

Project Description

Recent and ongoing research on gender issues in recruitment and retention of women in IT fields of study has focused either on women in computer science departments, or on women in a broad range of computing-related academic disciplines. (Cohoon, 2001; Cohoon, 2002; Computing Research Association 2002; Margolis & Fisher, 2001) However, in recent years, new programs emphasizing a broader (and often more human-centered) perspective on computing have begun to emerge, often using the specific term of "information technology" to describe the discipline. (Denning, 2001; Mitchell, 2002)

While IT is not yet as clearly defined as other technology-focused academic disciplines—including Computer Science—recent work on IT accreditation by the newly-formed ACM SIG on Information Technology Education (SIG ITE) has helped to clarify its boundaries. Core areas of programmatic focus include programming, computer networking and hardware, databases, web technologies. In addition, the curriculum focuses on underlying principles of these core technologies, the importance of user requirements in system design, and the social and ethical implications of information technologies. (See <http://site.it.rit.edu/> for the draft accreditation guidelines.)

Rochester Institute of Technology was the first university in the United States to form a department and offer a degree program in Information Technology; the Bachelor of Science in Information Technology degree was first offered in 1992, and was followed by a Master of Science in Information Technology in 1996. At RIT, the Information Technology department has differentiated itself from the other departments in the new "College of Computing and Information Sciences" (Computer Science and Software Engineering) not only through its name, but also through its curriculum; the IT program has a much stronger human focus, and a more contextual and applied approach to technology.

Over the past ten years, a number of academic programs across the United States have based their new IT programs on the RIT curricular model. RIT's IT department is no longer the only option for students seeking a degree in Information Technology, but it remains the largest. In fall of 2002, undergraduate headcount was over 2000 students, and the entering freshman class was 205 students.

RIT has also been a leader among the growing number of programs self-identifying as IT. In 2002, a group of universities from across the United States began working together to develop possible standards for accreditation in this new academic discipline. That initiative resulted in three conferences on Information Technology curriculum, and the formation of a new Society for Information Technology Educators, which will soon become an ACM SIG. The organization is also working with ABET to develop an appropriate set of accreditation guidelines for this emerging discipline. RIT is playing a key role in this process, hosting the fall 2002 conference, and providing leadership in the organization (the president and vice chair for activities are RIT IT faculty members). As the number of departments has grown, and the nature of the discipline has become more clearly defined and differentiated from related computing fields, the need for a better understanding of the IT environment is critical. Conventional wisdom and some research (AAUW, 2000) indicates that women will be more attracted to programs with this type of human focus than those with more mechanistic approaches. It remains to be seen if systematic research will validate those assumptions.

As noted above, there is existing and ongoing research into gendered attrition in CS. However, the issue of attrition in both undergraduate and graduate programs has been shown to be significantly different across academic disciplines; for example, Cohoon et al showed the disparity between gendered attrition rates in CS and Biology (2001). Accordingly, we cannot assume that these new departments and colleges of IT will necessarily have attrition rates that are comparable to—or based on the same factors as—those in CS.

We do know that the number of women entering the RIT IT program is distressingly small in relation to the size of the program. During the 2001-2002 academic year, preliminary numbers obtained from the department indicate that 34 of 318 entering students were women—only 11%, well below the overall national average of 28%. Preliminary numbers from fall of 2002 appear to show only 17 of 205 entering freshmen as women—a total of only 8%. We also know that of the ~120 students who transferred out of IT or left RIT entirely during 2001-2002, at least 18 of these were women—15% of the departing population. While this study is not intended to address the obvious “pipeline” problem affecting enrollment in the program, it will attempt to identify key factors in the decision of women in the program to enter this field of study. More importantly, it will attempt to determine why the proportion of women *leaving* the IT program is higher than the proportion *entering* the program.

The primary research question of the proposed research is “What factors are most influential in the decision of female students in IT undergraduate programs to enter these programs, and, where applicable, what factors most influence their decision to leave their programs during their first year of study?” An ancillary question is whether those influential factors for women in IT programs are comparable to those for women in CS programs. The goal of the study would be not only to answer these questions, but also to develop recommendations for IT program recruiting, curricula, and student support based on those answers.

This study would be done in two parts, spanning two years. The first year would involve the development and implementation of a qualitative study of students entering the IT department at Rochester Institute of Technology as freshmen. All freshmen women, and a randomly selected sample of freshmen men, would be interviewed upon entrance into the program, and at the end of the academic year. Based on the information gained in that study, key factors related to women’s persistence or attrition in the IT program would be identified.

In the second phase of the study, the results of the qualitative research would be tested by administering a survey based on those results to female students from IT

programs across the country. Using the membership of the Society for Information Technology Education as a starting point, IT programs nationwide would be identified for inclusion in the research. To statistically adjust for variations in programs, each institutional participant would be asked to complete a separate demographic survey. The purpose of the institutional demographic survey would be to obtain descriptive information about IT programs. For example, this secondary instrument might ask questions about the location of the program within the organizational structure, presence or absence of CS programs within the same organizational unit, faculty demographics and other factors. This survey would also be used to collect data about the number of women entering the IT program over the past 2-5 years, and the number of women known to have left the program (transfers out of the program, or departures from the institution). By collecting descriptive information about other IT programs, desirable adjustments in analysis are possible. Additionally, aggregate information about IT programs would then be available for current and future research.

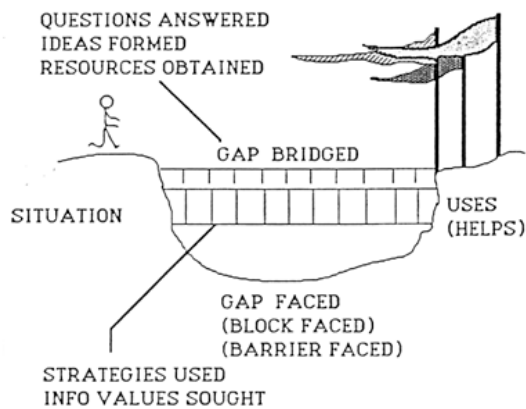
Until the participating institutions have been identified, and enrollment figures from those institutions have been received, it is difficult to accurately predict the total number of women who will be surveyed in the second phase. However, extrapolating from the RIT population (which has approximately 50 women entering per year), based on an assumption of 20 schools participating (many with smaller enrollments than RIT, which has one of the largest IT programs in the country), the total population of women in the programs involved would be 500-800 for each program year. A list of all students enrolling in the program for the year of the study, and the year previous to the study would be requested from the participating institutions, and a random sample of each population would be surveyed.

The qualitative portion of the study would use Dervin's Sense-Making approach for both its methodology and its analysis of data. (1987, 1992) This methodology is a primarily qualitative research method developed by Dervin that attempts to identify the ways in which individuals make sense of their surroundings and actions in a given situation. The Sense-Making methodology can incorporate a range of data

gathering methods, including participant interviews, questionnaires, and document analysis.

The key concept underlying the Sense-Making approach is the shift from what Dervin terms a “systems perspective”—where researchers study a given system through the eyes of the professionals associated with that system—to what she calls a “people perspective”—seeing the system through the eyes of the user. This shift in focus has been very useful in changing the nature of needs assessment and accountability research in the context of large systems such as libraries, hospitals, and technological infrastructures. As an illustration, systems-oriented research typically asks questions that focus on the system itself—for example, asking a student “what do you like about the department”, or “what do you think of the services we offer.” People-oriented research, in contrast, would involve asking the student to talk about his or her needs, and how the program met or did not meet those needs.

Also central to the Sense-Making approach is the understanding of a given user’s decisions and choices being situated in a specific time and space context. Sense-



**Illustration 1:
The Sense-Making Metaphor**

Making conceptualizes the user as traveling on a life path, and encountering obstacles or challenges that force detours from the expected path, as shown in Illustration 1.¹ These troublesome situations, or “gaps” as Dervin terms them in her model, are typically the triggers that lead a user into a given system (a need for information might lead a user to the library; a need for medical assistance might lead a user to a hospital), as well as precipitating departures from the system—either because the gap has been

¹ Illustrations adapted from Dervin & Clark (1987)

successfully bridged, allowing the user to continue on his or her path, or because the user was unable to bridge the gap, and thus took a different path.

The Sense-Making methodology attempts to isolate what it is about an individual's experiences that leads them to choose a particular path through a system, and to discover how it is that individuals handle troublesome situations in their navigation of a system. Dervin defines a troublesome situation as "any situation...where a person faces some kind of gap preventing movement ahead," and provides the following possible characterizations of such a situation:

- being out of control and seeming to have no direction
- being dragged down a road not of your own choosing
- having to choose between two or more roads ahead
- facing a barrier between you and where you want to go, and
- needing to follow someone who has been there before. (Dervin & Clark, 1987)



Illustration 2:
The Sense-Making Triangle

focuses on the blocks (what stops the person from accomplishing their goals), the questions (what information does the person seek), and the helps (what assistance would the person like to receive). These questions form the "Sense-Making triangle" shown in Illustration 2, allowing the researcher to "circle the experiences of the individual" and begin to make the difficult topic of human motivations approachable in a systematic way.

The basic Sense-Making research tool is a "time-line" interview, during which the subject is asked to reconstruct, step-by-step, a specific problematic situation,

focusing in turn on each of the sides of the Sense-Making triangle—the blocks encountered, the questions arising, and the helps sought. This interviewing process is highly detailed and time-consuming, but yields a richness of results that is difficult to match in any other form of interviewing. Because such interviewing is not always practical, however, the Sense-Making techniques have also been adapted to a number of other methods, including brief interviews, questionnaires, and document analysis. In her 1999 dissertation, the PI of this proposal implemented the Sense-Making methodology through an e-mail version of the timeline interview, which yielded data comparable to, and in some cases richer in detail than, traditional in-person interviews (Lawley, 1999).

This type of situated approach is encouraged by Tinto in his influential book on undergraduate attrition, *Leaving College* (1987). He argues that our current understandings of student attrition are seriously flawed specifically because we do not look at the time-space context of student decisions to leave their schools:

Successful retention efforts are difficult to mount, if only because of our continuing inability to make sense of the variable character of student leaving. Despite the extensive body of literature which speaks to the question of student departure, there is still much we do not know about the longitudinal process of student leaving and the complex interplay of forces which give rise to it. Furthermore, much of what we know is wrong or at least misleading. A good deal of the literature on student dropout is filled with stereotypes of the character and causes of student departure. For instance, student dropouts have been frequently portrayed as having a distinct personality profile or as lacking in a particularly important attribute needed for college completion. As a consequence, we have been given the mistaken view that student dropouts are different or deviant from the rest of the student population. (p. 3)

This argument supports the appropriateness of Sense-Making as a tool for understanding attrition, since it is one of the few methodologies that does address the “variable character” of the people and events it studies, and acknowledges the time-space situatedness (“longitudinal process”) of those events and activities as well.

When Sense-Making research focuses on needs assessment, the interview focuses on the “what” questions: what gaps were faced, what questions were asked, and

what helps were sought, with an emphasis on the nature of the gaps encountered. In contrast, Sense-Making research on accountability focuses more on "whether" questions: whether gaps were faced, whether questions were answered, and whether helps were sought, and places particular emphasis on the nature of the helps encountered and the role of the institution in providing those helps.

In a response to a request for assistance in developing the instrument for the dissertation research on doctoral attrition that serves as the basis for the methodology proposed in this study, Dervin commented:

The topic [...] deals with what I call path-changing -- moments of BIG gap-bridging when people change the roads they are on. It's important, I think, in studying such moments to free oneself as much as possible from pre-conceptions -- e.g. that money drives these changes, or that these changes are self-controlled, etc. --because these pre-conceptions lead one to "name" the world for respondents/informants. [...]

[S]he might consider not studying her topic directly because to do so catapults respondents into a world so constrained by expectations. Think, for example, of the difference between asking people about major times in their lives when they made path-changes, or perhaps times when they set out to do one thing and ended up doing another. Compare this with asking them what happened that led you to drop out of LIS? (personal communication, September 25, 1996)

This indirect approach to the topic being studied is something that sets the Sense-Making methodology apart from many other forms of qualitative and quantitative research. Sense-Making's focus on the time-space situatedness of the "troublesome situation" means that the decision to attend (and/or leave) an academic program must be viewed in a larger context, one that the researcher cannot identify independently of the subject. What are the troublesome or significant situations that lead women to choose a program of study in IT (as opposed to CS or other fields), and what are the situations that lead them back out of that program? Once those situations and associated "gaps" have been identified, one can more easily identify the "helps" that they find in their undergraduate program that either bridge the gap that led them there, or prevent them from detouring back off again. Additionally, the focus on "helps" in the Sense-Making model moves the inquiry away from identifying only the troublesome or problematic aspects of the students'

experiences, and allows the researchers to identify and describe specific aspects of the experience that were positive and helpful.

Once the qualitative component of the study has been completed, descriptive analysis of the results will allow us to identify key criteria for data gathering in the larger population of women in IT programs nationally. The data analysis will be done first by hand, using color-coding of passages to identify key themes and narrow down coding categories. Qualitative analysis software (either NVivo 2.0 or HyperResearch) will then be used to code the electronic versions of the documents and refine categories. The full methodology used for this analysis is described by Lawley (1999).

Using categories identified in the qualitative analysis, we will develop a web-based survey based on the original instrument to be administered to women at as many IT programs as we can recruit to participate.

Project Timeline

Summer 2003

During the summer of 2003, the Sense-Making interview instruments for qualitative phase of study would be developed and refined. The graduate and undergraduate student positions would be posted, the applications would be reviewed, and students would be selected to work on the project. Software would be purchased for the analysis of the qualitative data, and installed on the computers of the investigators and the graduate assistant. Books related to both attrition and qualitative research would be purchased for use by all members of the project.

Fall 2003

During freshman orientation, all women entering the IT program would be approached individually and asked to participate in the project. A randomly selected sample of freshmen men would also be approached regarding participation.

Assuming enrollment numbers for 2003 are slightly higher than those in 2002 (reflecting RIT's current push for growth in the college housing IT), this would be between 40 and 50 women, and approximately 20 men. They would be offered a respondent's incentive fee of \$25 to be provided at their first interview, and notified that an additional \$25 would be provided at the end of the academic year to those who had completed the second interview. Those agreeing to participate would be interviewed by the investigators during the first month of the quarter, with a focus on situations and factors related to their decision to enter the IT program. Interviews would be conducted and recorded in the IT department's HCI lab.

Given the relatively small size of the population, the non-intrusive nature of the inquiry, and the financial incentive provided, we expect close to a 100% participation rate by the students approached for this qualitative portion of the study.

Upon completion of the interviews, the data would be transcribed, and then entered into qualitative analysis software for initial coding and analysis of data.

Investigators would attend the fall 2003 conference of the new Society for Information Technology Educators (SITE) in order to begin soliciting participation by other institutions in the second phase of the study. Based on informal communication with faculty and administrators from a number of schools represented in SITE, we expect enthusiastic participation from most (if not all) of these schools. The data gathered will be useful to all programs in IT.

Winter 2003-2004

During the winter quarter, analysis of the data would continue, and a preliminary project web site would be implemented, focused primarily on providing information about the project to schools that might participate in the second phase of the study. After completion of the site, investigators would begin contacting and soliciting commitments for participation from IT programs other than those attending the SITE conference.

Spring 2004

At the end of the academic year, in-depth e-mail interviews would be conducted with all participants, along with brief in-person interviews. These interviews would focus on their overall experiences during their first year of study.

The list of institutions participating in phase 2 of the study would be finalized at this time, and the institutional survey would be developed.

The web site would be expanded and enhanced to enable support for delivering the phase 2 survey electronically and storing the results in a back-end database.

Summer 2004

Detailed analysis of the data from all interviews would take place after the end of the school year. Based on that analysis, the survey instruments for the second phase of the study would be developed. One would be based on the Fall 2003 interviews with entering students, and would be administered to female students entering the IT programs. The other would be based on the Spring 2004 interviews with students at the end of the academic year, and would be administered to women who had matriculated as freshmen the previous year (whether or not they were still continuing in the program).

The student surveys would be integrated into the project web site, in preparation for administration in the fall. This would include development of security and privacy measure to ensure protection of data during transmission, and after receipt.

Each of the schools agreeing to participate in the study would be visited by one of the investigators over the summer, in order to gather detailed information on the program itself, arrange for the completion of the institutional survey, and plan for the introduction of the study and survey to the targeted populations.

Fall 2004

All women entering IT programs at participating institutions, and women who had entered the IT programs the previous year, would be asked to participate in the survey. Those agreeing to participate would be given instructions on how to access the web-based survey, and encouraged by local faculty/administrators as well as the project investigators to complete the survey. The web site would be designed to validate students when they log in, but to store the login information separately from the responses, so that responses cannot be correlated with specific students (in order to protect anonymity). As an incentive to participate, students completing the survey would be registered for a drawing of several \$50 prizes.

If participation rates are low on the survey, the investigators will attempt to arrange telephone or chat-based focus groups with a random sample of students from the participating schools.

Both principal investigators would attend the SITE 2004 conference to present results of the first phase of the study, and discuss the expanded research agenda of the second phase.

Winter 2004

Data from the phase 2 survey would be analyzed and compared to the results from the qualitative research done in fall of 2003. Statistical analyses would be performed to determine relationships between variables, and assess their significance.

Spring 2004

During the spring, the results of the data analysis would be disseminated via the project web site. The results would also be used to develop recommendations for IT programs regarding recruitment and retention of women.

Dissemination of Results/Impact of Study

The results of the research would be presented in papers at the ACM SIG Information Technology Education (SIG ITE), and submitted for publication in either a journal sponsored by that group, or the SIG CSE journal. The final project report would also be made available to all participating institutions, and published on the project web site.

The results of this research would be significant in several ways. First, it would be the first gendered attrition research to use the user-centered Sense-Making methodology, a methodology that is in many ways better suited to attrition research than the more typical systems-centered approaches. Once the instruments have been developed and refined, they can be shared with researchers in other science and technology fields for use in determining key factors related to recruitment and retention. Second, it would provide a body of data related to women's experiences in IT that could be compared to results from similar studies of other disciplines. Third, and most important in the short term, it would provide departments of IT with a clearer understanding of their female students' experiences, and a set of recommendations to make that experience a successful one whenever possible.

The impact of this research would lie in its ability to inform IT programs about factors related to the attraction and retention of female students. This, in turn will have a beneficial impact on the number of women pursuing careers in IT-related fields.

Researchers and Facilities

The investigators in this project bring a range of skills and experience to the proposed research. Both investigators are female professors in RIT's Information Technology department, who have worked with both undergraduate and graduate female students. Both have master's degrees in the field of Library & Information

Science, a predominantly female field, and have moved from that field into the predominantly male field of IT.

The relatively high levels of salary support requested are based on the investigators' current full-time teaching load of three courses per quarter, three quarters per year. This load makes it impossible for faculty to participate in a research project. The salary calculations are based on full-time summer support for the PI, half-time summer support for the co-PI, and a one course per quarter release for each of the investigators—each investigator would still be teaching two courses per quarter for each of the three quarters of the academic year.

Elizabeth Lane Lawley, the principal investigator, has experience with use of the Sense-Making theory and methodology, specifically in the context of attrition from degree programs. Her expertise and experience with educational research methods will provide a foundation for the first phase of the study.

RIT provides an excellent environment for the first phase of the study. In addition to being the largest current undergraduate program in IT, it has facilities well-suited to an in-depth qualitative research project. Construction on a new College of Computing and Information Sciences building will be completed by spring of 2003. The new building will include a Human-Computer Interface lab, with one-way mirrors and audio and videotaping equipment. These facilities are ideal for the first phase of the study.

The current institutional climate at RIT is also conducive to the research proposed. The university has made a major commitment to addressing retention problems, and institutional support for research on this topic is strong. The Information Technology department, as a founding member of the Society for Information Technology Educators, is particularly interested in research that helps to clearly define the nature of the discipline and the institutions housing these programs.