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ABSTRACT

In this qualitative study, undergraduate computing students from two mid-sized southeastern universities participated in focus groups to explore their (1) developing professional identities, (2) salient stressors within their computing education programs, and (3) coping strategies used to navigate these stressors. Students provided contextual evidence to support the formation of professional identity as it relates to the IT field. Examples of student stressors drawn from our analysis were demanding coursework, unbalanced life, long nights, feelings of lack of preparedness, and constantly changing technology. The dominant coping strategies employed by these computing students were (1) the problem-focused strategies of planning and realism and (2) the emotion-focused strategies of avoidance and comedic-displacement. Additional themes were discovered and are discussed.

Keywords

Professional identity, stress, coping strategies, computing students, retention

INTRODUCTION

Few would argue that individuals pursuing careers in the computing disciplines are faced with occupational demands such as continuous change, long work hours, insatiable user demands, unmet deadlines, and the constant demand to enhance technical skills (LeRouge et al. 2006 pg. 2; Gallivan 2003). Given the nature of IT careers, it is not surprising that computing education programs (i.e. CS, IS, IT) typically attract 'Type A' individuals who thrive on being challenged, enjoy multi-tasking, and take pleasure in working hard and long (LeRouge et al. 2006). This combination of working style preferences and the nature of IT work influences the extent to which individuals identify with the IT profession (also known as professional identity).

The importance of professional identity - defined as "the relatively stable and enduring constellation of attributes, beliefs, values, motives, and experiences in terms of which people define themselves in a professional role" (Ibarra 1999, pp. 764-765; Schein 1978) – has largely been ignored in the computing student literature. While not explicitly examining professional identity, information technology researchers (Stanton et al. 2006; Guzman et al. 2004) have found that experience in the first IT paraprofessional experience significantly influences a student's perception of the "IT workforce subculture". In contrast, numerous studies have examined the professional identity of students in the fields of education, social work, medicine, psychology and engineering (Rubineau 2007; Harris 2005; Loui 2004; Lamb et al. 2002; Kuzmic 1994; Rosenbloom 1992). What appears to be salient across these studies is that professional identity serves as a frame of reference by which students make significant professional decisions (e.g., to stay in or leave the computing field).

This decision pattern is reinforced in a longitudinal case study conducted by Irani (2004). When interviewing students enrolled in a preliminary systems course, she found that being "hard core" (i.e., willing to eat and sleep CS) is universally associated within a CS identity. These students described two primary images of suitable CS majors: (1) the calm, talented coder and (2) the "hardcore kid" who has a hard time but "has a good time doing it" (Irani 2004, p.2). Individuals not perceiving themselves as talented or "hardcore" (i.e., reporting low professional identity) often decide to leave computing programs. If constructing a professional identity is considered one of the most important functions of the computing education process (Lamb et al. 2002), a greater understanding of the development of the IT professional identity and its outcomes is needed.

Since early research has shown that within the IT profession, high professional identity is strongly correlated with positive perceptions of their ability to handle IT workplace stressors (Walsham 1998), we also examine stressors students report experiencing in their computing program. There is considerable anecdotal evidence that students pursuing degrees in computing-related professions face particular stressors in the computing classrooms in addition to the stress of being a college student. Indeed, feeling "stressed" is a pervasive part of college-age students' lives. Nearly 80% of college students have reported being moderately stressed or burned out at some point in their academic career (Cushman et al. 2006; Larson 2006; Anderson et al. 2001). However, relatively little empirical research was found exploring undergraduate student reports of the salient stressors specifically within their computing programs.

Also unexamined in the literature is how computing students cope with these stressors. Researchers have generally organized coping strategies around two categories: problem-focused and emotion-focused. *Problem-focused coping* involves taking actions of exerting efforts to remove or circumvent the stressful situation (Kim 2003; Glanz et al. 2002). Common problem-focused coping strategies include confronting, problem solving, practical planning and seeking social support. In contrast, *emotion-focused coping* involves attempts to relieve or regulate the emotional impact of a stressful situation (Folkman et al. 2004). Typical emotion-focused coping strategies are venting, engaging in distracting activities, humor or comedic-displacement and denial. Against the backdrop of the issues raised in this paper, it seem likely that coping strategies students continue to use in their computing education programs will be those (1) that are reinforced by their peers and/or (2) those that fit their IT professional identity.

Developing a richer description of computing student stress will contribute to our understanding of how computing students cope with the stressors in computing programs and their contribution to the development of a computing professional identity. To accomplish this, we will explore contextually rich (i.e., qualitative) data, specific to computing students, to address the following research questions:

- What is the nature of computing students' professional identity?
- What stressors do computing students experience?
- What are the typical ways computing students cope with these stressors?
- What are the relationships between computing students' professional identity, experiences with stressors, and use of coping strategies to deal with these stressors?

METHODOLOGY

In order to elicit more robust responses to these questions, we use a qualitative research approach: focus groups. Qualitative studies allow researchers to describe and explore the area of study, in a rich context, in order to gain an understanding of the subjective experiences of the participants (Bryman 1988). In contrast to positivist approaches that utilize methods from the natural sciences, the theory underlying qualitative research is drawn from sociological and philosophical perspectives, largely from the field of phenomenology. Focus groups allow researchers to get deeper into the topic of interest by providing more background information about the circumstances of the answer (Krueger 1994).

Respondents

A total of seven focus groups were conducted at two universities. One of the universities is a historically black college and university (HBCU), while the other is a primarily white institution (PWI). The participants represent a convenience sample of respondents to an initial survey, within a longitudinal study, on the persistence of African-Americans in computing education. See (Belanger et al. 2006; Harrington et al. 2006; Belanger et al. 2005) for detailed analyses and results of the initial survey.

This sampling strategy allowed us to obtain a diverse set of respondents while meeting the requirement for relatively homogeneous groups of respondents for individual focus groups (Krueger 1994). We collected data from a total of 40 computing students, 19 from the HBCU and 21 from the PWI. All students were from upper-division courses, junior and senior-level students with declared majors of Information Technology or Computer Science. The sampling strategy for the focus groups resulted in the desired diversity across the two sites used.

Table 1. Observed Respondent Demographics

DEMOGRAPHIC		HBCU	PWI
Respondents (total)		**19**	**21**
Gender	**Male**	**12**	**19**
	Female	**7**	**2**
Ethnicity	**Caucasian**	**0**	**19**
	African American	**19**	**1**
	East Indian	**0**	**1**
	Panamanian	**1**	**0**

Focus Group Procedures and Coding

Prior to conducting the focus groups, a protocol was developed, tested, and modified several times. During the focus group sessions, participants were asked the ten open-ended questions from the focus group protocol, followed by probing questions to obtain further details when appropriate. One researcher moderated the focus groups, which were videotaped. The sessions lasted an average of 60 minutes. The recorded focus group sessions were then transcribed into text files, which were imported into the Atlas.ti™ qualitative analysis software for data analysis.

The first step in the analyses of the focus group data involved the development of coding categories. An initial list of categories was developed from the focus group protocol and knowledge gained during the focus group sessions (Miles et al. 1994). The list was revised several times. Once the research team agreed on the list of categories, two independent coders were trained on the Atlas.ti™ software and then asked to separately code one focus group session each. The unit of analysis for this coding was the individual. The coders then met with one of the researchers to compare their coding and discuss differences until agreement was reached on the categories, meanings, and future coding procedures. The coders then separately coded the remaining transcripts for the focus group sessions. The average inter-rater agreement between the two coders for the seven focus group transcripts was 83%, a satisfactory level of agreement (Shrout et al. 1979).

Data Analysis

Once the files were coded, the research team used these files to identify key themes emerging from the respondents' discussion during the focus group sessions. A set of rigorous interpretation procedures (Strauss et al. 1988) guided the analysis to develop theoretically informed interpretations of the data. Data analysis progressed through the stages of axial and selective interpretation. Axial interpretation put the data together in new ways by making connections between a category and its subcategories to develop several main categories. Selective coding integrated the categories to form a grounded theory for the development of the IT professional identity.

RESULTS AND DISCUSSION

The analysis of the data resulted in several findings that will be grouped in two sub-sections: first, we present a content analysis of the data and discuss the emergence of theoretically-supported categories that show how computing students: (1) perceive their role in the computing discipline (professional identity); (2) identify the stressors of the discipline; and (3) handle the stress related to the computing discipline. Finally, we organize our findings in a research framework that is designed to expand our understanding of the impact of these constructs on retention.

Content Analysis

Computing Professional Identity

For our first research question, we sought to document how strongly students identified with their computing profession. This inquiry was based on the assumption that computing students' professional identity is developed through socialization – the continuing interaction that leads to internalization of the knowledge, skills, norms, values and culture of the IT profession (Cohen-Scali 2003). Typically, the socialization of a computing student takes place when the student is completing his/her course work, working in the field, or interacting with students outside of their major.

Thus, we asked a series of questions on how they are perceived (i.e., the "geek" or "nerd" stereotype) by those outside of the computing discipline. Our analysis yielded responses that reflected an enthusiastic willingness to take on the "geek" stereotype with pride (See Table 2).

Table 2 Computing Professional Identity Reactions - Themes

CATEGORY	*SUB-CATEGORY*	*#*	*%*
PROFESSIONAL IDENTITY (STEREOTYPE) N = 62 (14.1%)	Take Pride	24	5.5
	Tolerate it	11	2.5
	Ignore it	15	3.4
	Lie	4	0.9
	Other	8	1.8

% column represents the ratio of comments made for this theme over the total number of comments across categories.

Social Identity Theory, developed by Tajfel and Turner (1986), offers an explanation for this theme of pride. These scholars and their colleagues suggest that individuals prefer in-group over out-group members. They further propose that an individual's self-concept is based on their identity as a member of groups they belong to. The pride expressed by the interview students merely illustrated their commitment to the computing profession and their self-concept. The level of pride students felt was illustrated in comments such as:

> *"I wear a t-shirt that says 'PS: I'm a tech-nerd.' I'll be a computer geek all the way to the bank!"*

Professional identity can also be reflected in passion or love of what you do. Most students feel you have to be passionate about computing to stay in the discipline. One interviewee, after enumerating the difficulties of being a computing major, said,

> *"If you love doing problem solving, if you love a challenge, if you love math, and you have a passion for computers…passion is like the will and the drive to keep on going and learn more and more about computer science. I always had a passion for computer science, anything that has an aspect of computer technology. That's why I pursued this major and stayed in it. Even when it was challenging and very, very hard, I didn't give up."*

Others who said they weren't so passionate said they thought about leaving the discipline. These individuals had low professional identity:

> *"I never had a passion for it. I've been forced into classes dealing with circuitry when I was in junior high. And, I knew then I didn't want to do anything with it. I did well in it, but I didn't want to. I just did it because I could*."

Compared to students who lacked passion and professional identity, other interviewees were fired up because of the challenging work. Comments reflecting their love of a challenge were evident throughout the interviews:

> *"I wouldn't say I have no passion or desire for it (IT), but I enjoy challenges."*

> *"Basically every other class I go to...it's the same thing. With computing, it's just doing more challenging things each time!"*

Other students reported putting up with being stereotyped as a "nerd" (i.e., tolerate it) because of the respect professionals in the computing discipline receive and the thoughts of securing a great paying job. This belief was captured in an interviewee's comment on salaries in the profession:

> *"You got to look to the end reward. All you got to worry about is getting paid."*

Other students wanted to have it all:

> *"I want money and I want the challenge!"*

On the other end of the professional identity continuum, students admitted they lied and hid their status as computing majors:

> *"I lie. I tell people I'm a PE major."*

> *"I don't tell people what I'm majoring in… because then two things happen. One, people either blow you off because they think you're a nerd, or two they ask you to fix their computer."*

For these students, the "geek" stereotypes were either inconvenient or threatening to their self-concept. Either way, they chose to actively avoid it through deception.

A significantly greater number of interviewees simply 'ignored' the perceptions. Those that ignored the stereotypes did so for two primary reasons. The first is that they don't care:

> *"I don't care. I've never really cared what people think about me. I'm not an ego. But I really don't care what people think, so it doesn't matter."*

> *"We're in college. If you care about getting called a geek, there's something wrong."*

The second reason for ignoring the stereotype was that "it doesn't matter":

> *"I'm not worried about it, personally. But, I don't think it's true. I mean we work hard, and spend a lot of time in the lab…"*

> *"I'm going to make more money than them…so I ignore them!"*

Computing Stressors

With our second research question, we sought to understand the stressors experienced by students in their computing program. This question emerged from the impression that many computing students seemed, at times, to be stressed to such an extent that it discourages effective learning. When asked whether computing students were more stressed than other students, students in five of the seven focus groups yelled out in unison – *"YES!"*

Interestingly, the same six stressors were present across focus groups and across universities: demanding coursework, lack of confidence in skill set, time requirements, unbalanced life, and difficult professors. While these six factors are not unique to computing, the combination may produce a cumulative impact that is discipline-specific (See Table 3).

Table 3 Computing Stressors - Themes

CATEGORY	*SUB-CATEGORY*	*#*	*%*
STRESSORS N = 108 (24.6%)	Demanding coursework	46	10.5
	Lack of confidence	19	4.3
	Time requirements	18	4.1
	Unbalanced life	15	3.4
	Difficult professor	10	2.3

% column represents the ratio of comments made for this theme over the total number of comments across categories.

Our first theme, demanding coursework, supports previous research on computing student stress. (Davy et al. 2000) found seven computing subject stress points when exploring student well-being and learning outcomes. Five of the seven stress points they found were driven by change in the computing discipline. For example, the rapid growth in the discipline has resulted in bloated course modules and an overcrowded computing curriculum.

The second category of stress points identified by Davy et. al (2000) centers on changing computing pedagogy. Active learning has become essential in today's computing programs. Faculty is increasingly using hands-on assignments that may cause periodic overloads and crises. Compounding the pressure on students is the movement towards group work and the indispensable use of electronic communication (Davy et al. 2000). Another stress point identified by these scholars is the emerging diversity of the student body. Working with technically less experienced students or students who have different motivation and expectations is stressful in any context. When viewing these stress points in combination, it is not surprising that nearly half of our interviews identified "demanding coursework" as their number one stressor. The following comments embodied this theme:

> *"When you think of computing majors here on campus, you think always busy, always in the lab; don't have any time to themselves."*

> *"It's stressful. Teachers think that their class is a student's only class. And you've got all this other work to do, but they think their class is the only class that you have. You've got other classes too, and you've just got a lot to keep up with."*

The second most common stressor reported was lack of confidence. When students lose confidence in their ability to handle a subject, they often begin to lose interest in the material. This may cause their performance to drop, which again decreases their confidence. It is no surprise that low confidence often results in a change of major. One student described this feeling best:

> *"Most people I've met here have been playing with computers since they were like 8, but I've only been playing with computers since I was 18. I don't have the same skills as them."*

The third stressor we identified was time requirements. As previously discussed, taking on challenging assignments in which students are often learning as they develop software is an essential part of the computing education process. By their very nature, these assignments are time consuming. One student even enumerated the comparison of time required across majors:

> *"…some of these [computing] classes require fifteen to twenty hours a week, outside of classes. As opposed to most other majors it's like maybe five to ten hours per class. "*

An additional stress point identified by Davy et. al (2000), is programming pressures 'to get it right', and students spend disproportionate time debugging even minor errors:

> *"It's definitely a more dynamic way of thinking. You spend ten hours doing computer science, and then you've got an error. And you have to change a whole part of your program, and hope it works. It's just a whole different way of thinking than you're used to with other classes."*

The result of these time requirements is the fourth stressor: an unbalanced life. Work-life balance has become a primary threat to retention in the computing profession. Studies have shown that even the brightest undergraduate students, especially females, plan to work in jobs that are not directly related to computing due to work-life balance concerns:

> *"It's also very typical to find these [computing] teachers assigning any combination of three or four tests and major projects to be due at the exact same time. And even with three or four weeks to do that, managing that, your other classes, your things that happen in your life, and just simply trying to enjoy your time here, becomes exceptionally difficult."*

> *"About half an hour before I go to bed, I talk to my girlfriend. Say 'hey, how you doing', then I'm going to sleep… we [have] no social life."*

The remaining theme was difficult professors. When examining the data to determine the characteristics of a "difficult professor," the English proficiency of their instructors was one theme. In today's environment of globalization, the skills of understanding foreign languages as well as English when spoken with a foreign accent are more essential than ever. Unfortunately, acquiring that skill while you are learning in a difficult subject domain is challenging:

> *"Sometimes its language, sometimes they just don't know how to get to the students. They don't know how to present the material in a way students can learn it."*

The next type of "difficult instructor" manifested in the data focuses on their ability to clearly teach the material:

> *"… it's difficult to understand the material, and a lot of the professors aren't that good at that dumbing it down enough for the rest of us. So then were kind of stuck on our own, maybe figuring out what we're doing."*

> *"I was sitting in class the other day. I was listening to the teacher talk, but she wasn't saying anything, she was just babbling. And I looked around the classroom, and like fifty percent of the class is asleep or drawing. And I'm wondering why do we even have this teacher if were going to go to our room and read the book. And that's how were going to learn, were not getting anything from this class. I don't get that. I don't get how somebody can just stand in front of the class and not say anything. Talk for forty five minutes and not say anything."*

Coping Strategies

In this study, students were also asked how they cope with the stressors they previously identified in their computing programs. As noted earlier, *Problem-focused coping* involves taking actions to manage the stressful situation, while *emotion-focused coping* involves attempts to relieve the emotional impact of a stressful situation (Folkman et al. 2004). As shown in Table 4, two specific strategies emerged for each category of coping strategies.

Table 4 Coping Strategies – Themes

CATEGORY	*SUB-CATEGORY*	*#*	*%*
Coping Strategies N = 123 (28.0%)	Emotion-focused: Avoid	43	9.8
	Emotion-focused: Comedic-displacement	30	6.8
	Problem-focused: Planner	30	6.8
	Problem focused: Realism	20	4.6

% column represents the ratio of comments made for this theme over the total number of comments across categories.

Research indicates that people use both problem-focused and emotion-focused coping strategies to combat most stressful events (Folkman et al. 2004) . Which strategy they elect to use is determined, in part, by their perceptions of the stressful event and by personal style (e.g., some people cope more actively than others). For example, people typically employ problem-focused coping to deal with potentially controllable problems. On the other hand, stressors perceived as less controllable prompt more emotion-focused coping.

When students were asked how they handled stress, an overwhelming 59% percent of the comments related to coping strategies were emotion-focused. The most common strategy was to emotionally avoid the situation. Common strategies were to:

"Get out, escape, go to a party, go to a club, get drunk."
"I get drunk and just stop thinking about it."
"I play video games. "

Comedic-displacement was also used to relieve the stress. For example, students reported playing down the situation by telling jokes about the problem:

"I laugh at other people"
"Ridicule them [other students]."
"I make fun of art [majors]."

When examining the comments related to problem-focused coping, two coping strategies were consistent: planning and realistic acceptance. According to the data, planning involves *"starting early"* and taking a time-out when needed:

> *"One time we had a lab that was like 600 lines of code and there was a party… so we went to the party, and decided to come back and work on the lab at two-thirty. So just take a break and do something completely not computing related. You can't be all computers, because you'll just lose your mind. So you need something outside to take your mind off it."*

The second theme, realistic acceptance, involved understanding that there will be times when stress will be present and it will just have to be dealt with:

> *"I think in this major there are times that are very stressful, and then we'll have a lot of downtime. Like, I'll have a week or two where I'm not doing much. So you just simmer down, and then you've got a ton of workload again, you've got stress, you get it done, and then it's like you don't have that much to do. And I think a lot of times, sometimes in industry, it's the same situation. A lot of times you just have to chill out when you don't have a lot going on, and then when you do have it going on you just make a few sacrifices here and there in terms of how you spend your time, and you get it done. And then when you don't have anything, you just relax."*

Research Framework

The purpose of this research was to conduct an in-depth exploration of the nature of computing students' professional identity, the stressors they experience in their computing programs and the ways in which they cope with these stressors. Figure 1 illustrates a research framework by which we can organize the findings of this study, and possibly, serve as the foundation for future research investigating the relationships among these factors and computing student retention.

This framework is supported by social identity literature which reported that high organizational social identity (professional identity) results in low turnover rate (i.e. intent to remain in the computing discipline) (Dick et al. 2004). For example, Haslam (2006) found that the relationship between professional identity and turnover rate was mediated by job-related stressors and coping strategies. Our future research will explicitly examine the strength of the proposed relationships.

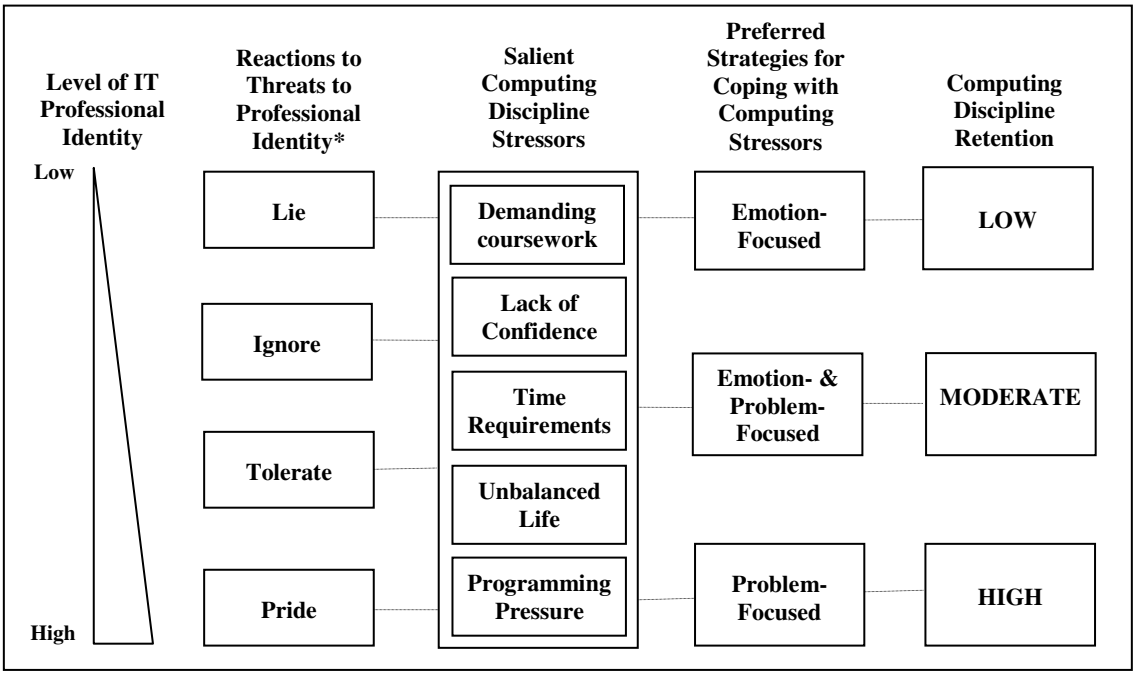

Figure 1 Emergent Framework of Computing Student Retention
*= The threat was negative stereotyping/discrimination (e.g., being called a "geek" or "nerd").

CONCLUSIONS

This research provides an exploratory investigation of stressors students face in computing programs, strategies they use to deal with those stressors and the level of professional identity those students have for the computing domain. It is clear from these focus groups that the computing programs studied attract computing students that "thrive on being challenged and working hard and long." This is consistent with the prior research studying IT professionals (LeRouge et al. 2006; Gallivan 2003) as well as IT students (Stanton et al. 2006; Gallivan 2003). While students reported that the discipline is demanding and requires a time commitment unparalleled by many other majors, they find pleasure in the trying to overcome those challenges. Interestingly, individual students, regardless of race or gender, were not afraid to voice their likes/dislikes about the computing discipline, even if they were contrary to the beliefs of the others in the room. This is inconsistent with prior professional identity literature and requires further investigation. Further, students provided practical suggestions on ways to improve the discipline for incoming students, although analyzing these comments was beyond the scope of this paper. The proposed emergent framework can serve as a starting point to further explore how these various factors affect the students' intents to remain in a computing discipline.

Despite the many important and potentially helpful findings that arose from this research, there are some limitations to the study. First, findings were based on focus group interviews from only two mid-sized universities, raising generalizability issues. Second, while work experience surfaced as anecdotal data, the participants were not explicitly questioned about their level of IT paraprofessional experience. More research is needed to explicitly address IT work experience and support Stanton (2006) findings that exposure/submersion into the IT workforce is related to an IT student's perception of the IT workforce subculture. Another noted limitation is the possibility for biases when the researcher is also the interviewer. This bias was addressed by using several external coders to code the data as well as frequent reviews of the data interpretation with external researchers representing multiple disciplines. Finally, the small number of interviewees per focus group raises questions as to whether interviewee comments are truly representative of their computing department. The selection of the universities was designed to provide sufficient variety in experience, credentials, and other demographic variables to overcome the possibility of selection bias. The unique and concerted perceptions and experiences of the computing students were actually strengths of the study rather than a limitation, in that their uniqueness contributed to the variety of perspectives and thus themes which emerge in the analysis of the data.

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