionally been
underrepresented in the mathematics discipline. Standards are presented in the document
for intellectual development, content, and pedagogy. Mathematics education has
traditionally focused on content knowledge, knowing certain pieces of subject matter.
This document takes the position that knowing mathematics means being able to do
mathematics and that problem solving is the heart of doing mathematics. Students should
understand mathematics as opposed to thoughtlessly grinding out answers. The standards
for pedagogy in the Beyond Crossroads are compatible with the constructivist point of
view, which is based on the premise that knowledge cannot be “given” to students.
Instead, it is something that they must construct for themselves. Recommended is the use
of instructional strategies that provide for student activity and student-constructed
knowledge. Furthermore, the standards are in agreement with the instructional
recommendations contained in Principles and Standards for School Mathematics.
Faculty who teach introductory college mathematics must increase the mathematical
power of their students by actively involving them in meaningful mathematics problems that build upon their experiences, focus on broad mathematical themes, and build connections within branches of mathematics and between mathematics and other disciplines. Guidelines for pedagogy include: active involvement of students rather than passive listening, use of technology rather than paper-and-pencil drill, multistep problems rather than one-step single-answer problems, mathematical reasoning rather than memorization of facts and procedures, conceptual understanding rather than rote manipulation, realistic problems encountered by adults rather than contrived exercises, open-ended problems rather than problems with only one possible answer, and a variety of teaching strategies rather than lecturing. These standards provide a new vision for introductory college mathematics focused on the needs of non-traditional-age students who have come into their college experience without the necessary mathematical skill to begin at the college level.

Programs reflecting the original *Crossroads* standards continue to show remarkable results. One such program is the “Womenwin” program at Miami-Dade Community College, in Miami, Florida.

*Womenwin at Mathematics Through Writing.* The Womenwin at Mathematics Through Writing project is designed to help women build on their verbal skills to improve their knowledge of mathematics. Research indicates that writing about mathematics may lead to a better understanding of the subject. Preliminary results show a trend that students in the writing groups are more likely to pass from college-preparatory mathematics to college-level mathematics in one semester; whereas their non-writing counterparts are more likely to repeat college-preparatory course work. The
investigators feel that the “emphasis has moved from ‘calculating’ to ‘understanding’ and great things are happening to the students both academically and emotionally” (Austin & Ballester, 1999, p. 20).

**Developmental Algebra: Restructuring to Effect Change.** Another innovative Crossroads program took place at William Rainey Harper College, in Palatine, Illinois. Objectives of the program included the development of curriculum materials for teachers who want to make changes in the way they teach algebra, particularly at the developmental level. A specific goal was to determine the effect a student’s confidence has on learning. Key to this project was the shift in instructor toward facilitator and the shift in student from passive to active involvement in the classroom. Findings indicate that, although not all faculty and students responded positively to the new structure, those who did expressed empowerment. A field study at several other community colleges around the United States indicated “significant shifts in students’ self evaluation of their abilities to do mathematics following the use of the project materials” (McGowen & DeMaroïs, 1999, p. 26).

**Mathematics for Elementary Teachers.** Providing meaningful mathematics for preservice teachers majoring in elementary education was the principal goal of a two-course sequence developed jointly by faculty at the University of Michigan Flint Campus and Mott Community College. Students worked in groups in an active laboratory setting with discovery-based, hands-on activities. A locally developed instrument called the Mathematics Concept Scale (MCS) was administered to students completing the sequence and also to a group who were still taking the old curriculum. Findings indicated that attitudes toward mathematics of students exposed to the new courses became more
like those of experienced mathematicians, while the attitudes of the students still taking the old curriculum did not change (Sharp & Sutton, 1999).

EQUALS. EQUALS programs, based and coordinated at the Lawrence Hall of Science, University of California, provide workshops and curriculum materials in mathematics for teachers, parents, and community members. The program includes creative innovations such as Family Math I and II, Math Matters BEAM program, and algebra institutes for mathematics instructors. An important focus of EQUALS is to provide ideas on multiple assessment: portfolios, teacher logs, performance tasks, open-ended questions, and student journals. Their concern is that standardized tests are not always understood and are biased against minorities, including females. Their program is ever expanding and is presented on an interactive website.

Project SEED. Project SEED is a growing program whose purpose is to increase the number of minority and educationally disadvantaged youth majoring in mathematics and related fields. The goals of the program are to increase academic self-confidence, develop problem-solving and critical thinking skills, and raise mathematics achievement levels. The program is four-pronged: classroom instruction, staff development, parent workshops, and curriculum development. The parent workshops, covering topics ranging from supporting a child’s mathematics education at home to algebra curriculum designed to help parents increase their own mathematical knowledge, have been enthusiastically appreciated by parents.

The Project SEED specialist works to make the class the arbiters of knowledge so that they feel a sense of ownership in the material. This is in opposition to the traditional focus of teacher as expert. The use of silent feedback hand signals allows students to
constantly interact and provide feedback to one another in a non-disruptive, polite and yet very clear fashion. The constant feedback also allows all students to participate without risk. This risk-free environment then makes it easier for students to take academic risks without fear of embarrassment or humiliation. This provides a setting for social growth along with the development of critical thinking abilities. Various learning and teaching techniques that Project SEED has used to help students develop mathematics confidence rather than mathematics avoidance may support the findings of the proposed study.

What all of these initiatives have in common is their desired outcome: to take the process of “doing” mathematics out of the domain of only a small percentage of the college-prepared, college-ready elite, and place it in the realm of something possible for everyone to achieve, even the at-risk, math-anxious, educationally disadvantaged individual. The programs start with the assumption that studying mathematics can be an enjoyable, rewarding activity, one that is both meaningful and relevant. They demonstrate how mathematics can be integrated with other disciplines. Seeing the need for making mathematics understandable, comfortable, and even fun is a beginning point from which may emerge new ways of teaching mathematics, improving the mathematics curriculum, and fostering an appreciation of mastering mathematical concepts rather than just memorizing how to manipulate numbers.

*Phenomenological Research in Mathematics*

The phenomenological method is useful in cases where a particular type of experience is the subject of scrutiny (Marderness, 2000). Success with this method requires articulate, expressive individuals who have experienced the phenomenon under investigation and who are willing to share, in detail, their stories. Unlike other methods
that are controlled by the researcher, the phenomenological method depends on participants to provide the material for data analysis. In cases where participants cannot contribute detailed description, additional contributors need to be sought. Researchers must be willing to continue the interview process until no new themes surface. In the last two decades, phenomenological research has contributed to the discovery of valuable information useful to educators.

Grood (1985) studied four women over 30 years old and how they each responded to the demands of being college freshmen. The investigation focused on their academically-related behaviors, needs, concerns, and learning styles, as well as their reactions to and interactions with college instructors and younger classmates. Qualitative research methods were employed including: participant observation in the classroom, structured essays, in-depth interviews, and visits to participants’ homes. Results indicated similarities among participants with respect to motives for college enrollment, orientation towards learning, obstacles to schooling, adaptation strategies, interactions with students and teachers, physical concerns, and attributions for academic success and failure. Grood offered implications to educators related to modifications in students’ behavior: creating and maintaining open lines of communication with instructors and classmates, and learning about and availing themselves of the various services offered on campus.

Grood’s findings were further augmented by Schatzkamer (1986). Through a qualitative analysis of in-depth interviews, Schatzkamer attempted to understand, describe, and explain, from a feminist perspective, the educational experience of returning women students in community colleges. She chose a qualitative design because
a quantitative approach “could not tell [her] what [she] wanted to know: the realities of
the experience of another human being and how that person thinks and feels about her
experience” (p. 30). Three 90-minute in-depth phenomenological interviews were held
with each of 18 returning women students at nine community colleges in four states.
Participants were 25 to 70 years of age and had returned to traditional schooling after an
absence of four to fifty years. Findings were reported through profiles, in the women’s
own words (Schatzkamer, 1986).

Although women’s studies are pertinent to understanding self-concept and gender
issues in education, there are other areas of study that relate to both sexes. For example,
Hartman-Abramson (1990) did a study of the phenomenology of mathematics anxiety
and found that it is not uncommon. While she found that earlier studies had been done
using quantitative analysis, she utilized a qualitative approach and focused upon adults’
fear of numbers through the eyes of those who experienced this phobia. Ten
mathematics-anxious persons were selected for the study and represented a cross-section
of any major American metropolitan area: five adults from the United States and five
from other countries (Brazil, Jordan, Lebanon, and the Soviet Union). The information
related by these interviewees was transcribed and distilled into descriptive data. The
material was then analyzed according to the standard qualitative research design of
phenomenological reduction. This technique enabled the researchers to detect nuances of
the experiences of those with numerical phobia. Additionally, this work points to the
sources of mathematics anxiety, reveals aspects of its nature and provides
recommendations for dealing with a fear of figures (Hartman-Abramson, 1990).
Building on Hartman-Abramson’s findings, another qualitative-design study on mathematics anxiety was conducted by Bisse (1994) utilizing focus group interviews with 14 students, and individual interviews with 10 students. The Math Test Anxiety Survey (MTAS) was used to identify mathematics-anxious students at the beginning of the research period and also at the end of the research period to find out if any exposure to developmental mathematics over the length of a summer session had any influence on students’ mathematics test anxiety. The focus group interview and the individual interviews helped to establish categories and sub-categories, which permitted the placement of students’ responses into tables and matrices. Conclusions reflected students’ perceptions in eight categories that were responsible for mathematics anxiety. These conclusions were used to create a profile of a mathematics-anxious student, in terms of worries and concerns. Recommendations addressed necessary improvements of the curriculum, assessment, placement, teaching methodologies, and classroom environment (Bisse, 1994).

Research by Parker (1997) went beyond describing mathematics anxiety and focused on the ways adults overcome it. The purpose of the study was to understand the nature of the transition that adults make as they move from being mathematics-anxious to being more comfortable with mathematics. Parker chose 12 formerly mathematics-anxious adults and conducted a series of semi-structured in-depth interviews and personal documents. Three areas of inquiry were examined: (a) the participant’s mathematical history, (b) how the participant overcame mathematics anxiety, and (c) the impact of overcoming mathematics anxiety. Analysis of the transcripts using the constant comparative method resulted in inductively derived categories descriptive of the
experiences of overcoming mathematics anxiety during adulthood and how those experiences affected the participants’ lives. A six-stage process of overcoming mathematics anxiety was uncovered. First, adults perceived a need to become more comfortable with mathematics. Recognition of the need was followed by making a commitment to address the problem. Third, the mathematics-anxious adults took specific actions to become more comfortable with mathematics. Learning how to get the most out of mathematics, they refined their study techniques, used learning tools, attended tutoring sessions, and applied relaxation techniques. These time-consuming actions required them to make sacrifices. Fourth, the adults recognized that they had reached a turning point and were no longer mathematics anxious. The adults’ mathematical perspectives changed. Finally, the adults became part of the support system for others seeking help with mathematics, just as others had helped them overcome their mathematics anxiety.

In support of further research on mathematics anxiety, a qualitative study was conducted by Zopp (1999) at McHenry County College, a small community college in northern Illinois, with eight students selected to participate. Criteria for selection included being non-traditional-aged (25 and older) and having a high score on the Math Anxiety Rating Scale (MARS). Case study methodology was used whereby three interviews were conducted with each of the participants. Data collected were categorized according to three research questions. Question 1 investigated how adult students describe the causes and nature of mathematics anxiety. Question 2 addressed participants’ perceptions of useful strategies in overcoming mathematics anxiety. Question 3 asked how adult students describe the impact of a program designed to reduce mathematics anxiety. Their responses included feelings about mathematics anxiety,
confidence about mathematics achievement, willingness to ask for help, changing career goals, and connections of mathematics to work and life. The findings in the study are of importance to educators, curriculum specialists, teacher trainers, and all individuals having a role in the education of adult students, especially at the community college level.

Although mathematics anxiety appears to be a common problem for adults, it is not the only problem adult students face when returning to higher education. Ham (1998) investigated the lives and realities of adult basic education learners who had experienced a gap in their schooling. The selected participants were a diverse group, but through their stories, patterns emerged concerning their childhood, their teen years and their adulthood. The study revealed that some of the more difficult adults to reach are returning to school. Caring and competent adult educators must help connect the two worlds. The challenge presented to educators is to make sure that the system does not fail the adult learners in their quest of becoming the ideal—a lifelong learner.

Lang (1999) used a combination of qualitative and quantitative research designs to investigate the various facets of developmental education in community colleges. The study compared the academic performance of students who successfully completed developmental courses with the performance of students who entered the college ready for college-level courses. The qualitative portion of the study consisted of collecting data through a focus group and telephone interviews. Findings indicated that students who were ready for college-level classes were more likely to be white and male than their counterparts who participated in developmental courses. Other factors of age,
socioeconomic level, and entrance to the college by high school diploma/equivalency tests were not significantly different between the two groups.

Theoretical Background for Qualitative Research

Although relatively new in the field of research on teaching, a qualitative, interpretive, phenomenological approach emerged as significant in the 1970s in the United States (Erickson, 1986). The empirical phenomenological approach involves a return to lived experience in order to obtain comprehensive descriptions that provide the basis for a reflective structural analysis that uncovers the essences of the experience. The human science researcher determines the underlying structures of a given experience by interpreting the originally given descriptions of the situation in which the experience occurs. The aim is to determine what an experience means for the persons who have had the experience and are able to provide a comprehensive description of it. Although the interviewer can try to avoid making assumptions and inferences, and will seek to make the meaning revealed by the interview as true to the participants’ intent and reflection as possible, the interviewer must recognize that the meaning is, to some degree, affected by the interaction between the two of them.

From the individual descriptions, general or universal means are derived. The understanding of meaningful concrete relations implicit in the original description of experience in the context of a particular situation is the primary target of phenomenological knowledge (Moustakas, 1994). Thus, the primary concern of interpretive-phenomenological research is particularizability, rather than generalizability (Erickson, 1986). Interpretive research and its guiding theory developed out of interest in the lives and perspectives of people in society who had little or no voice.
The specifics of action and of meaning-perspectives of actors in interpretive research are often those that are overlooked in other approaches to research. There are three major reasons for this. One is that the people who hold and share the meaning-perspectives that are of interest are those who are themselves overlooked, as relatively powerless members of society. [A second reason that] these meaning-perspectives are not represented is that they are often held outside conscious awareness by those who hold them, and thus are not explicitly articulated. A third reason is that it is precisely the meaning-perspectives of actors in social life that are viewed theoretically in more usual approaches to educational research as either peripheral to the center of research interest, or as essentially irrelevant, part of the ‘subjectivity’ that must be eliminated if systematic, ‘objective’ inquiry is to be done (p. 124-5).

Developing the interview as a research method involves a challenge to broaden, and enrich the conception of knowledge and research in the social sciences. The research interview does not only yield qualitative texts rather than quantitative data, but reflects alternative ways of thinking about the subject matter of the social sciences. Many apparently methodological problems do not stem from the relative newness of the interview method or from insufficiently developed techniques, but are the consequences of unclarified theoretical assumptions. The mode of understanding implied by qualitative research involves alternative conceptions of social knowledge, of meaning, reality, and truth in social science research. The basic subject matter is no longer objective data to be quantified, but meaningful relations to be interpreted (Kvale, 1996).
There is a move away from obtaining knowledge primarily through external observation and experimental manipulation of human subjects, toward an understanding by means of conversations with the human beings to be understood. The participants not only answer questions prepared by an expert, but themselves formulate in a dialogue their own conceptions of their lived world. The sensitivity of the interview and its closeness to the subjects’ lived world can lead to knowledge that can be used to enhance the human condition (p. 11).

Qualitative data, in the form of words rather than numbers, have always been the staple of certain social science disciplines, notably anthropology, history, sociology, and political science. However, more and more researchers in fields with a traditional quantitative emphasis—educational studies, for example—have shifted to a more qualitative paradigm (Miles & Huberman, 1994). The strategy of qualitative methods is derived from a variety of philosophical, epistemological, and methodological traditions. Qualitative methods are derived most directly from the ethnographic and field study traditions in anthropology (Pelto & Pelto, 1978) and sociology (Bruyn, 1966). More generally, the holistic-inductive paradigm of naturalistic inquiry is based on perspectives developed in phenomenology (Bussis & Chittenden, 1976; Carini, 1975), symbolic interactionism and naturalistic behaviorism (Denzin, 1978), ethnomethodology (Garfinkel, 1967), and ecological psychology (Barker, 1968) (cited in Patton, 1980). An integrating theme running through these traditions is the fundamental notion or doctrine of verstehen.

The verstehen approach assumes that the social sciences need methods that differ from those used in agricultural experimentation and natural science because human
beings are different from plants and nuclear particles. The *verstehen* tradition stresses understanding that focuses on the meaning of human behavior, the context of social interaction, an empathetic understanding based on subjective experience. The tradition of *verstehen* or understanding places emphasis on the human capacity to know and understand others through sympathetic introspection and reflection from detailed description and observation (Patton, 1980). The *verstehen* tradition is rooted in phenomenology and existential philosophy more generally.

Phenomenology is the sense of understanding social phenomena from the actors’ own perspectives, describing the world as experienced by the participants, with the assumption that the important reality is what people perceive it to be (Kvale, 1996; Moustakas, 1977). Mishler (1986) suggests that stories are a way to knowledge and understanding and move the discussion of interviewing beyond the boundaries set by the traditional approach. Words, especially when they are organized into stories, have “a concrete, vivid, meaningful flavor that often proves far more convincing to a reader—another researcher, a policymaker, a practitioner—than pages of numbers” (Miles & Huberman, 1994, p. 15). Yet, graduate programs in education have, in the past, been almost totally committed to building knowledge in education through experimentation (Seidman, 1998). Although this approach is important and valuable, some researchers do not agree that scientific investigation in this form is the only valid design for inquiry. VanKaam (1966) believes that a preconceived, experimental design imposed on the “subjects” of an experiment, and statistical methods, “may distort rather than disclose a given behavior through an imposition of restricted theoretical constructs on the full meaning and richness of human behavior” (cited in Moustakas, 1994, p. 14). Mishler
(1986) agrees with this thinking and states that in standard interviewing practice, “respondents’ stories are suppressed in that their responses are limited to ‘relevant’ answers to narrowly specified questions” (p. 68).

The essence of the phenomenological method is this: Examine experiences carefully, without theoretical prejudice; discover the essentials of those experiences; and communicate what you discover to others for verification (Boeree, 2007). A phenomenological approach suggests suspending our own theories, expectations, categories, and measurements and going to the source. The aim of this qualitative study was to remain open to the participants’ communications of meaning and at least approach an understanding of their understanding.

Summary

In conducting the review of literature and considering the current environment of questioning of our nation’s educational goals and how we will reach those goals, it appears that this study was very timely. It is clear that our country needs as many talented students as possible to pursue mathematics and science at advanced levels; yet it is clear that fewer girls and women are pursuing majors and careers in these fields. They remain, at least in the minds of many women, a male domain. A low academic self-concept in many women, low self-efficacy, stereotyping, and socialization factors are evident and tend to preserve the status quo. Debilitating mathematics anxiety paralyzes many students and frustrates their efforts to succeed. Teachers play a critical role in influencing female students either positively or negatively. Mathematics initiatives have increased awareness of inequities and promoted new ways of teaching and new approaches to learning, including constructivist methods of classroom interaction.
Due to the valuable contributions phenomenological research has made in the area of mathematics education, it appears that a qualitative research design was a valid process which has allowed the researcher to share, to a degree, in the actual experience of the participants. The strengths of qualitative research lie in its inductive approach, its focus on specific people describing their experience as they see it, and its emphasis on words rather than numbers (Maxwell, 1996). Since this study is concerned with discovering and understanding the phenomenon of mathematics avoidance or mathematics confidence, a topic that is often sensitive and ambiguous, the phenomenological approach seemed especially appropriate. An open-ended questioning of this phenomenon, as opposed to a more traditional survey and analysis of quantitative data, has provided a greater opportunity for the researcher to understand participants’ perceptions of their experience, unravel some of the factors contributing to it, and translate this understanding into greater sensitivity to students’ needs.
Chapter Three

Method

Problem

It is clear that our country needs as many talented students as possible to pursue mathematics and science at advanced levels in high school, college, and graduate school. Yet, in the last few decades, it has been clear that fewer girls and women are pursuing majors and careers in either mathematics or science (Reis & Park, 2001). Women are more educated, more employed, and employed at higher levels today than ever before, but they are still largely pigeonholed in *pink-collar* [italics added] jobs, according to the American Association of University Women (AAUW) Educational Foundation report, *Women at Work (2003)* [italics added]. The report goes on to say that the new high-tech economy is leaving women behind because they don’t have the keys to open the door to this high-tech sector of the work force. National census data show that the highest proportions of women with a college education are still in traditionally female careers: teaching and nursing (AAUW, 2003).

A report by the National Research Council, entitled *Everybody Counts*:* A Report to the Nation on the Future of Mathematics Education*, emphasizes that undergraduate mathematics—the mathematics of the college experience—is vitally important, perhaps even more than elementary or secondary school mathematics. “More than any other subject, mathematics filters students out of programs leading to scientific and
professional careers. From high school through graduate school, the half-life of students in the mathematics pipeline is about one year…” (Smith, 1994, p. 135).

Undergraduate mathematics is the linchpin for revitalization of mathematics education. Not only do all the sciences depend on strong undergraduate mathematics, but also all students who prepare to teach mathematics acquire attitudes about mathematics, styles of teaching, and knowledge of content from their undergraduate experience. No reform of mathematics education is possible unless it begins with revitalization of undergraduate mathematics in both curriculum and teaching style (cited in Smith, 1994, p. 135).

For a myriad of reasons, mathematics inspires more emotion than any other school subject (Segeler, 1986; Zaslavsky, 1994). Furthermore, anxiety and fear of mathematics may keep a woman from completing her degree program and succeeding in her academic goals. It has been found that women are more likely than men to suffer from debilitating mathematics anxiety (Clewell, Anderson, & Thorpe, 1992; Stewart, 1990; Tobias, 1990).

Purpose

The first purpose of this study was to examine metacognitive and affective factors that are perceived to contribute to mathematics avoidance or mathematics confidence in non-traditional age women attending a community college. The second purpose of the study was to explore and describe the meaning participating, non-traditional age women attach to their experience with mathematics. The third purpose of the study was to determine the relationship, if any, between metacognitive and affective experience in the learning of mathematics.
Research Questions

1. What metacognitive and affective factors are perceived to contribute to mathematics avoidance or mathematics confidence in non-traditional age women attending a community college?

2. What meanings do participating non-traditional age women attending a community college attach to their experience with mathematics?

3. What is the relationship, if any, between metacognitive and affective experience of participating non-traditional age women attending a community college in learning mathematics?

Overview of Chapter

The method for conducting this study is presented in the following eight sections of this chapter. The first section is an introduction explaining the value of a phenomenological approach to in-depth interviewing. Section two describes the study design: the informal conversational interview. In section three, a personal testimony regarding my own experience in learning mathematics is disclosed, followed by a description of the research setting in section four and the selection of participants in section five. The procedure involved in implementing the study is reviewed in section six, including a briefing on the results of a pilot study. Section seven clarifies the way the data were compiled and analyzed. The final section concludes with a discussion of trustworthiness and credibility issues.

Value of Phenomenological Interviewing

Phenomenology is the attempt to describe, rather than explain or analyze, an experience as directly as possible, without any thought about the origin, or cause, or
nature of an experience (Kvale, 1996). Feelings are best described and understood through phenomenological research—in-depth interviewing that investigates, delves, digs beneath the surface to discover and describe what lies beneath a shallow, superficial surface view of a subject. The strength of in-depth interviewing lies in the reality that we can come to understand the details of others’ experience from their point of view (Seidman, 1998). [Interviewing] “has led me to a deeper understanding and appreciation of the amazing intricacies and, yet, coherence of people’s experiences. It has also led me to a more conscious awareness of the power of the social and organizational context of people’s experience. It has also given me a fuller appreciation of the complexities and difficulties of change” (Seidman, 1998, p. 112).

My use of the term **phenomenology** [italics added] primarily refers to the interviewing process based largely on Seidman’s (1998) work. In-depth, intensive interviewing is the major way a qualitative researcher seeks to understand the perceptions, feelings, and knowledge of people (Patton, 1980). The task is to provide a framework within which people can respond in a way that represents accurately their points of view about their world. The challenge is to get close enough to the people and situation studied to be able to understand the depth of what is happening. The aim is to capture what actually takes place, what the participants actually say. The interview data consist of a great deal of pure description—direct quotations from those being interviewed (Patton, 1980).

The commitment to get close, to be factual, descriptive and quotive, constitutes a significant commitment to represent the participants in their own terms. This does not mean that one becomes an apologist for them, but rather that one
faithfully depicts what goes on in their lives and what life is like for them, in such a way that one’s audience is at least partially able to project themselves into the point of view of the people depicted (quoted in Patton, 1980, p. 36).

Educators need this curiosity in order to understand, and thereby to act, to enable students under their guardianship to succeed and thrive in the particular setting, whether that setting is elementary, secondary, or postsecondary education. Understanding and humility are not bad stances from which to try to effect improvement in education (Seidman, 1998).

For investigation of the problem of this research, I found that a quantitative, experimental study could not tell me the realities of the experience of another human being and how that person thinks and feels about his or her experience. Quantitative measures are succinct and easily collected for analysis, whereas qualitative measures are longer, more detailed and irregular in content. Quantitative data are systematic, standardized and presented in tables and charts. In contrast, qualitative data may be difficult to analyze because responses are neither systematic nor standardized. Nevertheless, where it may be possible to discount quantitative data as being biased or rigged (as in what may be perceived as a loaded [italics added] questionnaire), one cannot so easily dismiss the emotions and feelings revealed in participants’ own reflections (Patton, 1980). Consequently, I believe that a qualitative study of in-depth interviews has uncovered what questionnaires or rating scales could not. Prior to conducting this research, I was inspired and guided by comments and concerns of undergraduate and graduate students, faculty members, university professors and
administrators who suggested that a qualitative study of attitudes regarding mathematics would be of interest and value to educators.

This study sought to provide an understanding of factors in the educational experience that are perceived to contribute to mathematics avoidance or mathematics confidence in non-traditional age women attending a community college, and the meanings the participants attach to their experience with mathematics.

An understanding of these factors is needed in educational research, first because they inhabit the “invisibility of everyday life” (Erickson, 1986). Everyday life is largely invisible to us because of its familiarity and because of its contradictions, which people may not want to face. We do not realize the patterns in our actions as we perform them (Geertz, 1984). Second, there is a need for specific insight through documentation of concrete details if one is attempting to understand the points of view of the actors involved. Third, we need to consider the local meanings that experiences have for the people involved in them (such as getting an “F” on a test or being called to the board) because events that seem ostensibly the same may have distinctly differing local meanings to different people. It may be found that the differences in participants’ perceptions of their experiences are quite small and that a small adjustment made by educators may lead to a big difference in student learning.

Study Design: The Informal Conversational Interview

The informal conversational interview is the phenomenological approach to interviewing. The interviewer uses it in order to maintain maximum flexibility to be able to pursue information in whatever direction appears to be appropriate, depending on the information that emerges from talking to one or more individuals in that setting. Most of
the questions flow from the immediate context. Although the interviewer may compose a
standard list of open-ended questions to begin the interview, no complete predetermined
set of questions is possible under such circumstances, because the interviewer does not
know beforehand what is going to happen and what it will be important to ask questions
about (Patton, 1980). The questions may change in response to the distinctive nature of
carrying out the interviews or in response to changes in the researcher’s perceptions and
understandings as the interviews progress (Erickson, 1986). The data gathered from
informal conversational interviews are different for each person interviewed. According
to Patton, the phenomenological interviewer must “go with the flow” (p. 199).

The interviewer is also part of the process and must be disciplined and dedicated
to keeping each interview true to what the participant is saying. On the other hand, the
interviewer must be aware that the meaning is, to some degree, a function of the
participant’s interaction with the interviewer (Seidman, 1998). The challenge is to
minimize any distortion of meaning created by interviewer bias.

When studying data, researchers may use bracketing, which is a mental exercise
in which the researcher identifies, then sets aside taken-for-granted assumptions. It allows
the researcher to complete his or her own reconstruction of the experience under
investigation in order to become aware of personal biases and preset opinions.
Bracketing reveals what “everyone knows,” what people assume but rarely say (Erickson,
1986). For example, one might say, “You’re going the wrong way” [italics added]. Who
is to say that an individual is going the wrong way? If one does not know where that
individual came from or where he or she is heading, who can judge which way is the
wrong way? The [wrong way] then is bracketed. It is held aside from judgment in order
to create a path to a clearer view of something. By doing this, a researcher can understand something on its own terms without interference of his or her own frame of reference.

Another example of bracketing is one that may appear humorous, yet it frequently occurs in households. One might say, “The toilet tissue is on backwards” [italics added]. Who is able to decide the direction of backwards? To one individual the direction appears to be backwards; to another it is certainly not. [Backwards] is bracketed, temporarily suspended from judgment until an investigation has taken place. “Presuming that critical analysis provides new or different data to assess, the release [italics added] of the brackets provides the opportunity for a clash of the old and the new…resulting in yet another new [italics added]…which may or may not culminate in a change of values or position” (Kessel, 2007).

The researcher has made a conscious effort to bracket all presuppositions, standards, and prior commitments, not in order to deny their existence or importance, but simply as a methodological move to see clearly, without bias, what the participants are saying. To accomplish this, I underwent a bracketing interview prior to the beginning of the participant-interviewing phase of the study. This was done with the help of another faculty member at the community college where I am employed. This faculty member holds an Ed.S. degree from the University of Florida and is Director of the college’s Center for Counseling and Academic Development. He is a published author and has 20 years experience in counseling and supervision of student personnel services. The bracketing interview was transcribed and reviewed by me and provided valuable considerations and insights for the study.
Researcher (Jo Ann Rawley)

I am particularly intrigued by a description by Kvale, presenting the interviewing process using a traveler metaphor (1996). The interviewer is pictured as a traveler on a journey that leads to a tale to be told upon returning home. The interviewer-traveler wanders through the environment and enters into conversations with the people. The traveler explores the country, as unknown territory or with maps, roaming freely around the territory. The traveler may also deliberately seek specific sites or topics by following a method of questioning. The interviewer wanders along with the local inhabitants, asks questions that lead the participants to tell their own stories of their lived world, and converses with them. What the traveler hears and sees is described qualitatively and is retold as stories to be shared with the people in the interviewer’s own country, and possibly also to those with whom the interviewer wandered. The potential meanings in the stories are differentiated and unfolded through the traveler’s interpretations and are proven trustworthy and credible by their impact upon the listeners. The journey may not only lead to new knowledge; the traveler might change as well. The journey might instigate a process of reflection that leads the interviewer to new ways of self-understanding, as well as uncovering previously taken-for-granted values and customs in the traveler’s own country. Through conversations, the traveler can also lead others to new understanding and insight.

I have drawn upon many years of experience in tutoring mathematics at different levels—middle school, high school, and college. I have worked with students in middle and secondary school, recent high school graduates, adults returning to college, aspiring teachers, and graduate students studying to pass standardized exams. I am fortunate to be
currently working in a community college where students from all ethnic, socioeconomic, and age groups are represented. I have witnessed many eyes light up as understanding took the place of confusion and fear. Most importantly, I understand how debilitating mathematics anxiety can be from personal experience.

One experience, or defining moment relating to mathematics, occurred in my senior year of high school. Needing another mathematics credit to qualify for entrance as a freshman at Shippensburg State Teachers College, I was placed into a tenth-grade algebra I class. Being accustomed to earning A’s in all of my other courses, I was devastated by the failing grades I was receiving on my algebra tests. I stayed after school to receive additional help from the teacher, only to be more confused after the session was over. Taking tests was a nightmare accompanied by severe anxiety. Even more humiliating was the fact that the students in the 10th grade class seemed to have no problem whatsoever with the material and rarely asked questions. A final grade of a C (a gift) in the algebra class caused a drop in my GPA and placed me fourth in the graduating class. It was not until many years later, in a community college, that a mathematics teacher was able to undo the psychological damage of that high school experience and give me the confidence to pursue mathematics as a career. The teacher thoroughly explained each new mathematical concept, connecting it to previously known and understood concepts. Contextual examples of using this new concept were given on the board and students were given the opportunity in class to practice a problem or two on their own. Each class began by allowing time for questions before new material was presented, thus clearing up misunderstandings and encouraging student feedback. Tests were challenging. However, credit was given for evidence of critical thinking even if the
answer was incorrect. The teacher was available outside of class time to talk. She was interested in students’ goals and encouraged risk-taking and perseverance. In this mentoring role, she remained in contact with me after the class ended and suggested participation in several confidence-building on-campus activities, one of which was helping in the mathematics tutoring center. It is experiences such as the one just described that I hoped would emerge from the participants’ stories and, in doing so, shed light where there was confusion and bring insight, understanding, and motivation.

I identified my interest and my desire to channel it properly in order to minimize any distortion that might have resulted in the way the interviews were carried out. A conscious effort was made to ensure that I was not “reading into” or “interpreting” participants’ comments for them.

*Research Setting: Reading Area Community College*

The study took place at Reading Area Community College in the state of Pennsylvania. The college is approved by the Department of Education of the Commonwealth of Pennsylvania as an institution of higher education, and is authorized to award the Associate in Arts Degree, the Associate in Applied Science Degree, the Associate in General Studies Degree, and the Certificate of Specialization, as well as appropriate diplomas and certificates. The Commission on Higher Education of the Middle States Association of Colleges has granted the college full accreditation. The Associate in Arts (A.A.) degree is designed for students who are planning to transfer to a four-year college or university and carries a requirement of at least 60 credit hours of study, with not less than 15 credit hours earned at the local college. For students not desiring to pursue a bachelor’s degree, the college offers the Associate in Applied
Science (A.A.S.) degree, which broadly prepares students for employment upon graduation and is referred to as a Career Program. The Associate in General Studies (A.G.S.) degree is an individualized curriculum which allows students to design their own degree programs for professional development or transfer and has a minimum course requirement of 60 credit hours, with not less than 15 hours earned at the local college. Certificates of Specialization are designed to give students an opportunity to gain specialized knowledge to advance in their jobs, learn new skills, update the skills they have, or to help them change careers. Many candidates elect to enroll in the certificate program first and then, after completion, continue in the Associate in Applied Science degree. Diplomas offer college credit and provide students with specific technical job skills for workforce entry or promotion.

The college is a publicly-supported, comprehensive community college and serves a student body of approximately 4500 students. It is located in a busy, downtown section of a city, on the banks of a river, which gives it both a vibrant, community feeling, yet one of peace and reflection. Classes at the college are small, averaging 18 students, allowing teachers to get to know each student by name. The atmosphere is friendly and supportive; teachers act as mentors and guides in addition to their teaching responsibilities in the classroom.

At the community college, students are welcomed from all academic backgrounds—with competitive SAT scores or no SAT scores at all. Some are bound for advanced degrees or seeking to refresh their skills, while others may have doubted they were college material [italics added]. For those who wish to continue their education, credits can be easily transferred to other colleges and universities, due to the Academic
Passport program, which guarantees students with associate degrees from the college admission to any of 14 universities in the Pennsylvania State System of Higher Education.

All students are required to take placement tests before registering for credit courses at the college. Based on the scores they receive, students will be advised concerning the appropriate courses to take as they begin their college careers. Such advice is based on test scores and follow-up interviews. In some cases, students may move directly into freshman level English or mathematics courses, in others, they may be advised to consider noncredit developmental courses. One of the college’s institutional goals is to provide students with effective developmental services that link into college level course work and remedial programs that allow them to reach their potential. To achieve this goal, free tutoring and academic counseling are available to everyone on a walk-in basis. Tutoring is offered in a tutorial center where tutors are available during posted hours.

In addition to the walk-in tutorial center, the college participates in three federally funded programs that offer individual tutoring: The Student Support Services Program (SSSP), the ACT 101 EMPHASIS Program, and the Carl Perkins Program. Students eligible for the Student Support Services Program receive personal counseling, tutoring and college success strategies courses free. The ACT 101 EMPHASIS Program provides supportive services for students who have good potential to succeed in college but who need to overcome academic and financial barriers. The EMPHASIS Program is funded by the U. S. Department of Education through ACT 101, the Pennsylvania Higher Educational Opportunity Act of 1971. The Carl Perkins Program provides academic and
counseling support services to academically and financially challenged students who are pursuing technological degrees.

Although there are some support services in place for struggling students, there are no special programs operating expressly for women. Many women do not qualify for individual help and find the hours the tutorial center is open, and the tutorial assistance available, insufficient to meet their needs. Especially in the mathematics area, the supply of tutors cannot accommodate the demand by substantial numbers of students who require one-on-one help. Furthermore, the majority of student tutors may not be sensitive to the unique needs of non-traditional students, which are described in Chapter One. It is expected that the results of this study may provide suggestions to benefit the student support programs at the college.

Selection of Participants

At RACC, students are drawn from a wide surrounding local area as well as internationally. Potential participants for this research were selected from a pool of non-traditional age women who applied to the college and enrolled in a mathematics course. The researcher was not involved in any way with the instruction in any of the mathematics courses. Placement in the participant pool depended on answers to several questions on the college entrance/placement profile. This 28-question profile is called COMPASS and is designed to give information about incoming students, which is then used to anticipate student needs (see Appendix A). The COMPASS data are entered via computer. The researcher used 13 of the 28 questions to determine qualification for the participant pool. Answers to these 13 questions provided necessary demographic information—gender, ethnicity, birth date, parents’ education, size of household—and
uncovered those students who had strong positive or strong negative feelings about mathematics. The researcher selected only those participants who chose mathematics as the subject they would most enjoy or least enjoy (questions 22 and 23).

I wondered if a sufficient number of participants could be obtained from this type of selection process. Therefore, a year before this study was conducted a trial was performed during a six-month period with a sample of over 1200 in-coming college enrollees. One hundred eighty-two students chose mathematics as the subject they would least enjoy; 77% (140) were female and 68 of these were of non-traditional age. Forty-seven students chose mathematics as the subject they would most enjoy; 43% (20) were female and 5 of these were of non-traditional age. Using this trial as a forecaster, I was confident there would be a sufficient number of sample participants from which to draw.

Thirty potential participants were sent a letter through the mail describing the research and were invited to respond by contacting me either by email or telephone. Response to this letter was very low. Only one person contacted me and volunteered to be interviewed. Consequently, telephone calls were made to as many potential participants as could be reached. Three of the participants could not be reached due to phone numbers that had been disconnected. Of the original 30 women, I was able to reach 27. I found that this method of contact proved to be much more successful; all of the persons to whom I spoke agreed to at least stop by my office to discuss the research study. Of the 27 women, 18 agreed to be interviewed. Due to scheduling conflicts and lack of interest on their part, 3 of the 18 were never included in this study.

In gaining access to potential participants and making contact with them, I made every effort to achieve as much equity in the interviewing relationship as possible by
assuring them that the outcomes of this research would in no way affect their grades, that participation was voluntary, and that the results from the research would be kept strictly confidential. I wanted to minimize differences in perceptions of power and authority between the participants and myself. I believe that when the participants saw a genuine interest in getting to know their backgrounds and experience with mathematics, they felt important and flattered that they had been chosen to participate in this research.

Following the initial selection and positive response of each participant, further essential criteria for selection included the following: the participant was willing to engage in an in-depth interview and granted the researcher the right to tape-record and publish the data in a dissertation and other publications. No attempt was made to choose participants based on socioeconomic background or ethnic group.

As soon as prospective participants were identified, a contact visit was set up before the actual interview process began. In these meetings, I explained who I was, what my study was about, how I intended to use the data collected, and the amount of time and the nature of the commitment necessary from participants. The goal was to be explicit about the work and try to create a situation in which the potential participants made an active choice about whether to participate in the study. Once that choice was made, a date and time for the interview was proposed.

After having made contact with each participant, secured her agreement to participate, and set up the time and place for the interview, one final step remained as a bridge between the contact process and the interview process. At the appointment for the interview, but before it actually started, the participant was given a consent form (IRB Adult Informed Consent Form, see Appendix B.). This form served to clarify further the
purpose and nature of the research. Participation in the study was voluntary and participants were free to withdraw from the study at any time.

Using a list of 10 interview questions (see Appendix C) as a starting point, the conversation was spontaneous according to the flow of ideas expressed by each participant. If an interesting comment was voiced, further unplanned questions were posed in order to follow the participant’s line of thought. The interviews were interactive, as the interviewer responded to the participant’s answers, giving feedback when necessary in order to encourage the participant to continue sharing her thoughts and feelings. Feedback might have included comments such as, “How did that […] make you feel?” “Did that […] happen again?” “Thank you for sharing that with me.”

There was no set limit on the length of an interview; length depended on each participant reaching a point at which she had depleted all her descriptions and thoughts regarding the interview questions. A quiet, comfortable environment, free from distractions, was chosen to put participants at ease and facilitate the interview process.

Interviews were taped and later transcribed by me, which provided another opportunity to reflect on participants’ stories. Recording assures an accurate and detailed account, including pauses, sighs, laughter, and so forth. After transcribing the interview, I read it, underlining important passages and assigning a code to each, while comparing the story in front of me to those of previous participants. Aspects of individual experience which were considered important included conflict, both between people and within a person, hopes expressed, language indicating beginnings, middles, and endings, frustrations and resolutions, and indications of isolation as well as indications of community. Gender, class, or ethnic issues that may have arisen were of importance, as
were indications of hierarchy and power affecting the participants’ experience. I strove to include every aspect of the interview that may have proven to be enlightening to those interested in learning about the results of this study. Interviews were conducted beginning in the fall term, 2005, and continued through the fall term, 2006.

I created a profile of each participant’s experience, thus opening up the material to analysis and interpretation. The narrative form of such a profile, written in the first person, allowed me to transform this learning into telling a story. Crafting profiles is a way to find coherence in the events of a participant’s experience and to link such an experience to the social and organizational context within which she operates. In addition to these profiles speaking for themselves I was able to explore and comment on salient issues within individual profiles and point out connections among profiles.

After compiling the data, I shared with each participant the specific material from her interview and removed all identifying data, such as the participant’s name. Participants were requested to examine carefully the description of the narrative derived from their responses, verify accuracy and make any additions and corrections necessary. I did not use any part of a profile that was not verified as accurate by the participant. This verification by participants provided trustworthiness of the data. Based on the visible emotional responses of some of the participants upon reading the transcription of their interview, I was encouraged in believing there was indeed trustworthiness and credibility in the data that had been gathered.

Procedure

The primary source of data for this study was the in-depth interview. Interview questions (see Appendix C) provided a structure for the investigation and were designed
to encourage participants to think about their past life experiences with mathematics and the meanings they made from these experiences. Anfara, Brown, and Mangione (2002) suggest providing readers of a research study with a cornerstone for the analysis of data. In following their recommendation, Table 6 serves to demonstrate how interview questions were related to the three major research questions in this study.

The interview aimed at establishing the context of each woman’s experience—how she came to seek a higher education degree, the reasons she chose to enroll at the college, and what preparation in mathematics she had previously acquired. Questions were asked about her memories, in elementary grades through high school, up until the time she became a college student, going as far back as possible. Some questions were aimed at eliciting descriptions of experiences, behaviors, and actions. Other questions were aimed at understanding the metacognitive and interpretive processes of the participant, delving into what was perceived. These questions focused on goals, intentions, desires, “How could that experience have been made more constructive?” Another set of questions were aimed at understanding the emotional responses of people to their experiences. “How did you feel when…?” “How would you describe your reaction to…?”

Each participant was asked to reconstruct her present experience in her mathematics class by relating stories about it in detail. Some questions were aimed at eliciting descriptions of experiences, behaviors, and actions. “What are your feelings now regarding mathematics?” “Do you expect to be successful in passing the mathematics course you are currently taking?”
Table 6

*Relationship of Research Questions to Interview Questions*

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Interview Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What metacognitive and affective factors are perceived to contribute to</td>
<td>Q2, Q4, Q5, Q6, Q8</td>
</tr>
<tr>
<td>mathematics avoidance or mathematics confidence in non-traditional age women</td>
<td></td>
</tr>
<tr>
<td>attending a community college?</td>
<td></td>
</tr>
<tr>
<td>2. What meanings do participating non-traditional age women attending a</td>
<td>Q1, Q3, Q4, Q5, Q6, Q7, Q8,</td>
</tr>
<tr>
<td>community college attach to their experience with mathematics?</td>
<td>Q9, Q10</td>
</tr>
<tr>
<td>3. What is the relationship, if any, between cognitive and affective experience of</td>
<td>Q2, Q4, Q7, Q9, Q10</td>
</tr>
<tr>
<td>participating non-traditional age women attending a community college in learning</td>
<td></td>
</tr>
<tr>
<td>mathematics?</td>
<td></td>
</tr>
</tbody>
</table>
The interview encouraged the participant to reflect on the meaning her experience held for her—the effect her mathematics performance had on her self-esteem, self-confidence, and motivation. The participant was encouraged to look at how the factors in her life interacted to bring her to this present situation. Questions were asked about self-concept, such as, “Would you define yourself as being smart?” “How do you compare your skills in other areas, such as English, with your skill in mathematics?” “How will your achievement in mathematics affect your career goals?” The data consisted of a great deal of description of people, activities, and interactions as well as direct quotations.

A pilot study with one college student was completed for the purpose of becoming familiar with the interview process and the time required in transcribing the data. I used different questions to ascertain which ones would bring out the most stimulating responses and interactions. Through the pilot study, I learned some of the practical aspects of making contact, setting up the interview, conducting the interview, and using a tape recorder successfully. I spent time to reflect on the experience and make adjustments and revisions based on what was discovered. The pilot study interview lasted for 30 minutes, even though an hour was set aside, and the participant was given time to respond thoroughly to every question. Transcription of the interview took approximately one hour.

The location in which I conducted the pilot study was rather distracting with other students too close by; therefore, I chose a private office to meet with the other participants in my study. I also revised the order of the questions by moving one question to an earlier point in the interview to achieve a better flow of thought.
The process of data collection continued until saturation of information was reached, a point in the study at which the interviewer began to hear the same information reported. In-depth, phenomenological interviewing, applied to participants who all experience similar structural and social conditions, gives great power to the stories of a relatively few participants (Seidman, 1998). A total of 15 participants were interviewed, followed by the important process of reading, modifying and verifying their profiles.

*Data Analysis*

Merriam (1998) recommends that data analysis occur simultaneously with collection. Transcripts of the interviews were analyzed and coded by looking for key themes, underlining statements I felt were significant and making notes in the margins to compare with other participants’ stories. The words that the participants used to describe their feelings were compared and I noted the similarities and contrasts among them. Codes were assigned to responses given by participants; as new or different responses occurred, new codes were added. When all of the interviews were completed, responses were compared and common patterns, or themes, became evident. By paying close attention to the words of the participants, connections and similarities were gleaned. Themes were identified that appeared to be shared by common structural and social forces. See Appendix D for detailed coding elements and patterns. This technique, utilized in this study, is referred to as constant comparative analysis (Glaser & Strauss, 1967), and helped me to assign codes to the data, recognize patterns, and develop themes.

The participants’ stories were written in the form of profiles, or vignettes, short narratives that covered an aspect of a participant’s experience. These profiles present the
participants’ stories in context, using their own words, in first person, to reflect their feelings and realities.

Trustworthiness and Credibility

Ensuring trustworthiness and credibility in qualitative research involves conducting the investigation in an ethical manner (Merriam, 1998). Because human beings are the primary instrument of data collection and analysis in qualitative research, interpretations come directly from their rich descriptions. Therefore, the trustworthiness of this study was determined, in part, by the voiced experiences of the participants themselves. Each participant read the transcription of her interview and then read her profile containing specific quotes from the interview. Each participant was asked to verify accuracy and make any additions and corrections. In the literature, this process is sometimes referred to as conducting member checks.

Creditability was also sought by involving two of my colleagues who read all 15 interview transcripts and independently wrote what each recognized as common meanings and themes expressed by the participants. Their findings were compared with my own and we reached consensus on the final list of themes.

According to Merriam (1998) “rigor in qualitative research derives from the researcher’s presence, the nature of the interaction between researcher and participants, the triangulation of data, the interpretation of perceptions, and rich, thick description” (p. 151). I recognize the possibility of human error in listening to and interpreting the words of the participants. However, being aware of the dangers of bias in interpretation, I did everything in my power to minimize any distortion due to my role in the interview.
Further trustworthiness of participants’ stories is the impact they have upon those who listen to them or read them (Kvale, 1996). As previously stated, I was surprised by the emotional reaction most of the participants evidenced when they read their profiles and the findings produced by this study. Several of the women were overcome with emotion and shared how meaningful this study had been to them personally and how appreciative they were to have had a chance to participate.

There is trustworthiness to the description of the data due to the audio recordings of the interviews and the verbatim transcription of those recordings. As the researcher, I strove not to impose my own framework of beliefs, or my own meanings onto the data; rather I tried to understand the participants whom I studied and the meanings they attached to their words. My questions, for the most part, were not closed, short-answer questions, but were structured to give participants the opportunity to reveal their own perspective.

Credibility of the data analysis is complicated by questions such as, “How do we know that what the participant is saying is true?” “If it is true for this participant, is it true for anyone else?” “If another person were doing the interview, would we get a different meaning?” “If we were to do the interview at a different time of year, would the participant reconstruct her experience differently?” “If we had picked different participants to interview, would we get an entirely dissimilar and perhaps contradictory sense of this issue?” (Seidman, 1998, p. 17). Merriam (1998) contends,

Because what is being studied in education is assumed to be in flux, multifaceted, and highly contextual, because information gathered is a function of who gives it and how skilled the researcher is at getting it, and because the emergent design of
a qualitative case study precludes a priori controls, achieving reliability in the
traditional sense is not only fanciful but impossible (p. 206).

Instead of using the term “reliability” in the traditional sense, Lincoln and Guba (1985) suggest that, with qualitative research, one should judge the “dependability” or
“consistency” of the results obtained from the data. “Rather than demanding that outsiders get the same results, a researcher wishes outsiders to concur that, given the data collected, the results make sense—they are consistent and dependable” (Merriam, 1998).

In attempting to make sense of the credibility dilemma, comparing interviews was a safeguard. Comparison placed participants’ comments in context and allowed for checking the comments of one participant against those of others. Furthermore, reading and verifying the accuracy of the transcribed interview encouraged participants to think about what they had said and correct or clarify anything that may have been ambiguous. Comparison of participants’ interviews, the passage of time over which the interviews occurred (one year), the internal consistency and possible external consistency of the words of the interviews, the syntax, diction, and even nonverbal aspects of the interview all provide a measure of confidence in the trustworthiness and credibility of these data.

Triangulation using multiple investigators and soliciting feedback from them was a strategy used to increase the credibility of this study and identify researcher biases and assumptions. Two of my colleagues studied the transcripts of the interviews and interpreted them independently, giving their own perspective to the findings. The first colleague is a learning specialist employed by the college. This individual holds a BA in Psychology and a BS in Education and is certified to teach in the state of Pennsylvania. She has worked in the field of education for 20 years and is currently responsible for
oversight of the Americans with Disabilities Act and Federal 504 guidelines for accommodations for students with disabilities at a community college. She has previously been employed as a remedial mathematics instructor for adult learners and was responsible for adapting mathematics curriculum to meet individual strengths and needs and for completing skill assessments for students. The second colleague is a professor in the Business Division at RACC as well as coordinator of the Business Management program. In these roles, she works closely with students in both an instructional and advisory capacity. She has had 30 years of experience teaching higher education. She earned a bachelor’s degree in Business Education from Bloomsburg State University, a master’s degree in Counseling at the University of Delaware, and holds a doctoral degree in Adult Education from the Pennsylvania State University. The three of us collaborated and reached consensus on the final list of themes.

Summary

This is a qualitative research study and is not meant to be generalizable since the findings are based on a small, purposeful sample selected precisely because my aim was to understand the particular experience in depth, not to find out what is generally true of the many. The extent to which the findings in this study apply to other situations is up to the people in those situations. A phenomenological approach to in-depth interviewing was used to examine factors perceived to contribute to mathematics avoidance or mathematics confidence in non-traditional age women attending a community college. This approach allowed me to gather descriptive information about the phenomenon of mathematics avoidance or mathematics confidence by interviewing those participants who have experienced one or the other, or possibly both. By using information provided
by the participants, I discovered themes that recurred and were shared. Participants were selected from a pool of students who, after completion of a COMPASS profile, chose mathematics as either the subject they most enjoy or least enjoy. After participating in an in-depth interview, data collected was transcribed, checked for accuracy by each participant, and read by the researcher and two colleagues. Consensus on themes was sought. Comparisons were made among the participants’ stories and the data were coded, analyzed, and crafted into profiles. By sharing common themes from the stories of the participants, factors that contribute to mathematics avoidance or mathematics confidence have emerged from the study and may lead to a better understanding of the phenomena. Identifying such factors adds to or supports the existing literature as well as provides information for educators to more effectively meet the needs of this growing group of students.
Chapter Four

Findings

The first purpose of this study was to examine, by means of in-depth, phenomenological interviewing, the metacognitive and affective factors that are perceived to contribute to mathematics avoidance or mathematics confidence in non-traditional age women attending a community college. The second purpose of this study was to explore and describe the meaning participants attached to their experience with mathematics. The third purpose of this study was to determine the relationship, if any, between metacognitive and affective experience in the learning of mathematics.

This chapter will present profiles of 15 women and findings, using constant comparative analysis, of 15 in-depth interviews. Details regarding procedure and data analysis can be found in Chapter 3. All participants were non-traditional age women enrolled at Reading Area Community College. Interviews were audio taped and transcribed by me. Transcripts were typed with first names only, and in the final form pseudonyms were used.

Interviews were conducted, beginning in the fall of 2005 and ending in the winter of 2006. During this period of time, approximately 4500 students enrolled at RACC for the first time and took the COMPASS placement test. Non-traditional age females who chose mathematics as the subject they would most enjoy or least enjoy were chosen randomly and contacted first by letter, then by telephone. Time did not allow taking note
of those who were not interested in being participants. It could not be expected that randomly chosen adults would cooperate with a researcher unknown to them. It became clear that some degree of personal acquaintance with me was a prior condition to their willingness to participate. Telephone conversations, for the most part, were very productive and, by making voice contact with the women, an initial measure of trust was built. A preliminary finding of this study was that when a student recognizes an instructor’s interest in her or his college experience and when that instructor takes time to make a personal phone call, a powerful impact is made on a student’s self-image and self-efficacy.

The findings are presented in two forms: profiles and themes/sub-themes. Profiles provide a brief description of why each participant was seeking an education and the challenges that each woman perceived as formidable in the path to completion of her academic goals. Themes and sub-themes provide a framework from which to compare and contrast the stories of the participants. Rich description from the participants’ own words allow in-depth insight into the meaning the participants made of their experiences. The themes and subthemes presented represent only the thoughts and meanings that the participants in my study shared and are not meant to be generalizable to other populations. Nevertheless, these themes and sub-themes are a means for those in mathematics education to continue the conversation on the meanings non-traditional age women give to their mathematics experience. There were eight common major themes and six sub-themes as listed in Table 7. The profiles will be presented first (in no particular order), and a discussion of the themes and sub-themes that emerged will follow.
Table 7.

*Themes and Sub-themes*

(1) Acquiring a college education is a personal goal.

(2) Adequate study time is necessary to understand and to retain mathematical concepts.

(3) Experiences with mathematics at an early age remain in one’s memory.
   (a) Poor experience with mathematics at an early age tended to make participants believe they could not learn mathematics.
   (b) Positive experience with mathematics at an early age tended to provide participants a higher degree of self-efficacy in succeeding in mathematics courses.

(4) Parental behavior and expectations play a role in children’s self-perception.
   (a) Absence of parental/family support tended to discourage participants from pursuing further education.
   (b) Presence of parental/family support tended to encourage participants in pursuing further education.

(5) Teacher behaviors and teaching methods matter.
   (a) Negative teacher behaviors tended to cause some to develop poor mathematics self-concepts.
   (b) Positive teacher behaviors tended to encourage some to persevere in understanding mathematics.

(6) Feelings of powerlessness may impede learning mathematics.

(7) Self-esteem can survive in spite of past failure.

(8) Motivation to understand mathematical concepts remained high.
Profiles of the Participants

The 15 participants who were interviewed were all non-traditional age women enrolled at Reading Area Community College. These individual participants included six White, six Hispanic, and three African-American students. There were no questions relating to ethnic background or race, neither was any notice taken or importance placed on these factors for the purposes of this study. Five of the participants had positive feelings about mathematics and ten described their feelings in varying degrees of negativity. Table 8 is an overview of the responses of the 15 participants interviewed in this study.

The following section begins by identifying the voices in the stories that were shared and includes a brief description of each of the participants including an account of why they were seeking a college education and what challenges they were facing in order to provide perspective to the data reported in this chapter. Pseudonyms are used to protect identities and maintain confidentiality.

Individual Participants

Alice is a vibrant, enthusiastic student who had previously worked in several service sector jobs including retail and waitressing. “I love working with people…that’s what I’ve always done.” She said she is pursuing a college education because “whatever I do, I give my 100%. And I decided that, since I do give my 100%, I might as well get paid for my 100%; so that’s why I decided to get a degree. I left my job in order to be able to go to school. So I’m looking at my school as my job. So I want to be able to give myself at least—anywhere from five to eight hours a day of studying, because that’s what I would be doing if I was working.” Alice is currently enrolled in the LPN program at
Table 8.  
Constant Comparative Analysis of Participant Responses

<table>
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<tr>
<th>Most/Least</th>
<th>Pseudonym</th>
<th>Ethnicity</th>
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<th>#2</th>
<th>#3</th>
<th>#4</th>
<th>#5</th>
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<th>#7</th>
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<td>L</td>
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<td>Y</td>
<td>Y</td>
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<td>(J)</td>
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*Key

#1 College a personal goal? (Y/N)
#2 High importance of study? (Y/N)
#3 Experience in past mathematics classes
  P – positive memory
  N – negative memory
Memory from:
  E – elementary
  J – junior high
  H – high school

#4 Parental support/encouragement? (Y/N)
#5 Teacher behaviors important? (Y/N)
#6 Feeling powerless? (Y/N)
#7 Positive self-perception (efficacy)? (Y/N)
#8 Level of self-confidence/motivation
  Y high level
  N lacking high level of confidence

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RACC and notes her main challenge to attaining that degree is passing mathematics.

Sheila is a motivated woman who has a variety of work experience and is “very diversified,” as she describes herself. “I’ve always been very successful in moving up the corporate ladder, so to speak, to some degree. And I get as far…I believe…as far as I can go without a degree….I can never get past the next real level. It’s like somebody doesn’t really take you seriously. So I just made the decision that, after my children had all grown up, that I was going back to school and pursue a degree and see if that does actually make a difference to where I want to go….When you look at my resume, I have a really good variety of work experience, but yet I can’t seem to break into another salary level no matter how much experience I take into a position.”

Sheila continues, “I spend a lot of time [studying] on weekends. I’m tired. I’m at the age where I want to get to work and put school behind me. It’s hard to juggle [family, work and school]…even though my children aren’t little, it’s still hard.” Sheila is currently enrolled in a business management program at RACC and is afraid that mathematics will be difficult for her to master, therefore she has put off taking those courses until the end of her course schedule.

Lisa is a woman of color, born in the Virgin Islands, who always wanted to be the first one in her family to get a college education. After starting on coursework toward a business administration degree, she was forced to quit due to personal problems. “Actually I wanted to have my own business ever since I was in high school, but the business administration part got too hard for me….One of my problems is taking notes [in mathematics class]. I used single sheets [of notebook paper] and I would write down so many notes on it, but then I would forget to put them in the right order and they would
end up being mixed up in other material. I saw others had a spiral notebook and they were keeping their notes in order. I plan on getting a spiral notebook for my math next time.” Despite being out of school for many years, including a period of time serving in the United States Army, Lisa is now enrolled at RACC in the culinary arts program and failed in her first attempt to pass the mathematics requirement.

Courtney is an LPN who feels that her options in the nursing profession are very limited and therefore is back in college to pursue an RN degree. She is 50 years old and was overwhelmed with the amount of prerequisites she needed when first beginning her program. “I determined that I need to study every day—and chunks of time, not cramming the night before [a test]. I realized I had to do it—just continually feed myself the information. For the basics of math course I just drilled myself daily. I learn by the visual and hearing, the two together just work for me.” For Courtney, mathematics and chemistry are her main challenges in progressing toward graduation.

Dianne was a factory worker for years before getting laid off. She is a single mother of three and had been out of school for eleven years when she took her GED and passed. She has positive feelings about mathematics and is pursuing an accounting degree at RACC. “I always wanted to get a degree in something, but it’s hard when you have three kids. At first I wanted a degree in social services and then I looked at their incomes and things and I changed my mind. I decided to go into accounting. I’m not a good note taker but I try to be. I try to write down the important things that I need to know. Eleven years is a real long time span of not going to school at all to going back to school to learn how to do notes and everything like that. It’s like being taught to walk all over again. It’s rough.”
Sue never thought that she would need a college education; however, after losing her manufacturing job, she decided to try her hand at early childhood education. She is a mother of two and a grandmother who took a test through CareerLink at RACC and tested high in the area of working with children. Mathematics is an enigma to Sue because she experiences failure in trying to retain the information she learns in the classroom and tutoring sessions. She described her experience by stating, “I had one-on-one tutoring and I could do the stuff in the tutoring lab and then it just went somewhere… I just couldn’t get it for the test. There would be problems put on the board and I would just go blank. I would just lose it. When asked about her study habits, Sue replied, “I’m really conscious of getting my assignments done just like when I was in school, and I think I’m really even more adamant about it now than when I was in school. Things just have to be so. I’m always second guessing myself and I do ask a lot of questions if I don’t understand anything. Now I’m finding out, after all my terms, that professors are approachable. Before I was really scared—my first two terms I was really scared—but now I’m finding out they’re human and they do the same things and make the same mistakes…and a lot of them share, so it makes you more comfortable.”

Heather, an African-American student, came to RACC after earning a bachelor’s degree in religious studies at another college. Unfortunately, she found that the degree she had did not help her in finding employment. She is currently finishing her two-year degree in general studies and has struggled with the mathematics requirement. She describes herself as “a slow studier.” “Studying comes hard for me when I study by myself. If I study with someone it’s easier, but if I study by myself, it’s hard. I don’t have that attentiveness. Something is lacking…. If we were sitting in a group, I would—
nine times out of ten—lead the group. But if I had to go and study that same information [by myself], I would have a difficult time with that….Test taking has always been hard for me. I have always earned my grades. Everybody earns their grade, but I mean I spend a lot of time in order to earn my grades. So that’s something that’s lacking in my brain or something. I don’t know. I’ve taken all kinds of study tips and clues and sat down with A students and done everything I can to try to enhance my techniques and it’s still my problem.”

Lauren spent many years doing factory work, raised a family, and says that now “it’s my turn.” She works two part-time jobs and takes care of her grandchildren. She is at RACC to earn an RN degree and remembers that her weakness in high school was always in mathematics. When this interview occurred, Lauren had finally passed algebra I after her third attempt. “My study habits are probably not the greatest. But I put time aside for studying because I know that, for every hour of class, I should have two hours of studying at home. And I do work two part-time jobs. I am very glad that the tutoring center is at the college, because I’ve used the math tutoring very much. I’ve felt like it was my second home at times.”

Mary is a single mother with teenagers at home who never thought that she was college material. “I actually did not think about it (going to college) in high school. Eventually I wanted to finish school, get a job, and just work. I was always scared to do more studying as far as school was concerned because I wasn’t quite a smart person or someone who was able to think up the information and put it into play like it was being taught….When I study, I study during my lunch hour and I also study when I go home after I make dinner. I try to stay focused because, when I first came back to school, I was
not that excited at first. But then, once I got in [to college] and I was learning, and
teachers here took their time to actually work with me, I was able to understand what
they were teaching me. So it became very important to me.” Mary is enrolled at RACC
in order “to get a better job…to enhance my clerical skills, communication skills, and that
nature. I always wanted to do it (go to college). I just didn’t get around to do it. Every
time I started school, I had to stop because I had a troubled teenager at home. But once
that was all over with, then I finally enrolled and started coming to school.”

Mary describes her insecurities with mathematics and school in general. She is at
RACC in the office technologies program and has not yet been able to pass the GED test
because of the mathematics section. She is hoping that the developmental mathematics
courses at RACC will help her understand the material well enough to pass it. She has
put off taking those courses and says, “I’m worried now because I’m almost done with
my degree and I fear that starting at the bottom of math and having to take three or four
math classes scares me because, what if I don’t pass the first one. I can’t go on to the
second one. You know…and then I think…well, now if I have to go through all this,
come June I probably won’t be able to graduate. And that has me more scared than
anything else. I’ve done pretty good with all my other classes here at RACC, but math
scares me to death.”

Connie works full-time in a hospital as a nursing assistant, seven days on and
seven days off. She leaves her classroom and goes straight to work. She says, “I’ve been
a nursing assistant for fifteen years, so I’m tired of doing the dirty work. I want
something different. I want to work in an office and just do something different….I
study however I can, because my life is very, very full. I do realize that time
management plays a very important role in school. Sometimes I have to study at work because I work seven days on and seven days off. When I’m working, I leave right from school and go to work. So when I have down time at work, I have to study. When I come home, sometimes I have to study.” Connie is now working on a business management degree at RACC. She is plagued by past memories of school and describes them as “disheartening and…never, never pleasant…I never did math homework because I was very much ashamed because I didn’t understand it and it seemed like I just could never get it.”

Rose is a Hispanic woman who, as a young child, was taken away from her family and grew up as a ward of the state of Pennsylvania, shuffled from one foster home to another until getting married and starting her own family. Her dynamic spirit is evident when she says, “I want to have my children know that they have an educated mother. And I want to let them know that minorities can advance in life…if you have the willpower, you can do whatever you want.” Rose shared an uncomfortable situation in her mathematics class, “The students who had graduated from Reading High had already taken algebra there, but they were taking it again. They had more knowledge of it than I did in certain chapters of the book. I felt a little intimidated…and then especially being older too.” Rose works as a bartender part-time and is at RACC in the general studies program. Despite her difficult upbringing, she has a great love of mathematics and tries to encourage others when they become frustrated.

Brittan is a vibrant Hispanic student who worked in a factory for 17 years until it closed. Her children are grown and her company gave her the opportunity to go back to school for retraining. She has chosen accounting as her major at RACC since she has
always liked mathematics. “I’ve always wanted to be an accountant. But I had kids, and they were first, and I just continued to work.” Brittan dropped out of school in the ninth grade but never lost her desire to get an education. She is working on completing enough credits to get her high school diploma and is “whizzing through the math…I had no problem…I picked up everything that I didn’t know before. So far I have a 97.5% average in my class.”

Dorothy is a high school dropout who went back to get a GED later in life. It took her three years to pass the GED test because of the mathematics section and she says she has “blocked out” all of her high school memories and is very afraid of mathematics. “I really want to learn it now. I’m scared, but I want to….Math, that’s my only main concern. I can read. I can write. I can do a lot of things. But math, it’s just…” A busy mother of five girls, Dorothy is enrolled at RACC to earn a degree in counseling and aspires to be qualified to work with troubled teens someday.

Jennie is finishing a degree at RACC after many years of “on and off,” taking classes and working full-time while raising a family. She enjoys mathematics and the challenge of earning good grades. “Yes, I enjoy the challenge of passing my tests. Sometimes, when my class is in the morning, usually I get up earlier and I try to study one hour before I come to classes (because at that time my children are sleeping and they let me study). Sometimes when I finish my class and I have some time—half an hour, one hour—between classes, I take a little chance there and I study a little bit. Finally, nighttime when my husband comes home at eleven o’clock and my children are in bed again, that’s when I do my homework.” She hopes to earn a high enough GPA to graduate with honors.
Barbara grew up feeling she was not a good student in high school and therefore would never be a good student in college. After working in an accounting department for years, at the urging of her supervisor, she enrolled at RACC and is now pursuing an accounting degree. “I was encouraged by my supervisor to do it (enroll in college). I think that he saw something in me that I didn’t. I always had the thought…both my sisters went to college and I always thought about it—or wished I had—but thought I couldn’t…because I wasn’t a good student in high school, I just didn’t think I’d be a good student here.” Barbara is finding that her experience is far different than she had imagined and that she is succeeding in all of her courses, including mathematics. “I make sure I do my homework. I usually do that at my first opportunity. I think I’m pretty good with my study habits. I think I really apply myself well to study.”

The following section presents eight major themes and six sub-themes that were evident in comparing and contrasting the 15 participants in this study.

**Presentation of Themes and Sub-themes**

The themes and sub-themes presented are not meant to be representative of the thoughts and feelings of all non-traditional age women enrolled in a community college. What I purposefully set out to do was to be true to the participants I interviewed. The constant comparative analysis (technique described in Chapter Three) of interviews with 15 participants revealed eight major themes and six sub-themes (see Table 7).

**Theme 1: Acquiring a college education is a personal goal.**

Ten of the 15 participants described their motivation to enroll in the community college as a personal goal (see Table 8), not just to earn more money. Most of them wanted more rewarding jobs, offering security for themselves and their children.
Alice described herself as the type of person who is not interested in doing things half-heartedly when she said, “I would have to say the reason I am pursuing a college education is because I feel like, whatever I do, I give my 100%...and I might as well get paid for it...I love helping people.”

Sheila, Lauren, and Mary all waited for their turns to go to college. Sheila stated, “I just made the decision that, after my children had all grown up, I was going to go back to school and pursue a degree.” Lauren was emphatic when she said, “My children all went through college and I thought it was my turn. Even though my youngest thought it was a little too late to start now, I said, ‘No, I don’t think so!’ I’m giving it a shot. And, I’m amazed at how well my grades are...because they’re better than when I was in high school.” Mary recalled, “Every time I started school, I had to stop because I had a troubled teenager at home. But once all that was over with, then I finally enrolled and started coming to school.”

Lisa’s hope as a young woman was that she would be the first in her family to get a college education. That hope was never realized, due to several personal set-backs, however, now she is renewing her dream and is moving through her program one course at a time. She works a part-time shift at a large, downtown hotel, walking to work in the dark at 5:30 a.m. each morning, then back home again, covering the ten-block distance to her modest apartment.

Barbara watched as both her sisters went off to college while she did not. “I always had the thought [to go to college]...I wished I had [gone to college]...but thought I couldn’t....I wasn’t a good student in high school, so I didn’t think I’d be a good
student here....I thought I’d be the one always behind and not doing well. Kind of like high school all over again. But that’s not been the case.”

Heather has made her choice to be a lifelong learner. She already had one degree when she enrolled in college for a second. She shares, “I wanted to be more qualified for the challenge that I was facing.” Heather faced down an instructor who told her she was never going to be able to pass his mathematics class and, thanks to her determination and many hours spent in the mathematics tutoring lab, she proved him wrong.

Rose felt it was her duty, as a mother and member of a minority, to get a college education. “I want to have a better future. I want to have my children know that they have an educated mother…and I want to let them know that minorities can advance in life…and that’s why I’m doing it.”

Jennie is in college to make her father, her husband, and her daughter proud of her. “I owe it to my father…I want to give him that gift. Secondly, my husband, ...and I want to have my diploma hanging there to show to my daughter.”

Five of the participants had other reasons for coming to the community college, including needing better jobs or being forced out of their workplaces due to global competition, requiring them to seek training in alternate careers.

Theme 2: Adequate study time is necessary to understand and to retain mathematical concepts.

When asked for a description of their study habits, 13 of the 15 participants recognized the need for time management skills in order to schedule adequate study time (see Table 8, p. 123).
Alice said she was “…looking at my school as my job. So I want to be able to give myself, at least, anywhere from five to eight hours a day of studying, because that’s what I would be doing if I was working. I’m usually either at home or I’m here at the [math tutoring] lab. So I usually get about three hours a day in the lab and then the rest of the time I get at home studying.”

Five to eight hours of studying seemed like quite a lot to me, until I heard Heather’s response to my question. “I study all day, all night, all the time (laughs). I like to study immediately after my courses. While it’s still fresh in my mind I like to work on it. For me, the library is my study place. What I do is rewrite my notes and questions. And I review the work periodically so that I’m not cramming for exams. I think I take pretty good notes. I would say, per class, I study at least three to four hours. They say you need one or two hours [for every hour in class]. I need much more than what they say that you need….I’d need at least two times more.”

It was clear that Sheila had given studying a lot of thought when she said she had “tried several different [study] techniques, and what works for me is to go over it all and then I stop. And I come back the same day and go over it a little bit again….I absorb more if I continually go back and go over it…the more I see it, the more it registers for me…the more times I see it, it’s almost photographic in my mind.”

Barbara emphasized, “I make sure I do my homework. I usually do that at my first opportunity. I think I’m pretty good with my study habits. When I get to school early, I get it out. I look over it again. And before a test, I’ll probably go through all the chapters and do those reviews. So I think I really apply myself well to study….like over
the weekend, maybe I’ll sit there for an hour, and then I’ll go outside and walk
around…play with the dog or something…then I’ll come back to it.”

Sue said she was “really conscious of getting my assignments done just like when
I was in school. And I think I’m really even more adamant about it now than when I was
in school. I ask a lot of questions if I don’t understand anything.” When asked
specifically about mathematics material, she shook her head, “With math it was
just…constantly I had to be at it. I did the CDs. I was in the tutoring lab. Anytime I
wasn’t in class, I was in the tutoring lab.”

Courtney’s response was much like Sue’s. “Quickly I determined that I need to
study every day…and chunks of time, not like cramming the night before. I realized I
had to do it…just continually feed myself the information…with the CDs on the
computer or reading, or whatever. Just everyday I would do a little bit….Those CDs that
come with the books reinforce the learning. I learn by the visual and hearing…the two
together just work for me.”

Lauren, although working two part-time jobs, found time to study. “I put time
aside for studying because I know that for every hour of class, I should have two hours of
studying at home….I try to put an asterisk on my notes where a teacher emphasizes
something and I’ll jot that down maybe at the top of my paper when I rewrite my notes so
that it stands out for me. I can’t just hear it and then have it. I have to read it a couple of
times. I do take notes…I have to. And that’s very important.”

Mary took her homework along to work. “When I study, I study during my lunch
hour and I also study when I go home after I make dinner.”
Rose wanted a “silent place” to study. She studies “at night, because it’s always quiet. [I study in] small bits, because I get a little wound after studying long periods of time, so I break everything down into certain times.”

In contrast to Rose, Jennie said she “needs noise.” “I either need the TV on or the radio.” She steals whatever amount of time she has to study. “Sometimes, when the class is in the morning, I get up earlier and I try to study one hour before I come to class…because at that time my children are sleeping and they let me study. Sometimes when I finish my class and I have some time…half an hour, one hour between classes…I take a little chance there and I study a little bit. Finally, nighttime when my husband comes home at eleven o’clock and my children are in bed again, that’s when I do my homework.”

Brittan surprised me when she said, “Well, to be honest with you, I think I study too much…only because I haven’t been in school for so long and there is nobody home….I have a computer room and I sit in there and I’m constantly, constantly doing homework. I always pushed my kids, ‘You have to do good.’ So now it’s my turn and now it’s like, ‘I have to do good.’”

Two of the participants responded to my study habits questions a bit defensively. Connie reminded me that “I study when I can, because my life is very, very full.” Likewise, Dorothy talked about her busy, noisy household and said she liked studying but “after while I get bored.”

Theme 3: Experiences with mathematics at an early age remain in one’s memory.

Eccles (1989) argues that initially, boys and girls are alike in their perceived mathematical capabilities, but girls begin to lose confidence in their mathematics ability
as they move through the lower grades into high school. Why should this be the case?

Poor experiences with mathematics at an early age undermined confidence and increased mathematics anxiety for several participants.

Sub-theme (3a): Poor experience with mathematics at an early age tended to make participants believe they could not learn mathematics.

Of the 15 participants interviewed for this study, 10 participants had memories of poor experiences dating back to their years prior to community college enrollment (see Table 8, p. 123).

Alice said her earliest memory of mathematics was in fourth grade. “I don’t think it was a good memory. I didn’t grasp it. And, I wasn’t made to learn it. They just said, ‘OK, just move her to the next grade.’”

Sheila remembers, “Math was never a good subject for me. I really didn’t struggle until the eleventh grade. I went to vo-tech…half a day we went to vo-tech and the other half we went to the high school. But, because I was majoring in chemistry, I had math at vo-tech. But I decided, when I wasn’t doing well…and the chemistry teacher said to me, ‘You know what; you’re doing great in theory, but I don’t think you’re gonna pass this because you can’t get the math.’ So I figured I’d go back to Reading High and just do general courses to just meet the math requirement.” (Interviewer note: At that defining moment, Sheila gave up her desire to pursue the field of chemistry.)

Lisa remembers feeling “left behind in my math somewhere in elementary school….In high school I had a teacher…and he taught algebra. He taught OK, but, to me, the book was hard. When he taught, it’s like you have to learn that math in the same day he taught it…because you’d do the homework, and he’d teach you something else the
next day. That was hard…it was hard on me…and I’m not even sure I really got it. I could have gone on to trigonometry, but I chose not to go on in math…I took a vo-tech course instead of taking math. I was just tired of math…it was so difficult. I just needed more time with it and somebody who really cared about me.”

Courtney, when recalling her first memories of mathematics, said, “Yes, I remember having to count the haystacks…or bundles of tens…those confused me so much. And it…forget it…plus I was a year younger than the rest of my classmates. I don’t know if that was why, but I just couldn’t get the concept of those bundles. I felt a lot of anxiety…performance anxiety…big time.”

Sue remembers “being in first grade. I can remember my teacher…she was great with the ruler. And if you didn’t add right, you got smacked on your hands with the ruler. And then every teacher along the way would try and sit and help me…and it’s like…the foundation wasn’t there. Then, when I was in fourth grade, we moved from one school to the other and they were a little farther ahead, and I just felt like I never caught up with that…I always seemed like I was behind.”

Lauren shares an experience in the tenth grade. “I had a bad experience in tenth grade. I got the answer that he (the teacher) wanted, but I did it my way…but he wanted it in algebraic form…and I just could not understand how to break it down and put it in algebraic form. He called on me and made me go up to the front of the class to the blackboard. He had a problem on the board and I put down the answer and I turned around and sat down. And he made me come back up in front of the class and asked me why I did that. And the different questions he asked me…the kids were laughing at me…and I said that’s the only way that I understood how to get the answer. And he
literally made an ass out of me. And he…I don’t know what you want to call
it…badgered me, belittled me, to the point where I stood there and cried. And I just had
a problem with algebra from there on…nothing was clicking for me.”

Barbara recalls a ninth grade algebra class, “I just failed miserably. I don’t know
what my grade was, but it was horrible. I remember the teacher…and I don’t know if she
didn’t want to bother to help me…I don’t know. I couldn’t get her to help me. I
remember her being up at the board talking but I probably just tuned out because I didn’t
understand what she was saying.”

Five of the 15 participants either lacked any negative memories from their past
schooling or had positive memories to report. Dorothy, for example, was not able to
recall any memories relating to mathematics. Even after attempting to prod her to
remember either a classroom experience, a particular instructor, or any experience at all,
she only replied, “I don’t remember, I mean, maybe I block it out (laughs), but, I don’t
know…I’m scared of math.”

Sub-theme (3b): Positive experience with mathematics at an early age tended to provide
participants a higher degree of self-efficacy in succeeding in mathematics courses.

Four of the 15 participants had positive memories of learning mathematics. Rose
remembered her love of fractions in elementary school. “I love fractions. I don’t know
why, but I love fractions…division, multiplication, addition, subtraction…algebra?…so-
so, but if I work hard enough, I can advance in it as well.”

Brittan said she “always liked math. Always, always. But I don’t remember any
of my teachers’ names. But I was always getting good grades in math. I know that there
was a teacher there but that’s all I know (laughs)….I’ve always liked learning math.
When the kids were in school…when they needed help with their homework, [I helped them]. I also do a lot of budgeting with different [friends of mine]. [If] they can’t make it with the money that they’re making, I will go to their house, and fix it up for them. I helped out quite a few people….It gives you a good feeling. …And I started thinking, ‘Now, wait a minute! I should be getting paid for something like this (laughs)!’

Some of Jennie’s memories of mathematics were related to her father, who sat down with her and was “the first one who showed me the math.” She also remembered a Chinese teacher, “I loved the way he taught. And I’ll always remember him.” Earlier in her life, she recalled, “When I was back in my country…me and another guy…we were the smartest in the classroom. She (our teacher) invited us to go to her house and she would teach us what to do. So he was the smartest one of the guys and I was the smartest one of the girls. So the teacher used to teach us, and then we used to go back to the classroom…we used to tell them in our [italics added] way….I felt proud.”

Dianne remembered that she “always enjoyed math. I remember one day we were learning numerators and denominators and that just came so easy to me. Those were one of my favorites and I remember my teacher teaching that. I always had good grades in math. But you put me in English or social studies and I wasn’t good with that.”

**Theme 4: Parental behavior and expectations play a role in children’s self-perception.**

It was noteworthy that only five of the 15 participants gave positive responses to my question, “How does (or did) your parents feel about your math performance in school?” (see Table 8, p. 123)
Sub-theme (4a): Absence of parental/family support tended to discourage participants from pursuing further education.

Alice recalls that her parents were no help in the academic area. “I don’t think that our education was an interest of my mom’s…not so much that it wasn’t an interest but just that she didn’t have time. She ran her own business at the time to keep a roof over our heads and she just didn’t have the time to help us. So there was no one there to help.”

Sheila felt her parents just didn’t care. “Honestly, and I think it reflected [in my attitude]…my parents didn’t care one way or the other. My mom only had a seventh grade education and didn’t know to get involved. My father, on the other hand (I was the youngest out of four brothers), …I think I came along at a time in my family’s life when, for my father, it was—I don’t want to say it was a chore—but it was just, ‘Quick, she’s the last one, let’s get her on her way and if she just gets through…’ I can recall that my father worked as a draftsman so I automatically assumed that he was very good with numbers, and he probably was, but just a poor teacher. And he could not teach me math. He used to get extremely frustrated and there would be many times when he would just slam the book closed and say, ‘I can’t do it!’ You know, he would get frustrated. And I think subconsciously that—to this day—that has led me to believe that I don’t like math. Psychologically I feel like I’m never going to be good at math. If you don’t get encouragement—you don’t need a tickertape parade—but you need some kind of reinforcement.”

Lisa, Mary, Connie, and Rose also came from families that lacked formal education. Lisa stated, “My mother only had a fifth grade education. She tried to go back
to school, but, for some reason, she stopped. She never really attempted to teach me anything.” Mary was fortunate enough to have an older sister to help her get her homework done. “My parents, they dropped out of high school real early. They had to go to work back in Puerto Rico so they didn’t get a whole lot of education. They would ask my sister to help me.” Connie said her parents “didn’t even complete high school. So that’s a motivation for me to keep going on. I want my children to go to college. I don’t want them to have to struggle. I don’t want them to have to go through some of the things that I had to go through. I was never encouraged at home. …They (parents) couldn’t give me what they didn’t have.” Rose couldn’t look to her parents for help. “When I studied, I studied by myself. My parents weren’t very knowledgeable with school. I was an honor student in school. I was actually showing my parents how to do this stuff.”

When asked about her parents’ behavior, Courtney regrettably shared that, “They kind of just told me I was stupid. ‘You know you can do better.’ But I didn’t really have the tools to do better. I didn’t know how to get better with what I was doing in school.”

Sue recounted her memory of her parents by saying, “My mom had mental problems and my stepfather cared for her most of the time. I just felt education was just never a big point…it was, ‘You’re going to work in a factory like your mother did and you’re gonna get married and have babies…and, what do you need an education for?’ And they had no patience. My stepfather taught me to drive because my mother said she wouldn’t have any patience. To the day she died, the woman never drove in the car with me. So that’s the way things were. Nobody ever said, ‘Have you considered education?’ It was like, ‘OK, you’re going to get good grades, but yet we’re not going to give you
time to do your homework and get your homework done right, because you’re going to have to take care of the kids so that I can take my medicine and go to bed.’ So I really didn’t have the time that I could have put in to be a really good student when I was going to school.”

Lauren said her parents “had no clue at all what algebra was all about. And I didn’t know how to explain…and maybe I got some feedback from them as to what they thought about that kind of math, which kind of stuck with me also…their negative view of it. ‘You’re not going to need that in a factory.’”

Barbara said that her mother “just threw her hands up and didn’t know how to help me. And I just fell by the wayside all the way around when it came to math. I can’t remember my dad ever doing any kind of homework with us.”

Sub-theme (4b): Presence of parental/family support tended to encourage participants in pursuing further education.

In contrast to the 10 participants who shared there was no parental help given, Jennie’s experience was positive. “My father used to sit down with me. He used to show me the Roman numbers. My father showed me that until I could do it…division and all that stuff. My father was the first one who showed me the math. My father educated me from the beginning, since I was real small. He is very proud of me now.”

Dorothy remembers that her parents “were constantly always after me. Both my mom and dad said, ‘You need your education to get ahead.’ Also my older brother and sister would help me [with math]. I might have gone to them for math help, but I can’t remember much of it.”
Heather recalled that she did not feel any pressure to perform in school. She only spoke about her mother, who “thought she was good at math (laughs) but she wasn’t all that hot (laughs). She tried to help me with long division…and she stayed up all night…and it was the wrong answer…we still laugh about it to this day.”

Brittan and Dianne both said that although their parents were proud of them as students in school, it was their brothers and sisters who provided encouragement when it came to education in general.

**Theme 5: Teacher behaviors and teaching methods matter.**

Responses of the participants in the study revealed a common belief that a teacher can make a difference, that good teachers can build confidence in mathematics ability and help relieve anxiety, while poor teachers can have a devastating effect on students.

*Sub-theme (5a): Negative teacher behaviors tended to cause some to develop poor mathematics self-concepts.*

Connie stated, “I know that the instructor plays a major role in the learning process for me. A lot of instructors figure you get it or you don’t. It’s so frustrating to a student who doesn’t get it to have that look. Body language plays a major role in teaching. I mean, if you look at someone like they’re crazy because they don’t get it, how to you think that makes that person feel if they already have no self-esteem in that area of their life? I don’t have a problem with instructors being on top of me. Of course, that’s not their job, but sometimes it helps. Just because we’re adults, doesn’t mean that we sometimes don’t need that extra push.”

Sheila recalls her junior high teachers, “Believe me when I tell you, when I got to junior high, the teachers, I’d have to say, weren’t great. They were nothing to hoot and
holler about, believe me. And I didn’t just think that then. As I’ve gotten older and was able to go back and look and think—are some people just like that? Are some teachers just like, ‘Oh, go away,’ and tune you out, so to speak? If you wanted to go into the classroom and put your head down for the entire period, you could put your head down. It didn’t phase them.”

Upon entering the community college, Sheila encountered a challenge relating to her mathematics instructor’s teaching method. “I felt like we were kind of all over the place—chaotic and not methodical. We were in this chapter and then we were in the back of this chapter, but then we would come to the front of this chapter. And, in my mind, things go like this (participant gestures), so when you go to the back of the chapter, I’m already out of sync. I want to know, ‘Why are we back here?’ To me, if that was part of the chapter, shouldn’t it have been at the beginning? I got very disorganized, very out of sync. I would ask questions and I would only know how to ask them how I was processing them in my head. They may not have made sense to that instructor, but it was the best way that I could communicate where I was in the problem. And it’s hard when you’re trying to communicate like that and the person you’re communicating to isn’t getting you. So now it becomes an even more frustrating situation.”

Lisa spoke about a teacher she had in ninth grade. “She could have simplified the learning. All she did was follow the book…whatever the book taught.”

Barbara recalled a teacher in a ninth grade algebra class. “Oh I just failed miserably. I don’t know what my grade was, but it was horrible. I remember the teacher, her name was Mrs. P. And I don’t know if she didn’t want to bother to help me…I don’t know. I couldn’t get her to help me.” When I asked Barbara if she had actually gone to
the teacher to ask for help, she replied, “Yes, and I just remember getting an answer that I
didn’t really understand, so I just gave up. I remember her being up at the board talking,
but I probably just tuned out because I didn’t understand what she was saying.”

Mary blamed a teacher she had in tenth grade for insisting that students come up
to the board and do the math. She failed to get the correct answer “so he had someone
else come up and do it.” Mary felt her learning experience could have been more
constructive if the teacher, “knowing that I didn’t know how to do it, maybe working
with me and showing me, instead of having someone else do it.” After that experience,
Mary never asked for help because “as far as math was concerned, I just felt that I
couldn’t do it at all.”

Sue related a conversation she had with her mathematics instructor at the
community college. …”It doesn’t look like you’re going to get anywhere, Sue. If you
want to keep coming to class, fine. But the way you are in class, I’m really worried about
you. I can see when you come in [to class], you get so nervous. It’s not that you’re
stupid; some people just cannot grasp it.” Sue shared that she was “really afraid of her. I
don’t know why. I didn’t really know anything about her. And it seemed for each math
teacher that was the way it was.”

Earlier in her life, Sue had a teacher tell her, “You’re never going to be good in
math, no matter how hard you try, you’re never going to be good in math.” Sue’s earliest
memory of math was in the first grade with Miss F. She remembered that her teacher
“was great with the ruler. And if you didn’t add right, you got smacked on your hands
with the ruler.”
Heather recalled an instructor who “didn’t seem too approachable. He actually discouraged me—or tried to. He made a statement in the class, ‘Those of you that haven’t gotten it this far, you might as well forget it, because you’re going to fail.’ That was a motivating factor for me. I thought, ‘How can you stand up there and say that? The class is not over. Hey, it’s not over until it’s over.’ I didn’t think he had the right and I was determined not to be one of those people that he had crossed off.”

Lauren described an instructor she encountered at the community college. “I’ve had prealgebra with a teacher and she was very demanding. She said, ‘Well, if you can’t get it here in class, then go down to the tutoring center, that what it’s for.’ I knew how long she had been teaching and I thought maybe she needed a break. I don’t think that’s the way you’re supposed to talk to your students to make them feel good about their math. Yes, the tutoring center is there to help us, but I feel that the teacher should have taken a little more pride in the students trying to get it while they’re in her class.”

Sub-theme (5b): Positive teacher behaviors tended to encourage some to persevere in understanding mathematics.

Alice remembers a teacher who “would encourage me and tell me, ‘Oh Alice, you’ve got a mind like a trap. You’re just really good at memorizing things.’ And that just encouraged me to want to do it.”

Connie remembered an instructor who “was just so calm. He wasn’t all over the place. He was just so calm and explained things in a way that I understood it. Sometimes I have to go step by step even with simple things…it has to be step by step.”

Rose spoke of a teacher who “always took the time to show you how to do math and…especially with algebra. That was my hardest subject, but she showed me how to
understand negatives and positives and all that. She was a real good teacher. She was very patient and she explained everything step by step…and she made everything (long pause) clear.”

Brittan shared that she was very pleased with her mathematics instructor at RACC. “There was never one day that I went to the math class that I wasn’t happy with the way she taught me. I understood everything. She made it so much easier to understand….And because I sit up front, she was quick to point to me to answer questions, which was nice. Sometimes I’d be scared, thinking, ‘Oh, I’m not sure.’ But, for the majority of them, I answered them right.”

Courtney remembered a teacher whom she especially liked. “He was really cool. He was a great teacher. He was just relaxed in the way he taught. He was not, ‘You got to get this…got to get this.’ He didn’t pick and choose whom he thought was better.”

Sue described a teacher, Mr. M. who had a positive effect on her. “I sat in the back of the class the first couple weeks and, at the start of the one class, he said, ‘You will sit up front, and you will sit up front the rest of the year, and you will do your homework, you will pay attention, and you will keep your mouth shut so you can work.’ I did good that year and he would help me.” There was another teacher that stood out in Sue’s memory. “I had one teacher who would spend at least five minutes with each child. ‘Did anything happen in the home that you’re upset about? Did you do all your homework?’ Then, as you get older, that’s lost and you don’t feel like you’re an individual. And there are so many other issues with teachers that they don’t have time [to spend with each student individually]. It’s not their fault.”
Lauren struggled to pass her college introductory mathematics course and, after her third try, finally succeeded. She attributes her success to her instructor. “Mr. F. was very, very good. I can’t say that I’ve ever had a math teacher that was as patient as he was. And, if you couldn’t get it one way, and you had a puzzled look, he’d say, ‘Let me try this another way.’ And he would show the problem another way and I’d think, ‘Now that way I can get it.’ And that was wonderful. He took the time. I respect him and I like him. He had homework assignments that we could do and he always said if there were any problems with homework, we’ll go over it in class. He was very relaxed, very positive, very open. He would talk to us, not down to us, not at us. He had a very soft voice. I don’t think he had an anger spot in him. He was just very, very kind, and he understood where some of us were coming from that were struggling. But he also understood the other ones that were catching it and were right with him in class. He was just very understanding. He told me, ‘I enjoyed having you in class and just give yourself time, this will come…you will get it.’ I think he really helped me even out the negative experience I had in tenth grade.”

Dianne liked when her mathematics teacher in elementary school would have contests in the classroom with multiplication flash cards. Prizes were given out to the winners. Dianne recalls “I was fast at that. I know I won a couple of times. I enjoyed the competition.”

*Theme 6: Feelings of powerlessness may impede learning mathematics.*

Although only seven of the 15 participants spoke of feelings of powerlessness regarding their lack of understanding of mathematics (see Table 8), it is included as a
common theme since the particular stories of participants who described such feelings were extremely compelling.

Alice’s interview revealed three serious issues which rendered her powerless. First, she regarded asking for help with her mathematics as a sign of weakness. As a result, she neglected going to the math lab for help until it was too late. She recalls thinking, “They’re going to think you’re an idiot because you don’t know it.” In addition to her reluctance to ask for help, Alice felt her classroom was too crowded. “And that made it very stressful for me, because I just felt like there just was no room in the class. You just felt like…you were just…just so overcrowded. I don’t know, it just made it hard for me to take in the information because the room was so crowded. I felt overwhelmed.” Third, Alice found the presentation of mathematics material very rushed. “I think it was very, very rushed. …Like I ne ver had the algebra before. It was all new to me. That made it more stressful because you didn’t know what to expect.” Because Alice was hindered by her fear to ask for help and because she did not have any control over the size of the class or the speed with which the material was presented, she was, as she saw it, powerless to change her circumstances.

Whenever a test was scheduled, Sheila would rehearse a traumatic scene that had occurred years before, where her father, in frustration, would slam the math book closed because she didn’t understand what he was trying to teach her. “I think subconsciously that…to this day…[that incident] has led me to believe that …I’m never going to be good [at mathematics]. So many things go through my head as I’m studying…you know, the mental block.” Sheila’s debilitating memory of that scene with her father caused her to
experience a mental block, particularly when studying for a test, and she felt powerless to move beyond it.

Sue allowed incidents with fellow students to affect her self-confidence and self-efficacy. She explained, “There was a girl in my class that sat behind me…and the class hadn’t really started and [my instructor] was standing in front of my desk and she was asking how I was doing. I said I didn’t think I was doing very well….I don’t know how the girl behind me got involved, but she said, ‘Well, I surely wouldn’t want an F on my transcript.’ And I turned around and said, ‘Well, do you think I do? I’m sorry if I’m not as smart as you are.’ After class and the girl had left, I was trying to go out of the room quick and [my instructor] said to me, ‘I’m really sorry. You know, not everybody can get math.’…And then I was a little upset because one of my bosses was taking algebra with me…and he was getting it and I wasn’t…and I thought, ‘Uh-oh.’” These incidents, on top of other previous occurrences where she was up at the board and “got an answer wrong and a couple of kids laughed,” caused Sue to lower her expectations that she could understand the mathematics. When I asked Sue how she might have turned these negative experiences into something positive, she replied, “I don’t think there was anything positive to come out of any of my experiences…there was no way I could have turned it around. I didn’t know the answer to the math problem…I had multiplied wrong…and the girl behind me…it was just the way she was so out front with it…and nobody wants to have an F on their transcript…and she really wasn’t involved. She was just, more or less, listening, and I think that’s what really bothered me.” When one is convinced that there is nothing to be done to change a situation, that individual, for all practical purposes, is powerless.
When instructors use their power to embarrass a student, the result can be devastating to the student involved. Lauren experienced extreme embarrassment when, in tenth grade, an instructor used his power to humiliate her in front of the entire class. “Instead of making me feel like a total jerk in front of the class, he could have said, ‘If you don’t understand it, come over to my desk after class and we’ll discuss it.’ I guess I could have been more aggressive and just sit down and not stand up there and take it, but that wasn’t the way I was raised. So I stood there and I was trying to answer his questions, and the more I tried to answer…I was just over my head.” Lauren’s powerlessness to deal with that mathematics teacher still invades her current feelings about mathematics.

Maria was another participant who was embarrassed by an instructor in tenth grade. Her mathematics instructor used the strategy of calling students to the board. “I had an embarrassing experience going up to the board…being told to do a math problem that I didn’t know how to do. That was something the teacher did all the time. He wanted the kids to come up and do the math on the board. I was embarrassed and went back to my seat. So he had someone else come up and do it and show me how it was done.” When I asked Maria how that experience might have been turned into a positive one, she replied that she felt the instructor was unapproachable. When a student sees the instructor as unapproachable, a wall is erected between that student and the instructor. How much learning can take place in such a situation?

Connie expressed the confusion she experienced when the steps to finding a solution to a mathematics problem were explained in more than one way. “I knew the math. It just gets so confusing in my head when I take a test. And I know what I was
doing, but I allowed...if I know how to do something already, it’s not a good idea for me to allow somebody to show me a different way. And I know I tried to perform something on the test [in a way] that I wasn’t really familiar with and it cost me points, which caused me to get kicked out [of the LPN program]. Connie realized that, “The teacher plays a role, but the initial part I have to play. I have to perform. I have to give it back to you. If I’m not understanding it, I can’t give it back to you.” Connie saw herself as powerless to keep new, unfamiliar ways of solving the mathematics from confusing her previously learned method.

Theme 7: Self-esteem can survive in spite of past failure.

In attempting to identify a level of self-esteem which was characteristic of the 15 participants interviewed for this study, the question was asked, “Would you define yourself as being smart?” Twelve gave a positive affirmation to that question. Only three felt that others were much smarter than they. Overwhelmingly the findings seem to uncover the phenomenon that, irregardless of academic performance, the participants deemed themselves to be smart. In virtually all cases, smartness [italics added] was attributed to various accomplishments, other than academic, that these women had experienced.

Sheila asked me to, “Define smart. There are smart people in the world that are very booksmart and are—I don’t want to say stupid—but lack common sense, so I don’t consider them smart. I’d like to think of myself—and I don’t want to sound egotistical—but I am smart. I have some common sense and I have some book knowledge. I’m not a bookworm; I’m not an Einstein, but I’d like to think that I’m smart.”
Courtney proudly answered, “Smart? Yes, smart enough to get the grade I’m getting here at RACC…you got it! I learned—discovered—my learning style. As soon as I started college here, I discovered how I could learn better. Before that, I didn’t know if I was smart enough to do it. But I thought that this was just the right time and the right place…the right time in my life to try.”

Dianne qualified her affirmative answer by saying, “I’m smart in some ways; not smart in other ways. I’m smart as to coming in to my job and with my kids. I’m not stupid or I wouldn’t be where I am right now.”

Sue also said she was smart “to a point. I seem to be better since I came to college because I didn’t know I had a lot of this in me. And I did make the dean’s list! I didn’t apply myself while I was in high school because of family issues…so I didn’t really give it my all. But I now realize that I knew a lot of things. I’m finding out now that a lot of young people that are just coming out of high school really don’t know very much. So I don’t feel that I’m really, really smart, but since I’m coming to college, I’m more aware of knowledge and how to get it. There are two ways of being smart. You can be actual smart that God gave you or you can be smart where you can learn yourself. And, in order to be smart, you have to know how to get that intelligence. One way is to ask questions and read.”

Heather felt she was “pretty knowledgeable and pretty resourceful. I’m a good learner although I’m slow at comprehending. So if you give me an opportunity, given the time, I can understand a lot of things. I not only retain the material, but I think I apply it too. And that, to me, is the most important thing. But a lot of times that doesn’t occur so it hinders me in life, due to the fact that the time and opportunity is not there.”
Lauren said, “I like to think that I’m above average. It doesn’t come easy for me. I do have to work at it. When you say, ‘smart,’ I don’t know exactly which way you mean it—if it’s booksmart or streetsmart. I’m an older student coming back to school and I’ve already raised a family—I have grandchildren…so I think in some instances I may be smarter than some of the younger ones in college. If you ask me if I’m smart—booksmart—I’d have to say that I am above average, yes.”

Connie responded, “Yes, I believe that I am very smart. I have problem-solving skills—maybe not for math—but I have them for life. Like, if this doesn’t work, you don’t stay stuck in the closet, you move on to the solution. I’m very smart; my husband told me so.”

Rose found that question humorous and replied, “I am smart, yes. I have a head on my shoulders. I already have a year in college so, if I wasn’t smart, I wouldn’t even have completed a year. I have a lot of knowledge in a lot of areas, and I never thought I had that…and I do…thanks to college.”

Dorothy and Brittan had similar responses. They both said they were smart “in particular areas.” Dorothy went on to say, “I guess throughout life you learn a lot, especially when you have five girls. You gotta be smart…you gotta be on top of things. So I guess in that way I consider myself smart.”

Jennie shared, “I want other people to tell me I’m smart, not me saying it. I don’t want to show off. Oh, I’m smart. I understand a lot.”

Barbara also answered affirmatively, but went on to say, “I never used to [think I was smart], but yes, I am. I get good grades. I don’t do foolish things in my personal life or financially or anything like that. I think I’m pretty heads up and common sense.”
When I was in school, I didn’t feel that way at all. I have two younger sisters and they’ve both gone to college. My one sister actually is a PhD and she has two master’s degrees. I was always the ‘not smart one.’ I was always better at baking pies and things like that. And so I thought that was my niche…not being smart.”

The three participants who responded negatively to my question gave their reasons. Alice felt, “No. It takes a lot to get into my head…to absorb the information. I’ve got to go over it and over it and over it…it takes me longer than it does the average person, I think. I would define a smart person as one that, when the instructor goes over the information, they’re grasping it right away. Me? I’m like, ‘What are they talking about?’ So then, I mean I just don’t get it that easy, as easy as most people would get it.”

Lisa said she defines herself as “used to being smart. I’m more laid back this time when I study. I’m trying to say to myself, ‘I don’t necessarily have to have an A this time.’ All I want is at least a C to pass the course. Before I think I used to be very hard on myself. But I’ve had some problems in the past…I had two breakdowns…and it will take a while to get used to going back to math. But since I’ve been in college, my environment has proved to me that I can [italics added] read and think.”

Maria was quick to answer, “No, I’m not smart. Sometimes, just like the smallest things, I can turn it into a big task when it’s really only a small task. If I ask help from someone else and they do it, I’m like, ‘O my gosh, I’m dumb! I couldn’t think of that. Why couldn’t I think of that?’ So I don’t think I’m smart at all.”

Theme 8: Motivation to understand mathematical concepts remained high.

One of the most fascinating discoveries made from the interviews of the 15 participants in this study was that, in spite of the sometimes disheartening experiences
throughout their past schooling, in spite of a lack of parental/family support, and in spite of less than desirable behaviors on the part of teachers, and in spite of feeling powerless at times, these women still exhibited a self-confidence and expressed the motivation to and belief that they would succeed.

Alice stated, “Whatever I do, I give my 100%. And I decided that, since I do give my 100%, I might as well get paid for my 100%, and so that’s why I decided to get a degree.” When Alice was asked if she expected to be successful in passing her mathematics courses at RACC, she responded, “Oh, absolutely, absolutely…whatever it takes. I know I have help here, so that’s why I know that as long as I search to get that help, I’m going to get the help that I need.”

Lisa said her feelings about mathematics remained positive. “There’s no reason a woman shouldn’t know as much math as a man, because they go to the same classes, the same schools. They should be able to understand it just as well. That’s why I say, ‘I’ve got to finish my education!’ I’m used to being in the smart group, and then, all of a sudden, all of these things in life get the better of me…and I know fully well I am up to this level. Yes, I’m going to do everything I can to pass it (referring to her mathematics class)!

Courtney said her feelings about mathematics currently are, “Awesome. I love math because there’s an answer…there’s got to be an answer…one answer. Actually what happened is that I fell in love with learning. It’s true. I liked learning about subjects I was interested in, but, to learn about a subject that I wasn’t interest in, and then discover I liked it, was just an eye-opener for me…too much fun. I can do it. I know what I have to do to get it done.”
Dianne stated, “To me, math is easy to learn. It’s always growing…there’s always more and more to learn about math. And you use math every day of your life. I look forward to studying math. I wouldn’t be scared or I wouldn’t back down. I would be looking forward to that (referring to taking mathematics courses). I’m not saying I wouldn’t struggle, but I know that I would be able to do it.”

Sue described mathematics, “It’s a challenge but I’m not going to give up because I need that to graduate. I want to graduate with some kind of a degree so I can better myself. Nobody can do it but me and I’ve decided that I’ve just gotta get through it. I gotta put a lot of time in it and I’m gonna do it…even if I have to take it again. Just like the computer. I didn’t let it defeat me when I started taking word processing. My teacher, Ms. F. says, “You can do it, you just gotta put your mind to it.’ Down the road, I’d really like to transfer [to a four-year university]. All these other people are saying about furthering their careers and getting a degree. It might take me a course at a time, but you build a house one brick at a time. So that’s how I look at it. I’ve got to do this. I’ve got to get through that math to get me somewhere else.”

Heather credited her mother for some of her determination. “My mother thought she was good at math but she wasn’t all that hot. She tried to help me with long division (she only went to eighth grade) and she stayed up—talk about dedication and sticking to it—she stayed up all night. I remember being asleep and I would wake up and she was still trying to do this problem. And I’d go in to school and I was so proud that my mother did it. And it was the wrong answer! We still laugh about it to this day. It was the wrong answer and she was up all night working on that problem. So maybe that’s where some of my determination to hang in there comes from.”
Lauren was facing a chemistry course when her interview took place. She said, “I’ll do the best I can. I’ll go to the tutoring center for help. I’ll keep taking them (referring to her mathematics courses) until I pass…yes, I’ll do the best I can.”

Mary had a positive outlook. “I’m confident. I’m going to seek help. I know that help is available. I’m hoping that, because I go to school in the evening, I hope that help will be available to me—someone to help me in the evenings, because during the day I work. But I am going to look for extra help.”

Connie was emphatic about succeeding. “I intend to stand up to my adversity. I have a friend who has struggled for three years straight with the math. She gave me so much hope…she did it. I will never forget that, because that’s what it takes. On the days when I feel like pulling the cover up over my head, I think of her. Who am I to cop out? I don’t have the right to do that.”

Rose expressed her passionate desire for “a better future. I want to have my children know that they have an educated mother. I want them to know that minorities can advance in life…if you have the willpower, you can do whatever you want. And that’s why I’m doing it (referring to being in college). I came from a background—I was taken away from my family and everything—I was in foster homes all my life—I was a ward of the state. It just made me stronger. It made me realize that without an education, you’re not going to succeed in life….I think math is a challenge; it’s food for the head. I think, out of everything, math is the number one thing. You can succeed by knowing about numbers in life, because everything is about numbers….I’m a very determined person. [I’ll be successful in my mathematics courses] even if I have to go to four or five days of tutoring just to advance in it, yes.”
To the question of being successful in passing all of her mathematics courses required for her degree, Brittan answered, “Definitely. I love challenges. There’s no reason why I can’t pursue something and pursue it with a good grade…not just passing by the skin of my teeth. I’m hoping I can carry this excitement all the way through [my college education].”

Barbara said she gained confidence after doing well in an algebra class. “My teacher said that [understanding] math gives you confidence. And yes, I knew what she was talking about there because I finished up that class and, yes, I did. I have that whole new confidence. I can do anything now.”

Rose had a word of advice to others who are intimidated with mathematics. “Just keep sticking in there. Don’t ever give up because, if you give up, you are saying you’re a failure. You don’t want to ever give up. You’ve got to strive if you want something in life. That’s the way I look at it. I strived all my life and it’s with math…so math will never put me down. It will just make me want to strive harder to succeed in that area.”

Summary

Fifteen individual interviews of non-traditional age women enrolled in Reading Area Community College were conducted. Ten chose mathematics as the subject they would least enjoy and five chose mathematics as the subject they would most enjoy. Data were analyzed by comparing profiles of each of the participants and drawing out common themes that emerged. Eight major themes and six sub-themes emerged: (1) Acquiring a college education is a personal goal; (2) Adequate study time is necessary to understand and to retain mathematical concepts; (3) Experiences with mathematics at an early age remain in one’s memory, (3a) Poor experience with mathematics at an early age
tended to make participants believe they could not learn mathematics, (3b) Positive experience with mathematics at an early age tended to provide participants a higher degree of self-efficacy in succeeding in mathematics courses; (4) Parental behavior and expectations play a role in children’s self-perception, (4a) Absence of parental/family support tended to discourage participants from pursuing further education, (4b) Presence of parental/family support tended to encourage participants in pursuing further education; (5) Teacher behaviors and teaching methods matter, (5a) Negative teacher behaviors tended to cause some to develop poor mathematics self-concepts, (5b) Positive teacher behaviors tended to encourage some to persevere in understanding mathematics; (6) Feelings of powerlessness may impede learning mathematics; (7) Self-esteem can survive in spite of past failure; (8) Motivation to understand mathematical concepts remained high.

The findings of this study are important in order to emphasize the attention that needs to be devoted to this female population, particularly in the area of mathematics education, and the valuable contributions non-traditional age women can make if colleges can attract and retain them in college classrooms.
Chapter Five

Summary, Discussion, and Implications

This chapter will accomplish the following purposes. First, the problem and purpose of the study will be reviewed. A summary of the findings of the study will be then be provided. Next, major themes that emerged from the study will be reviewed and discussed in connection with the literature. Implications for practice will be addressed along with suggestions for further research. Finally, I will conclude with my own reflections.

Problem

It is clear that our country needs as many talented students as possible to pursue mathematics and science at advanced levels in high school, college, and graduate school. Yet, in the last few decades, it has been clear that fewer girls and women are pursuing majors and careers in either mathematics or science (Reis & Park, 2001). Women are more educated, more employed, and employed at higher levels today than ever before, but they are still largely pigeonholed in pink-collar [italics added] jobs, according to the American Association of University Women (AAUW) Educational Foundation report, Women at Work (2003) [italics added]. The report goes on to say that the new high-tech economy is leaving women behind because they don’t have the keys to open the door to this high-tech sector of the work force. National census data show that the highest
proportions of women with a college education are still in traditionally female careers: teaching and nursing (AAUW, 2003).

A report by the National Research Council, entitled *Everybody Counts: A Report to the Nation on the Future of Mathematics Education*, emphasizes that undergraduate mathematics—the mathematics of the college experience—is vitally important, perhaps even more than elementary or secondary school mathematics. “More than any other subject, mathematics filters students out of programs leading to scientific and professional careers. From high school through graduate school, the half-life of students in the mathematics pipeline is about one year…” (Smith, 1994, p. 135).

Undergraduate mathematics is the linchpin for revitalization of mathematics education. Not only do all the sciences depend on strong undergraduate mathematics, but also all students who prepare to teach mathematics acquire attitudes about mathematics, styles of teaching, and knowledge of content from their undergraduate experience. No reform of mathematics education is possible unless it begins with revitalization of undergraduate mathematics in both curriculum and teaching style (cited in Smith, 1994, p. 135).

**Purpose**

The first purpose of this study was to examine, by means of in-depth, phenomenological interviewing, the metacognitive and affective factors that are perceived to contribute to mathematics avoidance or mathematics confidence in non-traditional age women attending a community college. The second purpose of the study was to explore and describe the meaning participating non-traditional age women attach to their experience with mathematics. The third purpose of the study was to determine
the relationship, if any, between metacognitive and affective experience in the learning of mathematics.

Summary of the Findings

Findings from this study may be applicable to a universal population. That is, the identified themes may not be specific only to non-traditional age women. Nevertheless, this qualitative study supports and extends the existing literature by providing depth through interviews of participants, discovering the meanings they make of their experiences in their own words. The study followed the interpretive form of educational research described by Carr and Kemmis (1986), where education is considered to be a process and school a lived experience. To understand the meaning of that process is to gain knowledge by an inductive, theory-generating mode of inquiry. Multiple realities are constructed socially by individuals. Schwandt (1998) argues that individuals construct knowledge in an effort to make sense of their experience and that this knowledge is continually tested and modified in light of new experiences. I was interested in understanding the experience of learning mathematics from the perspective of the women themselves, regardless of whether that experience was a positive or negative one. Also of interest to me was discovering factors, if any, that served to differentiate those women who had not succeeded thus far from those who may have had a struggle but who, nevertheless, were successful in completing their mathematics courses.

Findings are grouped into eight major themes and six sub-themes: (1) Acquiring a college education is a personal goal; (2) Adequate study time is necessary to understand and to retain mathematical concepts; (3) Experiences with mathematics at an early age
remain in one’s memory, (3a) Poor experience with mathematics at an early age tended to make participants believe they could not learn mathematics, (3b) Positive experience with mathematics at an early age tended to provide participants a higher degree of self-efficacy in succeeding in mathematics courses; (4) Parental behavior and expectations play a role in children’s self-perception, (4a) Absence of parental/family support tended to discourage participants from pursuing further education, (4b) Presence of parental/family support tended to encourage participants in pursuing further education; (5) Teacher behavior and teaching methods matter, (5a) Negative teacher behaviors tended to cause some to develop poor mathematics self-concepts, (5b) Positive teacher behaviors tended to encourage some to persevere in understanding mathematics; (6) Feelings of powerlessness may impede learning mathematics; (7) Self-esteem survived in spite of past failure; (8) Motivation to understand mathematical concepts remained high.

The trustworthiness of this study was determined, in part, by the voiced experiences of the participants themselves. Each participant read the transcription of her interview and then read her profile containing specific quotes from the interview. Each participant was asked to verify accuracy and make any additions and corrections. Creditability was also sought by involving two of my colleagues who read all 15 interview transcripts and independently wrote what each recognized as common meanings and themes expressed by the participants. Their findings were compared with my own and we reached consensus on the final list of themes.
Discussion

Theme 1: Acquiring a college education is a personal goal.

Acquiring a college education was not simply one in a list of many other priorities for the participants. It was expressed as a lifelong desire and at the top of the list of personal goals. Many of these participants had raised children, supported their households by working in factories or service occupations, and postponed their own dreams until it was finally their turn [italics added]. They were serious about doing well academically. They were serious about doing well in mathematics. Some of them had succeeded in passing the required mathematics courses, some had not. Those who had not were unwilling to accept defeat. Some were discouraged momentarily but were determined to try again.

A serious attitude about school, evidenced by the participants in this study, supports the research (noted in Chapter One) of Cox (1993), Miglietti (1994), and Richardson (1995), who found that non-traditional age students often exhibit a deep approach or a meaning orientation toward their academic studies.

Theme 2: Adequate study time is necessary to understand and to retain mathematical concepts.

The question of study habits, or lack thereof, was an area I, as the researcher, was curious to explore. All 15 women had their own unique study strategies, favorite places to study, best times of day to study, and various approaches to note-taking. Some needed quiet; others had to have noise. Most preferred studying in small chunks of time rather than cramming for hours. The common thread among all of the participants, however, was the fact that studying was very important—important enough to take their books to
work, spend hours in the library, get up early before the rest of the family, or stay up late after others had gone to sleep. In other words, they realized the effort required to learn, understand, and retain information. With mathematics, however, some of them were beginning to question if learning the material was beyond their ability, regardless of how much time they spent studying.

As reviewed in Chapter One, Carney-Crompton and Tan (2002) found that study skills often must be developed or refreshed as non-traditional age women assume their role as students. Counselors and academic support staff may help here to give advice, guidance, and encouragement.

Theme 3: Experiences with mathematics at an early age remain in one’s memory.

The third major theme that was evident from listening to the participants’ stories was that they remembered experiences with mathematics from their early school years. If the experience being reported was a positive one, the memory was often expressed in rather vague terms. However, if the experience was unfavorable, or negative in some fashion, participants were able to recall the words spoken to them, body language, and accompanying emotions in vivid detail. Five of the 15 participants shared positive past experiences and good memories of learning mathematics. Less than positive memories were more common, however, and this particular phenomenon emerged as a shared experience for 10 of the women, representing two-thirds of the participants in this study. Six of these participants shared experiences from elementary school (one remembered an experience as early as first grade), two found junior high school to be where they remembered falling behind in mathematics, and two experienced difficulty beginning in the tenth grade.
Sub-theme (3a): Poor experience with mathematics at an early age tended to make participants believe they could not learn mathematics.

Having a poor experience with mathematics at an early age was perceived by the participants as having a significant effect on their self-efficacy when performing in the college mathematics classroom. This finding supports research studies discussed in Chapter Two. Hamachek (2000), for example, asserts that “the self is not something with which individuals are born but something they create out of their experiences and interpersonal relationships” (p. 230). Each of the participants had a self-concept and a certain level of self-esteem that, as they grew, was influenced by their surroundings. As they moved through elementary school, junior high school, and high school, the interactions they experienced and the feedback they received from parents, teachers, and peers, were important components in the development of their self-concept. Tomkins (1992) refers to individuals as victims [italics added] when the world he or she has experienced contains negative scenes.

Belenky et al. (1986) learned, through intensive interviews with women, that, in general, they often felt alienated in academic settings. If feelings of alienation are carried through one’s school experiences, it is no mystery that cognitive ability to understand mathematical concepts is hindered. Bandura (1997) argues that self-concept has been shown to be intimately involved in the cultivation of cognitive competencies. Stodolsky (1988) agrees that an individual’s belief in his or her ability plays a critical role in learning mathematics.

Sue explained, “I can remember my teacher [in first grade]…she was great with the ruler. And if you didn’t add right, you got smack on your hands with the ruler.”
Connie could not remember when her problems with mathematics began. However she
did say, “I don’t remember my grade school experience vividly, but I do remember spurts
of it and it was never pleasant…never pleasant. Now when I get the right answer [to a
mathematics problem] I’m excited about it because of past experiences which were so
disheartening.”

Since, from elementary grades on up, some of the participants were told that they
lacked the ability to succeed in mathematics, they accepted that as fact. Sheila
remembered the chemistry teacher telling her, “You can’t get the math.” This study
supports the findings in both Crawford’s research study (1980) and Marderness’ research
study (2000), that a belief that one is an outsider to the world of mathematics becomes
ingrained in one’s belief system during one’s early years and this belief remains intact
throughout one’s adult life.

Theme 4: Parental behavior and expectations play a role in children’s self-
perception.

Parental support and encouragement, or parental indifference toward academic
achievement, seemed to play an important role in the participants’ self-perception of how
well they might fare in what they perceived as more difficult subjects, such as higher
levels of mathematics or college level courses. Parental support was lacking for 10 of the
participants, representing two-thirds of the women interviewed. In some cases, the lack
of support was due to the parents’ own lack of schooling. In other cases, parents and
relatives did not see the value of getting an education, particularly mathematics
education, for girls. Rather, parents encouraged the participants to concentrate on finding
a job, getting married, raising a family, and expected them to be satisfied with those
options. Five of the participants said they had parents who cared about their education and encouraged them to do well in mathematics. Four of these five participants evidenced a positive attitude toward mathematics and were achieving success in their mathematics courses.

Children’s self-concept of ability and their confidence in mathematics are more directly related to their parents’ beliefs about their mathematics aptitude and potential than to their own past achievement in mathematics (Eccles-Parsons et al., 1982). As noted in Chapter Two, Tocci and Engelhard, Jr. (1991) found a positive relationship between parental support and student attitude toward mathematics. They also argued that perceptions of parents’ reactions to mathematics, along with the amount of encouragement children receive to study and do well at it, may affect the child’s attitude toward mathematics. The power of the home environment should not be underestimated. Students need to see indications from others, including their parents, siblings, and peers, that mathematics is important (Fennell, 2007).

Sub-theme (4a): Absence of parental/family support tended to discourage participants from pursuing further education.

Several of the participants came from homes where one or both of their parents lacked a formal high school education. This being the case, the participants assumed that their parents “just didn’t care.” Sheila remarked, “…my parents didn’t care one way or the other.” In several cases the participants were told that mathematics was not important for girls to learn. Sue was told by her father, “You’re going to work in a factory like your mother did and you’re gonna get married and have babies…and, what do you need an education for?” Lauren’s parents convinced her, “You’re never going to need that in a
factory.” Several participants’ responses revealed that their parents felt frustrated because they couldn’t help their child with mathematics. Barbara remembered that her mother “just threw her hands up and didn’t know how to help me.” Other participants shared that their parents were just too busy to be concerned with their education. Alice’s mother ran a business and “just didn’t have the time to help us.” Sue had to take care of her younger siblings and wasn’t given the time or opportunity to “be a really good student when I was going to school.” In contrast to those participants who did not receive parental support, the findings of this study show that in each case where the participant remembered receiving parental support, there was a corresponding motivation to be successful in the academic arena, particularly in mathematics courses.

Theme 5: Teacher behaviors and teaching methods matter.

All of the participants in this study shared the belief that a teacher makes a difference, not only affectively in a student’s belief in himself or herself, but in the cognitive learning of the mathematics material itself. I found it very surprising how vivid the memories of the participants became when they described issues with past teachers, whether the incident occurred in their early schooling or in their current experience in the community college. Their memories were clear, even to the point of recalling exact words that were spoken by the teacher, the teacher’s body language they perceived to be either negative or positive, punishments inflicted when an incorrect answer was put forth, and, in some instances, the numerical grades they received for their mathematics performance. Those who received encouragement, praise, attention, and mentoring from a teacher, whether in their past or currently at the community college, responded by persevering, working harder, and in many cases, mastering the mathematics material.
Greenwood (1984) and Swetman et al. (1993) state that teachers are considered to be a major force in contributing to student achievement, more important than either the method or curriculum. Hodges (1983) emphasizes the importance of affective variables in the learning process, that there is an emotional side to learning as well as a cognitive side. Teachers who provide supportive, encouraging environments increase student confidence levels and improve achievement and interest in the subject matter.

Theme 6: Feelings of powerlessness may impede learning mathematics.

The sixth theme that surfaced from the participants’ stories was never explicitly spoken. However it was implicit in some of their rich description and in the emotion that was evidenced in their voices. Feeling powerless to move away, to take oneself out of a situation, to change the circumstance, to speak back, to say stop [italics added], to take control, or to regain one’s self-respect can be not only physically and mentally painful but also restricts and inhibits learning (Erchick, 1996). Several of the participants shared events that occurred in mathematics classes in which they found themselves to be powerless. These events served to hinder their learning and erect a mental barrier to understanding the mathematics material.

Theme 7: Self-esteem can survive in spite of past failure.

A surprising, yet welcome, finding from this study was that 13 of the 15 participants thought of themselves as smart [italics added]. Interestingly, 7 of those 13 were struggling with mathematics, having failed to pass their mathematics courses in previous attempts. The participants revealed what I call survival techniques [italics added] in order to maintain a level of self-esteem that would enable them to continue to persevere in order to move through their mathematics requirements.
In most cases, the participants attributed their *smartness* [italics added] to having common sense, displaying wisdom as wives and mothers, proving an ability to juggle family and work responsibilities with their college classes, or achieving a level of success in their college courses thus far. As noted in Chapter Two, Marsh and Yeung (1996) assert that a positive self-concept is an important mediating variable that may promote academic achievement and other valuable educational outcomes. Marsh, Craven, and Debus (1991) show that enhancement of self-concept can improve academic performance and is strongly related to subsequent course selection.

Perceived beliefs of one’s ability (self-efficacy) contribute independently to intellectual performance. In fact, Pintrich and DeGroot (1990) found that the higher the students’ efficacy beliefs, the higher the academic challenges they set for themselves. Individuals of high self-efficacy persist while those of low self-efficacy are more apt to quit (Bandura, 1982). A positive self-concept, evidenced in the findings of this study, lends credibility to the final theme which has to do with self-confidence and motivation.

**Theme 8: Motivation to understand mathematical concepts remained high.**

Collins (1982) conducted studies giving children mathematical problems to solve, and found that efficacy beliefs predicted interest in, and positive attitudes toward, mathematics, whereas actual mathematical ability did not. Efficacy beliefs, therefore, are foundational to learning and persistence.

The participants in this study expressed a high sense of efficacy. Thirteen of the 15 participants expressed self-confidence that they would ultimately perform successfully in their mathematics courses. The two who were unsure said they hoped to pass and would do their best. This self-confidence produced a high level of motivation that was
evident in all of the participants. Schunk (1989) found that perceived self-efficacy was a better predictor of intellectual performance than skills alone and that self-efficacious individuals will intensify their efforts and, if necessary, change the environment, i.e. seek tutoring, restructure work schedules, form study groups, read additional mathematics material, watch publisher-produced teaching videos, or temporarily set aside other interests, in order to succeed. Participants in this study exhibited a level of motivation necessary to complete their educational goals.

Participants’ self-efficacy appeared to emerge as a result of raising families and working to provide financial support as single mothers or as housewives. Also critical to participants’ self-efficacy was having access to the student support that the community college offers in the areas of tutoring, advising, and simple, yet extremely significant, caring about the welfare of students.

Have the purposes of the research been attained? Do we have a description of factors these participants perceived to result in mathematics avoidance or mathematics confidence? The responses of the participants in their own words—their expressed desire to achieve a college degree, their diligence in applying themselves to study, their past experience in mathematics classes, the existence and degree of parental support and encouragement they received or did not receive, teacher behaviors and manner in which the mathematics was taught, feelings of powerlessness to improve their situations, their self-esteem and motivation—contain common factors which may contribute to mathematics confidence or mathematic avoidance.

Do we have a sense of the meaning that the participants attached to their mathematics experience? Perhaps the most prevalent meaning the participants expressed
was their belief that they were smart [italics added]. Despite past struggles, and in some cases, repeated failure in mathematics courses, they continued to display a level of self-esteem and were motivated and self-confident that they would succeed—if they continued to strive—in their mathematics courses.

Can we determine any relationship between metacognitive and affective experience in learning mathematics? Rich description from participants’ stories in their own words revealed both positive and negative metacognitive factors. For example, positive metacognitions included (1) recognizing that help was available, (2) that prior learned mathematics concepts were beneficial in connecting to new mathematics concepts, (3) that problems could be worked out in more than just one way, (4) that the instructor was helpful and cared, and (5) that being “stuck” was only temporary. Along with these positive metacognitions were positive affective factors such as (1) enjoying the competition, (2) having a favorite grade, (3) feeling satisfied at earning a grade, (4) feeling the caring of the teacher, (5) respecting the teacher, and (6) feeling excitement about one’s grade.

Along with positive metacognitive awareness, participants expressed some negative thoughts. Negative metacognitions included (1) recognizing the fast-paced presentation of mathematics material, (2) the overcrowded classroom, (3) the sometimes hostile behavior of peers (being referred to as an “idiot” or “stupid”), (4) the fact that one’s powers of concentration are limited by stress, (5) the fact that high school mathematics was not adequate preparation for college, (6) the observation that the teacher was not approachable, and (7) the recognition that one’s capacity to absorb information had been reached and there was nothing to be done to expand that capacity. Along with
these negative metacognitive factors, the following negative affective factors were expressed in the participants’ own words: (1) feeling very stressed, (2) overwhelmed, (3) anxious, (4) humiliated, (5) lacking in self-confidence, (6) discouraged, (7) blown away, (8) lost, (9) flustered, (10) frustrated, (11) feeling like a total jerk in front of the whole class, (12) embarrassed, (13) disheartened, (14) hopeless, (15) intimidated, (16) disappointed, and (17) upset with oneself.

When feelings of alienation (affective information) are carried through one’s school experiences, it is no mystery that cognitive ability to understand mathematical concepts is hindered. Nevertheless, metacognitive information, such as knowing which teaching style works best, which learning style makes learning easier, or what type of study regimen results in the best performance on a test, can result in affective information, such as how one feels about himself or herself, how much anxiety one feels when it is time for a test, or how much one feels cared for and respected by those he or she interacts with daily. Stories from the participants in this study revealed that it is not so much what mathematical concepts are learned, but how they are learned, which will determine the affective objectives that will be attained at the same time as the cognitive objectives. A relationship between metacognitive and affective experience was not apparent in all participants. However there was a correlation in most of the stories as may be seen in Table 8, in Chapter Four (p. 123).

Qualitative research is based upon “the view that reality is constructed by individuals interacting with their social worlds” (Merriam, 1998, p. 6). I, as the researcher, am interested in understanding the meanings non-traditional age women attending a community college have constructed relating to learning mathematics, and
how they make sense of their world and the lived experiences they have had. It is assumed that meaning is embedded in the participants’ experiences and that this meaning is mediated through my own perceptions. Patton (1985) explains:

[Qualitative research] is an effort to understand situations in their uniqueness as part of a particular context and the interactions there. This understanding is an end in itself, so that it is not attempting to predict what may happen in the future necessarily, but to understand the nature of that setting—what it means for participants to be in that setting, what their lives are like, what’s going on for them, what their meanings are, what the world looks like in that particular setting—and in the analysis to be able to communicate that faithfully to others who are interested in that setting (p. 1).

According to Merriam (1998) qualitative research is not a linear, step-by-step process. Collecting the data—meeting with each participant and audiotaping her story—and analyzing the data—listening intently to each participant and observing tone of voice and body language—occurred simultaneously to a large degree. My analysis truly began with the first interview, which happened to be my own. By allowing a colleague to conduct the interview and by taking on the role of a participant, I was made aware of my own feelings and responses to the questions I had composed. It was from this very personal perspective that I then set out to conduct interviews of my own and strove to bracket my own experiences, and the meaning I made from them, in order to more fully understand the stories told by the participants. During the period of time over which my interviews were conducted, there were insights that emerged, impressions that I
questioned, and tentative hypotheses which led to a final refinement of shared themes and believable findings.

**Implications for Practice**

The findings in this study of non-traditional age women can inform the practice of teachers in higher and adult education in a number of ways. Primarily, there must be a willingness to understand the importance of education to these women’s futures and the degree of weight that is placed on their shoulders to learn mathematics. Wolfgang and Dowling (1981) found that non-traditional students tend to focus on internal motivations instead of external motivations when attending postsecondary school. These students are going to college because they want to learn.

Following are 17 implications for both faculty and students drawn from the metacognitive responses of the participants. Suggestions are offered explaining what teachers might do to reinforce the positive metacognitions and reduce those that were negative.

(1) According to the participants in this study, a positive impact is made on their learning when they perceive their teachers care and are willing to listen to and answer their questions. Participants’ positive metacognition, recognizing that help in mathematics was available, can be reinforced by teachers scheduling their office hours around the times of their mathematics classes. I know of faculty who schedule office hours at 7:30 a.m. for the convenience of being able to leave when their teaching load is finished later in the day. There are others who schedule office hours only on a Tuesday or Thursday, which is of little help to students who are on a Monday/Wednesday/Friday schedule. Telling students they should go to the tutoring center for help is acceptable;
however, students often feel “brushed off” unless the teacher has already taken some personal time to see where they are having problems. Often the tutoring center is not able to provide one-on-one help for an extended period of time.

(2) Recognizing that new mathematics concepts seem more easily digested when connected to previously learned concepts was a second metacognition. Teachers could be careful to make connections between and among mathematical concepts as each is introduced. A worthwhile practice is to encourage students to look at the problem carefully, describe it fully, and seek the essence of it. Point out how the new concept takes the previous one a step further or helps to make the material useful in another discipline, such as engineering, architecture, or medicine. Help students to see the problem as legitimate [italics added], meaning it is engaging, relevant or entertaining. It must not be routine, repetitive, rhetorical, or contrived (Boeree, 2007).

(3) Sometimes realizing that a problem can be solved using alternative strategies is exciting to students; but, it can also be intimidating. It is important for teachers to listen to their students. What is their understanding, not only of mathematics, but of the world? Some students will have more experience with methods of problem-solving or creativity or have more general background from which to draw. We cannot take these things for granted. For adult women, particularly, with busy schedules and many details to manage, settling on one problem-solving strategy—the one they perceive is the best one—is sometimes preferred over learning multiple paths to a solution.

(4) Kern (2006) cited caring on the part of the instructor as an important concern for adult students, one that could not be overemphasized. Kern’s findings were supported
by this study. Participants’ metacognition that the teacher was helpful and cared, was a critical element in their persistence and performance in mathematics.

Teachers can show they care in any number of ways, including acknowledging the reality that students have lives outside of the classroom. As discussed in Chapter One, adult women are balancing many obligations and college is just one of them. Some flexibility may be helpful in turning in assignments or taking tests. I have heard women tell of their frustration in trying to complete a mathematics course, where they were told that, since they were unable to attend the scheduled test (due to a mandatory work requirement or caring for a sick child), they were given a grade of zero, with no other options. Even more troubling are the stories women have shared of their being dropped from the roll in a mathematics course, due to circumstances beyond their control. This, in my view, is comparable to being punished for a crime you did not commit. While there are pedagogical standards that must be met, flexibility in meeting such standards is appreciated by adult students.

In addition to flexibility, demonstrating empathy with students forms a bond that encourages learning. Empathy means that one tries to feel what it would be like to walk in the other person’s shoes [italics added], showing sensitivity, understanding, and responsiveness. While in other areas of their lives, adult students may be the local expert and amaze their friends, in school matters, the teacher is always better than they. Comparison with an authority takes away some of the potential for pride (Boeree, 2007).

Teachers can help adult students build a sense of pride by sharing their own struggles, challenges they are facing, or simply by listening without passing judgment or giving advice. They should then bolster students’ hopes by directing them to focus on
their goal and the pride that will accompany having reached it. In other words, teachers should try to connect with their students by being personable, being available, being enthusiastic, and encouraging them to persevere. Not surprisingly, teacher characteristics that participants noted as being especially meaningful to them were patience, calmness, friendliness, respect, and understanding.

(5) Occasionally students reach an impasse in their learning mathematics, where they feel bewildered and are at a loss to know how to proceed. Participants in this study described this as being stuck [italics added]. However, a participant metacognition revealed an awareness that this condition, although frustrating, was only temporary. A fitting metaphor may be seeing a light at the end of the tunnel or getting a glimpse of the sun behind heavy cloud cover on a dreary day. One can imagine getting past the momentary distress. When students are in this perplexing state, here is where a teacher’s encouragement is most needed.

(6) Metacognitions of a negative nature were more numerous than positive ones. The first was recognizing the fast pace of the mathematics material. Prawat (1992) questions the popular view of curriculum as “a fixed agenda, a daily course to be run that consists of present means (i.e., certain material to cover) and predetermined ends (i.e., a discrete set of skills or competencies)” (p. 358). He favors a more interactive approach to curriculum where it is viewed more as “a matrix of ideas to be explored over a period of time than as a road map. One would enter this matrix at various points, depending on where students are in their current understanding” (p. 358).

Viewing mathematics as dynamic, rather than as a static body of knowledge, would emphasize the importance of student reasoning instead of following a teacher-
centered approach where students learn by carefully attending to the teacher’s demonstrations and explanations and responding to his or her questions. The student-centered approach asks students to express their own ideas, which not only supports students’ efforts to make sense of the content, but also allows the teacher to understand what they are thinking. How else can a teacher know what the students’ needs and difficulties are? One implication from the participants in this study is that many times the fast pace of the mathematics material is overwhelming. Teachers should try to capitalize on remarks from students and incorporate them into the mainstream of the lesson or shift the discussion to clarify the students’ difficulties. “Attentiveness to student cognition is one of the defining features of constructivist teaching” (Pravat, 1992, p. 367). Simply moving through the mathematics content, chapter after chapter, does not assure that learning, i.e., meaningful learning, has taken place.

(7) One participant in this study was aware that she felt nervous and distracted due to the overcrowding in the mathematics classroom. Overcrowding is a problem that faces many educational institutions, particularly in urban areas where the student population is growing faster than facilities can be built to provide adequate space. Research has consistently shown that overcrowding negatively affects both classroom activities and instructional techniques. Crowded classroom conditions make it difficult for students to concentrate on their lessons. The implication is that smaller class size significantly increases the amount of learning that takes place.

(8) Comments from fellow classmates, although not intentionally meant to be offensive, may be hurtful or discouraging to a student. Several participants in this study shared that demeaning comments from classmates—or even anticipating such comments
from classmates—kept them from participating in class discussion or asking questions in class. Sandler (1996) found that hostile behaviors, such as rolling of the eyes, or hostile remarks, such as calling another student stupid [italics added], often leave women feeling angry, demeaned, and uncomfortable. Their class participation may drop considerably and some may drop out of class. Teachers, when taking notice of this kind of hostile overt behavior, should not ignore it, but actively discourage and express disapproval of it by indicating that such behavior is not acceptable.

(9) A repeated theme of participants in this study was that stress affected their power of concentration—in the classroom, when the teacher was explaining a problem on the board, and when studying for a test, or during the process of taking a test. As noted in the literature review relating to mathematics anxiety in Chapter Two, research has shown that stress produces a decrement in mathematics performance (Ma, 1999; Norman, 1997; Rabalais, 1998). College mathematics teachers can find ways to reduce the anxiety women may carry with them into the classroom by displaying an understanding attitude. They could invite women to express their opinions since women, more frequently than men, hesitate to speak up and show assertiveness (Karp, et al., 1998). Many women have been socialized to be silent, especially in formal mixed groups, such as a college classroom (Sandler, 1996). Students, particularly women, must be encouraged to discuss, openly talk about their discoveries, and feel comfortable entering into debate, when appropriate. Teacher behaviors establish the context for a classroom environment that is either hospitable to non-traditional age women or intimidating to them (Sandler, 1996).

One such technique is to bring the idea of stress out into the open. Help students to explore their anxieties about mathematics through discussion. Sharing my own
anxiety about mathematics and how I was able to gain control over it has been successful to some degree in encouraging other students.

(10) Inadequate preparation in high school has placed approximately one-third of enrolling freshmen into developmental classes in community colleges and universities (Ravitch, 2000). Being placed into developmental mathematics comes as a shock to many students if they had taken several years of algebra or calculus in high school. To non-traditional age students, taking developmental courses is expected since many of these students have been out of school for years. They accept the fact that their mathematical skills need to be refreshed. However, many are surprised at how little mathematics they had been taught when they were in high school (Fotoples, 2000; Hall et.al, 1999; Horn et.al, 1996; Zaslavsky, 1994), and how little they had retained (Karsenty, 2002). In the 1970s and 1980s, when the participants in this study were in high school, many girls were not encouraged to take higher level mathematics which would prepare them for college. (This trend is changing as recent statistics show that more girls than boys are now enrolling in degrees in science and engineering fields.) Teachers should be aware that non-traditional age students are learning mathematics that they may be seeing for the first time, as opposed to younger students who have had a lot of the material in high school. Participants in this study appreciated a teacher who demonstrated patience with them and understood that they were grappling with mathematical concepts, however basic [italics added], that were new to them.

(11) A non-threatening classroom atmosphere can only been developed when the teacher is non-threatening. Several of the participants in this study shared that, when the mathematics course first began, they were afraid to volunteer answers, afraid to ask
questions, or afraid to talk to the teacher face to face. In some cases, throughout the days and weeks that followed, a rapport was built between teacher and student, and the teacher was now described as approachable [italics added]. Teacher personality traits may be a factor that promote or hinder learning in the mathematics classroom (Norwood, 1989; Spanias, 1996; Jackson & Leffingwell, 1999). Injecting humor and sharing personal experiences that relate to the mathematical problems being solved makes the class fun and interesting. Studies have shown that a teacher who is approachable will smile, show interest in getting to know each student as an individual, learn students’ names, interact with students outside of the classroom, i.e., in the hallway, in the parking lot, in the cafeteria, etc., and demonstrate a genuine interest in seeing students do well (Kern, 2006).

(12) Time management becomes crucial to non-traditional age women who are working and raising children in addition to time spent in the college classroom and often experience tremendous stress in trying to handle the multiple roles of students, mother, spouse, and family breadwinner (Cross, 1981). For this reason, they need additional sources of support. The participants in the study stated that they were thankful for the help that was available at the community college in the form of tutoring. One participant expressed her hope that there would be tutoring services available during the evening hours for her to use before her evening class. Mathematics tutoring centers should be receiving support, both financially and otherwise, from the institutions they serve. They should be staffed with friendly, knowledgeable personnel who are trained to work with students who are struggling with mathematical concepts. Centers should have copies of all the textbooks being used by the teachers plus creative materials such as manipulatives for students to construct knowledge based on their own learning style. The hours of the
mathematics tutoring center should reflect the hours that classes are being offered and take into account students’ schedules. Having this service available serves as a powerful motivator for students to persevere and achieve.

(13) A challenge remains of attempting to reverse and counteract harmful, even humiliating experiences that students, particularly women, carry with them from past experiences with mathematics in elementary school, junior high school, or high school. Francis (Skip) Fennell, current president of the National Council of Teachers of Mathematics states,

A student’s view of what it means to know and do mathematics is shaped in elementary school; yet in the United States, elementary teachers are, for the most part, generalists. Their preservice teacher education typically includes two or three courses in mathematics content and one course in the teaching of mathematics. A mathematics specialist is needed because the preservice background and general teaching responsibilities of elementary teachers do not typically furnish the continuous development of specialized knowledge required for teaching mathematics today (November, 2006).

Perhaps, since participants recounted negative experiences from their elementary school years, renewed attention should be given to the preservice training of elementary teachers to better prepare them for the task of making mathematics meaningful and understandable to their elementary-age students. I suspect that there are similar needs at the middle and high school levels. Middle and high school mathematics teachers need ongoing content and pedagogical assistance as well.
Prior to coming to college, many women never found their inner voice so they did not ask for more teacher support. Rather they became convinced that they could never be good at mathematics. Because of the ways women are socialized, one area they tend to find difficult is higher-level problem solving. While one of their strengths is following rules, a weakness is in taking chances and risks (Karp et al., 1998). Teachers can encourage women to participate in the mathematics classroom by being attentive to them and involving them in class discussion. They can make an effort to make their classes interesting and teach in an enthusiastic manner.

(14) As already stated, participants regarded patience as an important quality for teaching mathematics. So often speed is prized over understanding. Karp et al., (1998) argue that “it is not surprising that many well-educated women who can successfully solve mathematics problems are still uncomfortable with mathematics because they are unsure of how formulas ‘work.’” Not enough time has been given to really understand and critically think through the mathematical concepts. Williams (1993) suggested that one goal of instruction is to make students comfortable with doing mathematics as part of their everyday getting on the world. Walen and Williams (2002) proposed that teachers attempt to engage their students with mathematics in ways that are personally meaningful and relevant to the context of their concerns, thus helping them to become comfortable enough doing mathematics so that it becomes a tool for solving real problems.

(15) Teaching mathematics in an organized, step-by-step, process was appreciated by the participants in this study. This traditional [italics added] approach to learning mathematics, which encourages rote learning of procedures, i.e. rules, algorithms, symbols, has been studied to ascertain whether procedural knowledge eventually leads to
concept development. The notion that there are stages of development in mathematics and learners typically go through a procedural orientated phase before they can effectively use their conceptual knowledge is studied in Davis, Gray, Simpson, Tall, and Thomas (2000).

The women in the current study felt that as they were able to comprehend the steps to solve a mathematical problem, they were also able to understand more clearly the reasoning behind the process. These findings support the work of Rittle-Johnson, Kalchman, Czarnocha, and Baker (2002), who studied the relationship between procedural and conceptual knowledge in the mathematical classroom and hypothesized that throughout development, conceptual and procedural knowledge influence one another in mutually supportive and integrated ways. Also supported are Baker, Czarnocha, and Prabhu (2004), who suggest that an optimal environmental for learning clearly involves coordination of procedural and conceptual knowledge.

An implication arising from this study is that procedural knowledge and conceptual knowledge influence one another continually throughout the learning process. Sketching visual pictures on the board, explaining problems in different ways, and purposefully tying new concepts to previously learned concepts all help women grasp the mathematical concepts.

(16) Teachers should be learners too. Unfortunately, not all classrooms have teachers who are learners. Berkas and Pattison (2006) report,

In our work with groups of teachers, we have found two distinct cultures, a culture of passivity and a culture of collaborative learning. The passivity culture is characterized by teachers who are set in their ways and believe that low-
performing students are responsible for their own lack of success. We hear
statements like, “kids these days just don’t care,” and, “kids are lazy—they have
no work ethic.” By contrast, teachers who belong to a collaborative learning
culture do not accept perception data about their students but strive to learn from
students about students. They work to understand not only their students’
leaking styles and gifts but also the personal background that influences their
learning. They plan lessons collaboratively and use a variety of instructional
methods to engage and motivate their students. In short, teachers in this culture
are always learning and fueling their own inner fires.

(17) Although many community colleges have orientation programs for new
students, a special program specifically focused on the needs of adult women could
emphasize their unique issues and concerns (Carney-Crompton & Tan, 2002; Johnson,
Schwartz & Bower, 2000). It would state clearly that the institution was committed to
their success and recognized their special needs. Emphasis should be placed on
promoting the benefits of learning mathematics and create incentives for women to
pursue courses in mathematics that would prepare them for fields in science, engineering,
or information technology, which are the better-paying, higher-status, and faster-growing
occupations in our society.

All of these implications have the potential to offer a window into the world of
the non-traditional age woman who enrolls in a community college and sits in an
introductory mathematics classroom. Teachers at all levels of education need to be
supported in their efforts to make mathematics education relevant, meaningful, and
motivating for their students. Fiore (1999) suggests that “instructors can teach students
who have had painfully negative experiences in mathematics through encouragement, positive talk, and accommodation” (p. 405). If students believe that they can learn mathematics and that the instructor cares about their learning, they will push themselves harder. We should not underestimate the power of encouragement and positive talk in the mathematics classroom, nor should we “underestimate the damage that negative talk from a teacher or parent can have on self-esteem and performance, regardless of how long ago it occurred” (p. 405).

Suggestions for Future Research

Because the stories of the participants in this study included memories of mathematics classes that took place in the elementary grades, and because it is in the elementary grades that teachers make sense of the manipulation of numbers and symbols, more research would be helpful in studying elementary school teachers and their level of mathematics anxiety and their attitudes towards mathematics. Allen (2001) contends that these attitudes, whether positive or negative, perpetuate themselves in students.

Participants in this study overwhelmingly agreed that their college mathematics teachers played a crucial role in their perceptions of themselves and their ability to learn mathematical constructs. Research conducted by Arriola (1993) showed that, for adult students in college developmental mathematics classes, teachers should be non-threatening and use a student-centered, active learning approach which stresses understanding over memorization and rote computations. More research is needed to determine the ways in which differences, other than cognitive, can help or hinder mathematics learning.
As already mentioned, the participants in this study evidenced a noticeable degree of emotion when sharing their past and present experiences with mathematics. The effects of emotion on cognitive functioning can be substantial (Walen et al., 2002).

As educators, we are all very interested in helping our students learn, and more than that, helping to make learning meaningful in their lives. According to Boeree (2007) “an examination of meaningful learning makes it clear that the amount of the affect is an intrinsic measure of the meaningfulness of the experience, i.e. of how important it is to the person.” Understanding mathematical concepts was very important to the women in this study. If teachers could present mathematical concepts as challenging without being overwhelming, and could demonstrate the finding of the solution as a real possibility, students would be motivated to learn.

We cannot allow distress and anxiety to discourage our students, to drive them into avoidance. Mandler (1989) points out that “stress tends to decrease attention to peripheral events and to focus attentional conscious capacity on those aspects of the situation that the individual considers important” (p. 9-10). Further research on the effects of emotion when sitting in a mathematics classroom, note taking, peer behavior, taking mathematics tests, the timed aspect of test-taking, and the various formats, lengths, and rapidity of mathematics tests would be useful.

Self-motivation and aspirations were evident in the stories of the participants in this study. These elements will determine, in large part, what is made of the educational opportunities presented to them. A belief in one’s self-efficacy (“I know what to do and I know how to do it.”) is the ingredient necessary to continue to persevere as long as it takes to accomplish the task. Bandura (1997) posits that “the major goal of formal
education should be to equip students with the intellectual tools, efficacy beliefs, and intrinsic interests needed to educate themselves in a variety of pursuits throughout their lifetime” (p. 214). Further research is needed to study how psychosocial processes are involved in the cultivation of cognitive competencies and contribute to their development. In addition, research studying how self-efficacy expectations impact the domain of mathematics could have considerable utility for the understanding and treatment of mathematics avoidance.

This study reinforces the recommendations of Carney-Crompton (2002) in that future research could clarify the role that age, intrinsic motivators, and child-rearing responsibilities play in the decision of non-traditional age women to return to school and in their strategies to survive and thrive in a demanding academic environment. Postsecondary institutions might re-examine their commitment to providing opportunities for many types of students, including adult women, and ensure that financial resources as well as social support are available and accessible.

Finally, further research is needed to study factors such as class size, length of semesters, and length of class time. What class size is most conducive to mathematics learning? What length of semester is the best overall for students to grasp the mathematical concepts in enough depth to build self-confidence? What length of class time is best for teachers to present mathematics material in such a way that engages students’ varying learning styles?

Non-traditional age women continue to face unique problems when it comes to learning mathematics. Although community college campuses have welcomed these women and acknowledge their presence, barriers to completing a degree continue to
exist. Administrator, faculty, and staff all must work together to create a user-friendly environment, especially in the area of mathematics education. We can all agree that, “adults and mathematics” is a complex subject where “emotional factors are just as important as cognitive ones in the psychological learning process” (Wedege, 1999, p. 206).

Findings from this study may be applicable to a universal population. That is, the identified themes may not be specific only to non-traditional age women. It is possible that interviewing a group of non-traditional age men would produce the same type of responses. A qualitative study interviewing male participants and searching for meanings they made from their mathematical experience may answer this question.

**Personal Reflections**

Several of the women in this study found strength and inspiration from their simple participation in this research. When they read their own transcripts and then saw, in the research findings, how the other participants shared many of their own feelings, they commented about how that connection between themselves and the other participants had impacted their thinking about themselves. This metacognition, in fact, seemed to be an immediate boost to their self-esteem.

Conducting this qualitative research study was an arduous task since it forced me to step into the shoes of 15 women whose lived experiences, although different in many ways, were much alike in that the learning and understanding of mathematics was a critical part of their self-concept. I could see myself and my own experience in many of their stories. In my work as a mathematics instructor in a community college, it is an ongoing rewarding experience to be a part of listening to the stories of other non-traditional
age women attending this college. Hearing their descriptions of their lives and feelings about themselves relating to mathematics is inspiring and helpful. Without the perspective gained from this particular research, I would not have the insight—neither would I have a compelling desire to use that insight—to stimulate a desire in my students to learn. My calling and privilege is to be an enabler, particularly to non-traditional age women, as they pursue the fulfillment of their academic goals.
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Appendices
Appendix A

Multiple Choice Questions for COMPASS

1. Learn about RACC
   What ONE source of information had the MOST influence on your attending RACC?
   A. Website
   B. Television ads
   C. Newspaper ads
   D. Friends
   E. Parents
   F. High school teacher or counselor
   G. College fair
   H. Presentation/interview with a college staff member
   I. Publication mailed to your home
   J. Billboards

2. Influence to attend
   What influenced you the MOST to attend RACC?
   A. Low cost
   B. Location/close to home
   C. Program of study
   D. Academic reputation
   E. Support services
   F. Campus climate
   G. Small class size
   H. Friends are attending RACC
   I. Parents

3. RACC 1st choice
   Was RACC your first choice when choosing a college?
   A. Yes
   B. No

4. Parent’s 4 yr degree
   Do either of your parents have a 4-year college degree?
   A. Yes
   B. No

5. Size of Household
   What is the total number of people living in your household, including yourself?
   A. 1
   B. 2
   C. 3
   D. 4
   E. 5 or more

6. Library use
   How often do you use a library?
   A. Daily
   B. Weekly
   C. Monthly
   D. Rarely
   E. Never use it
Appendix A (Continued)

7. Library Resources
   What type of library resources do you use the most?
   A. Primarily books
   B. Primarily magazines & newspapers
   C. Primarily video & DVD’s
   D. Primarily internet computers
   E. Many library resources
   F. None

8. Internet use
   How often do you use the internet?
   A. Daily
   B. Weekly
   C. Monthly
   D. Rarely
   E. Never use it

9. Internet used for
   What do you use the internet for most of the time?
   A. Primarily email
   B. Primarily chat rooms
   C. Primarily shopping or banking
   D. Primarily research
   E. Primarily news & current events
   F. Primarily games
   G. Primarily downloading software
   H. Many purposes
   I. Never use it

10. Can you type on PC
    Can you type on a computer keyboard?
    A. Yes
    B. No

11. Internet at home
    Do you have internet service at home?
    A. Yes
    B. No

12. PC at home
    Do you have a computer at home?
    A. Yes
    B. No

13. Software use
    Do you use any of the following software?
    A. Primarily word processing (WORD)
    B. Primarily data base management (ACCESS)
    C. Primarily spreadsheet (EXCEL)
    D. Primarily presentation (PowerPoint)
    E. Primarily WORD and ACCESS
    F. Primarily WORD and EXCEL
Appendix A (Continued)

G. Primarily WORD and PowerPoint
H. Primarily ACCESS and EXCEL
I. Primarily EXCEL and PowerPoint
J. None of these

14. On-line courses
Would you be interested in taking courses on-line?
A. Yes
B. No

15. Work exp. in health
Do you have any work experience in the health services field?
A. Yes
B. No

16. HS math level
What was the highest level of high school math you completed with a “C" or better?
A. General Math
B. Pre-algebra
C. Algebra I
D. Geometry
E. Algebra II
F. Trigonometry
G. Pre-calculus
H. Calculus
I. Unsure

17. HS chemistry level
What was the highest level of high school chemistry you completed with a “C" or better?
A. No chemistry
B. Chemistry
C. Advanced chemistry
D. Unsure

18. HS biology level
What was the highest level of high school biology you completed with a “C" or better?
A. No biology
B. Biology
C. Advanced biology
D. Unsure

19. 2nd language – speak
Do you speak a language other than English at home?
A. No
B. Yes, but not often
C. Yes, regularly

20. 2nd language – read
Do you read a language other than English?
A. No
B. Yes, but not often
C. Yes, regularly
21. Type of English
Which of the five major types of English have you learned?
A. American – USA
B. British – England
C. African/Middle Eastern
D. South Asian – India/Pakistan area
E. Caribbean

22. Most enjoy – sub
What subject will you MOST enjoy?
A. Business
B. English
C. Health care
D. Humanities/fine arts
E. Math
F. Natural science (biology, chemistry, environment)
G. Social science (history, psychology, sociology)
H. None

23. Least enjoy – sub
What subject will you LEAST enjoy?
A. Business
B. English
C. Health care
D. Humanities/fine arts
E. Math
F. Natural science (biology, chemistry, environment)
G. Social science (history, psychology, sociology)
H. None

24. ESL-EngLng
How would you BEST describe your feelings about learning English?
A. Enjoyable
B. Frustrating
C. Challenging
D. Boring
E. Necessary

25. ESL-EngCulture
Which answer BEST describes your adjustment to life in America?
A. Very difficult
B. Difficult
C. Not bad
D. Easy
E. Very Easy
Appendix B

Adult Informed Consent

Social Sciences/Behavioral
Adult Informed Consent
University of South Florida

Information for People Who Take Part in Research Studies

The following information is being presented to help you decide whether or not you want to be a part of a minimal risk research study. This consent form may contain words that you do not understand. Please ask the Person in Charge of the Study to explain any words or information that you do not clearly understand. You may take home an unsigned copy of this consent form to think about or discuss with family or friends before making your decision.

Title of Study: Factors That Contribute to Mathematics Avoidance or Mathematics Confidence in Non-Traditional Age Women Attending a Community College

Principal Investigator: Ms. Jo Ann Rawley, 38 Water Street, Oley, PA 19547
Home Telephone: 610-987-0410

Study Location(s): faculty work site-Reading Area Community College

You are being asked to participate because it is important to determine factors perceived to contribute to mathematics avoidance or mathematics confidence for non-traditional age women enrolled in one of three mathematics courses at Reading Area Community College—Mathematics Fundamentals, Basics of College Math, or Algebra I. This information will serve to guide policymakers and instructors in determining ways to improve pedagogy and learning outcomes in mathematics for non-traditional age women.

General Information about the Research Study
The purpose of this study is (1) to discover, describe, explore, and understand factors that are perceived to contribute to mathematics avoidance or mathematics confidence in non-traditional age women and (2) to understand the meaning non-traditional age women attach to their experience relating to self-esteem, self-confidence, and motivation.

Plan of Study
* The maximum length of time of your participation in this study will be 16 weeks.

* You will be asked to complete a student survey to determine if you meet the study requirements. This survey will take less than 5 minutes to complete. Based on this survey, the Person in Charge of the Study will determine whether you meet the requirements to participate in this study.

* If you meet the requirements and choose to enter the study, you will be asked to participate in one 30-minute interview, scheduled at your convenience. The interview will be conducted at a place that is convenient and accessible for you. The interview will be audiotaped.
• The interview will discuss your previous mathematics experiences and background, your current mathematics experiences and feelings you are currently experiencing, and the meanings you attach to your mathematics experiences and how these meanings are perceived to affect your future education.

As a participant in a research study, you have certain responsibilities. Your responsibilities are to fulfill the interview, be open and honest regarding the questions the researcher may ask, and be available to evaluate your responses when the researcher has finished transcribing them.

Payment for Participation
You will not be paid for your participation in this study.

Benefits of Being a Part of this Research Study
By taking part in this research study, you may increase your understanding of aspects of your learning experience in mathematics and contribute to efforts to improve pedagogy and learning outcomes at Reading Area Community College. You will gain satisfaction in knowing that the meaning you attach to your mathematics experiences are valued and appreciated by the educators at Reading Area Community College.

Risks of Being a Part of this Research Study
Minimal risk exists because only the interviewer will hear the responses you will give. Your name will not be reported in the research information.

Confidentiality of Your Records
Your privacy and research records will be kept confidential to the extent of the law. Authorized research personnel, employees of the Department of Health and Human Services and the USF Institutional Review Board and its staff, and any other individuals acting on behalf of USF, may inspect the records from this research project.

The results of this study may be published; however the data obtained from you will be combined with data from other people in the publication. The published results will not include your name or any other information that would in any way personally identify you.

Tracking numbers will be assigned to each respondent. Responses will be written to a file(s) on a floppy disk. Possession and security of the floppy disk will be maintained by the investigator. Only authorized persons will be granted access to the file(s).
Volunteering to Be Part of this Research Study

Participation in this study is voluntary. If you decide not to participate, you will experience no penalty or loss of benefits to which you would otherwise be entitled. Your decision about participation will in no way affect your job status. If you decide to participate, you may change your mind about being in the study, and may stop at any time.

Questions and Contacts

• If you have any questions about this research study, contact Jo Ann Rawley
  610-987-0410
  j_rawley@hotmail.com

• If you have questions about your rights as a person who is taking part in a research study, you may contact a member of the Division of Research Compliance of the University of South Florida at 813-974-5638.

Your Consent:

• I have fully read this informed consent form describing a research project.
• I have had the time and opportunity to ask any questions that I have about the study and this consent form, and all my questions have been answered.
• I understand that I am being asked to participate in research. I understand the risks and benefits, and I freely give my consent to participate in the research project outlined in this form, under the conditions indicated in it.
• I understand that I will receive a signed and dated copy of this consent form, which is mine to keep.

Signature of Participant    Printed Name of Participant    Date

Investigator Statement

I certify that participants have been provided with an informed consent form that has been approved by the University of South Florida’s Institutional Review Board that contains the nature, demands, risks and benefits involved in participating in this study. I further certify that a phone number has been provided in the event of additional questions.

Signature of Investigator    Printed Name of Investigator    Date

or authorized research investigators
designated by the Principal Investigator

Institutional Approval of Study and Informed Consent

This research project/study and informed consent form were reviewed and approved by the University of South Florida Institutional Review Board for the protection of human subjects. This approval is valid until the date provided below. The board may be contacted at (813) 974-5638.

Approval Consent Form Expiration Date:

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Appendix C

Interview Questions

1. Why are you pursuing a college education?

2. Describe your study habits. (time, place, etc.)

3. Would you define yourself as being smart? Why or why not?

4. What is your earliest memory of math?

5. Describe a female or male teacher who had a positive impact on the way you feel about mathematics.

6. Describe your most stressful mathematics classroom experience from kindergarten through college.

7. How could that experience (from question 6) have been made more constructive?

8. How do (or did) your parents feel about your math performance in school?

9. What are your feelings regarding mathematics?

10. Do you expect to be successful in passing the math courses in your RACC program of study?

Time necessary to transcribe ________________________
## Appendix D

### Code Mapping: Constant Comparative Analysis

#### Pattern Variables

| 1. Strong evidence of personal goals | 5. Influence of teacher apparent |
| 2. High level of study importance | 6. Classroom stress common, either currently and/or in the past |
| 3. Good self-perception/Good self-efficacy | 7. Lack of family contribution by either father or mother |
| 4. Memories were vague/ memories were clear/memory of doing poorly and feeling left behind | 8. Strong feelings of being successful and having a plan to succeed. |

#### Initial Codes

| 1A. Financial Goal | 5A. Influence-Mentor |
| 1B. ** Personal Goal | 5B. **Influence-Teacher |
| 1C. Work Related | 5C. Influence-Peer |
| 2A. Importance of study-Low | 6A. **Classroom experience stress-yes |
| 2B. Importance of study-Moderate | 6B. Classroom experience stress-no |
| 2C. **Importance of study-High | 7A. Family member support |
| 3A. **Self-Perception-Good | 7B. Father support |
| 3B. Self-Perception-Poor | 7C. Mother support |
| 3C. **Self-Efficacy-Yes | 8A. **Feelings currently-positive |
| 3D. Self-Efficacy-No | 8B. Feelings currently-negative |
| 4A. **Memories vague | 8C. **Succeed-yes |
| 4B. **Memories clear | 8D. Succeed-no |
| 4C. **Remember doing poorly | 8E. **Succeed-plan |
| 4D. **Feeling left behind |

#### Surface Content

| 1A. Financial Goal (7) | 5A. Mentor (5) |
| 1B. Personal Goal (11) | 5B. Teacher (10) |
| 1C. Work related (6) | 5C. Peer (0) |
| 2A. Study importance-high (11) | 6A. Classroom experience-stress (7) |
| 2B. Study importance-moderate (6) | 6B. Teacher (4) |
| 2C. Study importance-low (2) | 6C. Peer (2) |
| 2D. Regular times (3) | 7A. Family member (4) |
| 2E. Regular place (0) | 7B. Father (2) |
| 2F. Short periods (5) | 7C. Mother (6) |
| 2G. Long periods (5) |
| 3A. Self-perception Good (12) | 8A. Power to change things (1) |
| 3B. Self-perception-Poor (7) | 8B. Powerless to change things (11) |
| 3C. Self-efficacy-yes (10) | 8C. Giving up (7) |
| 3E. Self-efficacy-no (7) | |
| 3F. Comparison to others (4) | 9A. Feelings positive (14) |
| 4A. Memory clear (12) | 9B. Feelings negative (4) |
| 4B. Memory vague (10) | |
| 4C. Remember doing poorly (15) | 10A. Succeed-yes (15) |
| 4D. Left Behind (13) | 10B. Succeed-no (0) |
| 4E. Pride (5) | 10C. Plan (11) |
| 4F. Embarrassment (6) |

** highest reported response rate from participants
Appendix E

Letter of Permission

September 12, 2002

Jo Ann Rawley
38 Water Street
Oley, Pennsylvania 19547

RE: “Factors Perceived to Contribute to Mathematics Avoidance or Mathematics Confidence In Non-traditional age Women at Reading Area Community College”

Dear Ms. Rawley:

Dr. Richard Kratz, Diane Adams, Fred Indenbaum, and myself have reviewed your research request and concur that it is a worthwhile project. Your project is approved and you may use this letter as a means of documentation.

It is understood that student participation in the study will be voluntary and will in no way detract from time in the classroom or campus activities. Good luck with your research and if I may be of further assistance, you can reach me at 610-372-4721, extension 5040.

Sincerely,

John DeVere
Associate Dean of Academic Affairs
About the Author

Jo Ann Rawley was a non-traditional age student when she entered the world of academia. She began her postsecondary education at St. Petersburg College, in Tarpon Springs, Florida, completed her Bachelor of Science and Master of Science Degrees at National Louis University—Tampa Center, and completed her Doctor of Education Degree at the University of South Florida. Her interest in mathematics education grew while working as director of the Math Lab in the Learning Support Center on the Tarpon Springs Campus of St. Petersburg College. She recognized the need to give attention to non-traditional age students, particularly women, who struggled with mathematics and often experienced mathematics as an obstacle in reaching their educational goals. She initiated research into women’s career choices, mathematics anxiety, and other feminist issues. Currently she is employed as an instructor in the Business Division at Reading Area Community College in Berks County, Pennsylvania.