

AC 2007-1602: FEMALE STUDENT VIEWS ABOUT IT CAREERS IN HIGH SCHOOL AND COLLEGE

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Female Student Views about IT Careers In High School and College

Introduction

The low overall number of women engaged in computer-based college majors and occupations has been noted for decades. While programs and activities have been offered to remedy that inequality, systematic, theory-based studies of the influences on women's choices of academic pathways that could lead to a technical career have only recently appeared. The dearth of specific information about the decision-making process along with the growing need for a technology-literate workforce¹ led our research group to investigate the factors that influence and support information technology (IT) career choices for women.

Careers in IT encompass occupations that require designing and developing software and hardware systems, providing technical support for computer and peripheral systems, and creating and managing network systems and databases². IT workers enter the field from traditional undergraduate majors, like computer science, as well as from nontraditional areas that heavily incorporate technology into their curriculum, including statistics, graphic design, and business management. While women make up about 46% of the U.S. workforce, they comprise only about 23% of the professional IT workforce – and fewer than 10% are in IT management positions³. Some have attributed this low participation rate to computer phobia but research findings present a different picture. A report by the American Association of University Women⁴ suggests that rather than being reluctant or unable to use computers, girls were critical of the computer culture and turned off by the violent nature of many computer games and the monotony of some computer applications. They saw little connection between computer work and other people or to meaningful, real world problems. Our goal was to drill down into the attitudes of these young women and discover the pivotal events and influential people that formed their opinions about IT and the suitability of an IT career for women.

We used as our theoretical framework the theory of self-authorship developed by Dr. Marcia Baxter Magolda. Self-authorship, according to Baxter Magolda^{5,6}, is simultaneously a way of making meaning, an ability to create an identity that is separate from external influences, and an ability to engage in relationships without losing oneself⁵ (p. 12). Like the concepts of agency and self-efficacy^{7,8,9}, it centers on the ability to make decisions without undue influence by others. It reflects an internalized sense of self. Research suggests that young girls, particularly white girls, often lose voice or agency by early adolescence and grow increasingly subject to the opinions of others¹⁰.

Self-authorship is fostered through activities that promote social interaction and teamwork, as well as through activities that make the tie to personal experience by creating settings where students solve or propose ways to solve real-life problems that are meaningful to them⁶. It also can be developed by activities that promote critical thinking, including critiquing software and evaluating web sites. We sought to identify activities in the home, school, and community that might promote self-authorship and to explore its relationship to choice of an IT career¹¹.

Our research goals were to identify the critical influences on girls' career selection processes and to analyze the key transition points in the experience of girls and women with technology. In addition, we examined how the choice of a nontraditional career path might be associated with women's development of self-authorship. In this paper, we will examine the commonalities and differences between high school women who had the skills, abilities, and interest in computer-based activities and college women. This paper will analyze the critical influences on career selection processes female students use in computer-based fields and recommend practices for college advisors and educators about successful strategies to recruit and retain female IT majors.

Methods

The overall data collection process and analysis methods are presented in great detail in previous work¹². Briefly, we began by recruiting a sample of high school and university students in urban and rural areas of Virginia and then expanded our pool with students at the Pennsylvania State University College of Information Sciences and Technology (IST). Our total sample was racially diverse (21% African American, 4% Asian American and 70% Caucasian) and all socio-economic levels were represented.

We developed a 167-item, paper questionnaire that underwent three revisions between 2002 and 2006. The final instrument includes 11, 4-point Likert scales designed to measure levels of parental support, decision orientation, receptivity, opinions on diverse viewpoints, information sources, information credibility, important factors in career choice, attitude toward IT workers, computer use, familiarity with computer-related careers, and IT career interest and choice. The reliability of the five key variables that we used for this study (levels of parental support, decision orientation, attitude toward IT workers, computer use, and IT career interest and choice) ranged from Cronbach's $\alpha = .60$ to Cronbach's $\alpha = .71$, which indicates satisfactory levels for internal consistency. Female high school students (High School, $n=293$) were surveyed in 2004-05 to give a *prospective* view about their attitudes toward IT courses, possible college majors, and career paths. Female non-IT majors in 2004-05 (College 1, $n=80$) and female IT majors in 2005-06 (College 2, $n=22$) were surveyed for a *retrospective* view about how they came to their decision about their college major.

Our quantitative data analysis was performed using one-way ANOVA with the Welch's method to determine differences in variables between three groups: high school females, college students in non-IT related majors, and college students currently in an IT-related major. The key variables tested were: parental support for careers, decision orientation, attitudes toward IT workers, computer use, and IT career interest and choice.

In order to fully understand the scope of the factors that influenced their attitudes and actions with regard to computers and computer-based study and careers, we interviewed a subset of each group. The interview protocol was developed and refined over time. We used semi-structured interviews that were conducted face-to-face and by telephone. The questions included asking participants to identify an important decision they made and to talk about how they went about making that decision.

During the analysis of the first round of interviews, we found that parents were central to the decision-making process. For that reason, we added a question about the role of parents in the process. The protocol included questions such as: (1) Please tell me about some important life decision you have made in the last few years. (2) What process did you go through to make a decision about your major and career interests? (3) Were there events or incidents in your life or people who played an important role in your decision? Who were those people and what role did they play in the process you went through to make the decision? and (4) What role did your parents play in the decision-making process?

To analyze the interview data, we used a deductive and an inductive method to identify the coding scheme for the transcripts. The deductive element consisted of codes developed in previous research. The inductive element refers to codes that emerged during the process of analyzing the transcripts. We used multiple readers and an iterative process, coding and recoding transcripts until agreement was reached about the codes and their definitions. We coded the transcripts again and, after meeting and discussing the level of agreement about the coding, entered the data into the qualitative software ATLAS.ti. In reporting the findings, we used both the original transcripts and printouts from ATLAS.ti of the summarized responses to the key variables we identified in the study.

Results

In examining the overall group differences in key variables from the questionnaire data, we found some interesting trends (Table 1). The one-way ANOVA results with the Welch's method showed that there were no statistically significant group differences in the level of parental support among the three female groups. However, in the cases of decision orientation and attitudes towards IT workers, both College 1 and College 2 groups were not significantly different from each other whereas these two groups were significantly different from the High School group. High school students were more likely to be decision oriented and have positive attitudes towards IT workers. In the cases of computer use and IT career interest and choice, all the three groups were significantly different from each other. College 2 students were most likely to use computers than the other two groups and College 1 students were most likely to be interested in IT careers.

Parental Support. There exists a large body of evidence that parents are key sources of support for high school and college women^{13,14,15}. The questionnaire data we collected agreed with those findings and showed that parental support for students' career choice increased slightly, but not significantly, as students moved from high school through college (Table 1). As a key source of career advice, parents of high school and college women gave general advice and supported career exploration.

In a qualitative study about family influences on vocational exploration and career decision-making¹⁶, it was found that most of those interviewed felt that their parents and siblings had a positive influence. For those high school women who had the ability and interest in an IT career, at least one parent or sibling specifically encouraged IT as a career. We did find, however, that when a family member worked in IT, girls were often deterred from entering IT because the idea

that IT is a male-dominated profession was often reinforced. College women continued to see their parents and family as a strong source of support for remaining in a computer-based major.

Table 1. High School and College Women Group Differences ($N=398$)

Variable	Group [†]	n	Mean [§]	F^{\ddagger} (<i>df1</i> , <i>df2</i>)	Group Differences [#]
Parental Support	High School	293	28.59	1.05 (2, 58.82)	
	College 1	80	29.50		
	College 2	22	28.77		
Decision Orientation	High School	293	38.29	7.52** (2, 61.34)	a
	College 1	80	26.24		b
	College 2	22	34.82		b
Attitudes about IT workers	High School	293	23.53	24.18*** (2, 61.62)	a
	College 1	80	21.40		b
	College 2	22	20.00		b
Computer use	High School	293	13.72	38.09*** (2, 72.58)	a
	College 1	80	16.10		b
	College 2	22	17.59		c
IT Career Interest and Choice	High School	293	20.01	29.933*** (2, 68.73)	a
	College 1	80	20.78		b
	College 2	22	20.61		c

Notes. † College 1 group: students in non-IT major; College 2 group: students in IT-related major.

§ The higher the value of the mean, the more positive the interpretation (for example, the more parental support; the less outside influences on decision making; the more positive attitude about IT workers; the more computer use; and the more interested in an IT career).

‡ F results shown in this table were based on one-way ANOVA using the Welch's method due to the heterogeneities of variances across the three groups. * $p < .05$, ** $p < .01$, *** $p < .001$

In the Group Differences column, if the group shares the same letter, they are not statistically different from each other. For example, in the case of Decision Orientation, both College 1 and College 2 groups share the letter b, which means that they are not significantly different from each other. However, the two groups do not share the letter a, which means that they are significantly different from the High School group. In the case of IT Career Interest and Choice, no groups share the same letter, which means that they are all significantly different from each other.

Anna's parents see the value of a career in a computer-based field but have given her general support, too.

Well they [parents] taught me, they encourage me but they also encourage me to do something with computers. That's the big thing now these days. They don't discourage me to not be anything but they encourage me to look into computers and look at something with them now. (Anna, high school)

When asked by the interviewer, "If you had to pick one person or thing that has had the most influence in your career decisions, who or what would you say it is?", Kristen emphasized the

role her mother plays in the decision-making process. As we saw in other interviews, Kristen's mother is taking the lead in information gathering and also acts as a role model for her daughter.

My mom. Most definitely. Just because she's open to any option I have, pretty much, but she's also, she's probably done more work to help me figure out what I want to do. More than I have. And she's always, I mean not just with career things, but she's always been an inspirational person, with everything. (Kristen, high school)

As a college student, Stephanie values her parents' opinions. By listening to their own struggles, Stephanie has placed a high value on their opinions.

Yeah, my parents are major influences in my decisions like going through school and once I graduate and getting a job, because they've gone through that same thing. They've gone through college, they've gone through the whole career process, and so I think it's important to, you know they'll give me points on how to approach certain ways and getting jobs and looking for jobs and talking with companies and I just value their opinions and basically take their suggestions for me because they've gone through it and they've messed up so they know what to do and what's not good to do. (Stephanie, college)

In Elizabeth's interview, she mentions how the "value" and respect shown by her parents toward her is important to her. Other women mentioned that their parents are willing to listen to their ideas and value their – the child's – opinions and respect their decisions.

I don't know, for some reason parents' opinions of what you're doing in your life, their value of you, their respect for you is still important ever since you were a kid, for some reason. (Elizabeth, college)

Leah is moving further along on the self-authorship scale. She tells us that her parents have an input into her decisions, but that she is the one to decide.

Ok, my parents they'd probably help me out a little, tell me, give me ideas if it was a good decision or not, if I described like what was going on there, they'd tell me, they'd say, they'd either say oh it sounds good or it doesn't sound so good but either way they wouldn't tell me what to do. (Leah, college)

In this exchange, we see that Cathy's parents have confidence in her decisions and would be happy with the final outcome of her decision-making process.

Well they're my parents and of course I respect everything they say. So since they're encouraging, I think they'd be encouraging about any job because that's the way my parents are (Cathy, college)

Decision orientation. Female college IT majors had significantly less confidence in their decision orientation or in the clarity of their career goals than did high school women (Table 1). Female High School students reported significantly higher scores than both female College 1 and

College 2 students in the decision scale. Although there is an overall downward trend, there is no significant difference in the decision scores between female College 1 and College 2 students.

Julia relates a common concern: that although she likes working on computers, she will fail in a computer class. Other girls we interviewed who had enrolled in high school computer classes said that they felt out of place in the mostly male environment.

I thought about it some - to do something with computers [be]cause I like computers a lot. And I like working with them. I just don't think I would comprehend and understand it very well if I got into it... I just think that if someone sat down and tried to teach me to how to do something I wouldn't get it - but I can figure out how to do stuff on my own, but I am just scared to sit down and actually go through a class. I am scared, you know, that I won't understand it and then I will fail it. (Julia, high school)

Jennifer reflects a lack of understanding about the range of computer-based occupations there are. She has not had access to information about how a job in IT can involve interacting with people in a way that is helpful.

Well, I took a lot of classes in high school, like, software and the software classes, CISCO. I took that kind of stuff because I had found myself really good at it. It came easy to me, but once I took the classes they were fun, but I don't really, I never really wanted to do that for the rest of my life. Not, but I always thought of it as, I really liked it though. I don't think I ever thought of it as a career... I love computers but I don't think, I would like to be around people a whole lot more than sitting there on this computer. I like computers, don't get me wrong. I could be on those things all day, but I'd rather have something that's more interactive, that I could be with everyday. Something that would be different every day. (Jennifer, high school)

Female college IT students still have doubts about being able to succeed in the major, but they have enough confidence in their ability to "take a chance" as we see in Mary's comments.

I guess when it comes down to it you just have to take a chance sometimes, you know you choose the wrong path, but you learn from that and you try and find another route, but I think always that you should just trust your instincts and listen to you know advice from your parents and other people, but you always have to, you never know. So that's what I try to do. (Mary, college)

The male computer/IT culture remains, as we see in the comments of Kaitlyn and Amanda. In Amanda's case, she was drawn back to computers after trying another major first.

...some of the guys think they know everything about everything. We do everything in groups so you have to prove yourself a little more. The boys somehow know every little thing about every technical thing and I never wanted to know about it. I kind of wish I knew it, but I will know it eventually. (Kaitlyn, college)

There was so much stuff I wanted to learn but there was so much I didn't know and there were a lot of guys in the major so that's why I didn't want to jump on it right away, and I went into marketing first. (Amanda, college)

Ashley has a realistic picture about her future. She knows she will have to deal with life-long learning and the pressures and challenges of having a demanding career and a family life.

I probably do doubt sometimes that I'm not always going to be on top of the technical things because it's always evolving. Always everything is changing so I'm going to have to change. I'm going to have a family some day and take some time off work and since everything is changing it's going to be hard to go back. (Ashley, college)

Attitudes toward IT workers. Positive attitudes toward IT workers declined significantly from high school to college (Table 1). College 2 students had the least positive attitudes compared to College 1 and High School students. Perhaps because of their experiences with male students and professors, female college students had a more negative view of IT workers than high school females. High school students, either due to their lack of experience or because of generational differences, have a more positive view of IT workers.

Someone who is able to think more creatively and is self-motivated more than someone who needs clear cut directions from the professor. A lot of times you can ask the professor for clarification and they ask you what you think the solution is. You really have to be able to think more broadly than other majors. (Abigail, college)

Computer use. As expected, computer use in all applications increased from high school to college (Table 1). College 2 students used computers most compared to College 1 and High School students. During interviews, female high school students reported having easy access to computers at home, school, or at a friend's home, and they used computers daily. When asked, most high school girls could not remember a time when they were not able to use a computer. While a few identified themselves as "gamers," most used their computers for communication (IM and email), to gather information, and to complete school assignments. During the first years of college, women IT majors saw an increase in class assignments that required computer work. Female IT majors used all computer applications adding job searching to their use time.

I use computers to listen to music, to look on the worldwide web, find different people, talk to people via the internet, email people. It's changed a lot, like I do a lot more communication on the computer than I do over the telephone or anything like that. (Hannah, high school)

I think I use computers for everything now. I just bought a laptop so I use it to take notes on it in my lecture classes, type up reports. I use the internet like unbelievably, I can't survive without it, there are so many classes where internet access is mandatory. I also do the downloading music thing and burning CDs. (Ainsley, college)

IT career interest and choice. An understanding by college women of what an IT job entails and their ability to see themselves as IT workers increased significantly when compared with high school women (Table 1).

Lauren has a rather elementary idea of what an IT job might be like.

Basically just like work with computers and fix them and fix what's wrong with them and um, basically just work with them all the time. (Lauren, high school)

Emily gives us a more general view of IT when asked what IT careers entail.

Career in technology is like exploring new things and how to operate stuff. The technology is getting so good and getting like...technology, it's hard to, you know, it's hard to kind of explain it but...technology is like the future. (Emily, high school)

But, when asked what kind of job an IT worker would do, she is rather vague, saying, "Technology is computers, um, I think computer, electricity, and stuff like that."

College women who were IT majors had, not surprisingly, a better idea about their future in IT. Interestingly, College 1 had more interest in IT careers than College 2. It may be because College 2 students were more likely to have ideas about their specific career paths while College 1 students were more likely to explore diverse options.

Cecelia reiterates that changes and progress in technology will require her to keep learning, but she feels confident in facing that challenge. Courtney emphasizes the variety of IT jobs including those that would allow her to work from home. Kristi echoes the enthusiasm we heard from most IT majors about their job prospects and the possibilities awaiting them when they graduate.

Computers are always changing, there is always something new to learn and I never wanted to stop learning, I always wanted to continue it. There are also a lot of good jobs so after I graduate I won't be struggling. There are also a lot of jobs out there so I won't have to worry about that. (Cecelia, college)

I know there are a lot of projects you work on but with technology now you can do a lot of things from home and you don't have to go in everyday and that would be helpful. If I could work at home then I could do it on my own schedule as long as I get everything done by the deadline. (Courtney, college)

I think it's just a booming field and there are a lot of opportunities and it's not restraining, there are a lot of opportunities. I could have an IST degree and work for a pharmaceutical company if I wanted to because technology is relevant and prevalent in every field and aspect of the economy. You have to have technology, even basic business decisions have technology in the background. There are so many possibilities that either way I can't go wrong and I can find something relevant to myself. (Kristi, college)

Susan brings in the “helping people” idea and gives some specific examples. She has a fully formed picture of the variety of IT jobs and how IT is integrated into our culture.

The technologies we study are new technologies that are coming out, that are helping people, such as in the medical field with surgeries. They are able to have robots that do things and they even have robots that can vacuum for you which is amazing. I want to be able to help people to make their lives easier, that’s the most important to me and being in a field doing that. Any company needs to have some kind of technology in there to manage the company, it’s very important to have that in order for a company to excel. That is something that really attracts me to it. A doctor helps save people’s lives, so do IT people. They provide the machinery that saves lives and get rid of the manual labor to make it easier. (Susan, college)

Discussion

In an attempt to identify specific intervention strategies that could act at attitude transition points, we collected quantitative and qualitative data from girls in high school and college. These data helped us understand who and what influences girls’ attitudes about their place in an IT career path.

Parents, particularly mothers, have a substantial influence on girls’ career decisions^{14, 17}. This influence is maintained, albeit to a lesser degree, throughout the college years. We found that, in our sample population, most female high school students were quite dependent on their parents for career direction, as we saw in Kristen’s comment that her mother was “doing more work to help me figure out what I want to do” than Kristen was herself. College women still looked to their parents for affirmation but were now making their own choices. This transition over time indicates a shift from one who looks to an external authority to make decisions for them, an absolute knower in terms set forth by Baxter Magolda^{5,6}, to someone who can gather information and analyze it for herself as a transitional knower.

Once in an IT major, our female college students surveyed seemed to lose some confidence in their decision-making abilities compared to high school girls. Some of the variation we see may be due to the difference in numbers surveyed. In interviews, conversely, most college women, particularly those in their last two years of college, felt secure in their decision to pursue an IT career. They realized they would face some challenges, but they were confident they could meet and overcome those challenges.

Negative stereotypes about IT workers (being “geeks” or “nerds”) seem to be waning, perhaps because so many students use technology (cell phones, text messaging, iPods™, computers, DVD players, and pagers) so effortlessly. This finding is different from past research that showed girls more than their male peers had a negative view of those who work in computer-based fields. This may be a result of the nearly unanimous use of computers, from an early age, for a variety of tasks from entertainment to education. Because they were skilled in computer work and spent many hours on the computer, girls did not want to define themselves as “geeks” or “nerds.”

Finally, the knowledge about what IT jobs entail increases with age and education, as we expect. College women had a more finely honed sense of the possibilities inherent in an IT career while high school girls could only mention the most common cultural perceptions about IT work: that it was repetitive, mostly programming, not especially creative, and was a solitary work environment.

We extrapolated our findings to help advisors effectively counsel entering female students when they choose their major and retain females in computer-based majors like IT. The major finding was that advisors must find ways to include parents in their advising plans. Recent reports suggest that parents of college students are more involved in course selection and career planning than in the past. Thus, the student-parent dyad must be considered in any advising plan. Our suggestions include:

- Develop students' opportunities to practice making complex decisions and to defend a position.
- Expose students to multiple perspectives and to the idea that many problems have no clear answers.

These two suggestions will require advisors to reach out to instructors and parents so that students can test their decision-making and develop confidence in their decision-making abilities without fear of failure or retribution for making the "wrong" decision.

- Develop a trusting relationship with students
- Validate the student as knower by reinforcing the role of self in personal and career decisions.
- Steer students to information about the range and depth of IT jobs.

A recurrent phrase in interviews was that students listened and followed their parents' career advice because, "They know me best" and "They have my best interests in mind." Advisors must become that "trusted other" in order for the student to be open to the information that the advisor is presenting. Only then will the student hear what the advisor is saying.

- Introduce students to real life stories about career success and overcoming barriers success, and about how to deal with work/life balance.

Students told us again and again that having a female or male teacher who had worked in an IT field made more of an impression on them than someone who had never had that real life experience. Female students who are thinking ahead to careers want information about what kind of quality of life they can expect if they enter an IT career.

- Give students strategies to help them match their skills, abilities, and interest with the IT major.

Finally, students in high school must be able to see how their interest and ability match an IT position. Many times, high school girls who were their family's technical support person were steered into other career paths by well-meaning parents. Parents, as well as educators, were not

aware of the possibilities inherent in IT work and had a very superficial view of computer-based professions.

None of these suggestions should be implemented in isolation. What we surmised was that programs need to be developed with multiple activities; ones that can help the student develop a sense of themselves as decision-makers and show them how to match their skill, interests, and abilities with the range of IT professions.

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