Title: A Freshman Community Framework for Attracting and Retaining CS and IT Majors

Donna Berger, Ph.D., Mary Ann Hoffmann, M.S., M.A.
Marist College
Spring, 2015

ABSTRACT

This case study explores the application of freshman learning community principles to recruit and retain a diverse cohort of academically-talented and financially-disadvantaged students to the Computer Science (CS) and Information Technology (IT) majors. Because of the decreasing enrollment of minority and women students in the STEM fields, the National Science Foundation (NSF) awarded an S-STEM grant to Marist College to support cohort scholarships. As freshmen in 2010, the cohort attended the same courses in game development and self-management. They were assigned to the same residence hall and the same advisors; were offered tutors and industry mentors; and engaged in social outings to foster closer connections between cohort members. The students are now seniors, and the case study examines what worked well and explores some areas that need attention, or can be improved.

THE CHALLENGE

It was 2008 and the School of Computer Science and Mathematics at Marist College was experiencing a steady ten-year decline in its CS and IT majors, a trend occurring at many universities across the country. Nationally, only 2% of high school students were expressing interest in CS (Goode 2007; 2008; Margolis, Estrella, Goode, Holme, & Nao, 2008). In spite of the increasing demand for technology jobs and reports that earnings were consistently higher than in other occupational settings, incoming college freshmen choosing CS as a major had dropped over 60% from 2002 to 2006 (Carter, 2006). To compound the problem, attrition during the first two years of college was considerably higher for CS and IT majors than for non-STEM disciplines, and significantly higher among minority students (National Science Board, 2002; Reardon, Traverse, Feakes, Gibbs, & Rohde, 2010). Underrepresentation of women and minorities and the high dropout rate among CS and IT majors were not only a problem at Marist, but had become a national concern.

The STEM educational literature emphasized the importance of active learning and student engagement in the discipline. Yet, varying levels of experience with programming was often cited as a reason that so many students drop out of CS/ITS majors early in their undergraduate careers. In introductory courses, students with stronger backgrounds can become bored and disenchanted with the field as instructors take time to prepare those students with weaker backgrounds (Sloan & Troy, 2008). Many CS departments, including Marist's, were looking to increase enrollment and retention of CS majors and considering the incorporation of game development in the curriculum. While some controversy existed over the use of game design in a CS curriculum (Walker, 2003), feedback from male and female students alike in courses with

gaming assignments was positive. CS classes were adopting game programming projects to teach game development and software development in a fun and interactive way (Huang, 2001). Initiatives such as those at Carnegie Mellon University, the Guildhall at SMU, Women Gamers.com, and the Sony Online Entertainment Gamers in Real Life (G.I.R.L.) program had more appeal to women and demonstrated that there were a host of career choices available to women in the game development industry (Coley, 2008; SMUNews, 2005). Programs such as these had begun to change the image of gaming and CS as a male-dominated field by highlighting women-designed games and careers attractive to women, and by "diversifying the current image of the field and those in it" (Frieze, p. 3).

Retention of CS and IT majors was also far below the level of the majority of other majors. Many factors influence retention, including students' self-efficacy and self-management skills (Berger, 2003; O'Keefe & Berger, 1999, 2014) as well as the students' background, financial situation, and parents' educational background (Whalen & Shelley, 2005)**.** Academic self-confidence and achievement motivation are two of the major determinants of higher college GPAs (Lotkowski, Robbins, & Noeth, 2004). A critical factor impacting student retention and academic achievement is student persistence, which is largely dependent upon students' ability to self-manage in a variety of areas and circumstances (O'Keefe & Berger, 1999; 2014; Berger, 2003). A study conducted at Marist found that there was higher retention and higher grade point averages among 600 students who had taken a self-management course compared to those who did not take the course. Skills in self-management and general self-efficacy also improved (Berger, 2003). More recent college statistics from Marist's Office of Institutional Research had shown that the retention rates of students who took the course were a couple percentage points higher than students that did not take it. Other research also indicated that skills in motivation and problem solving improve when these approaches are integrated with discipline-based instruction (National Research Council, 2000). However, Marist had not yet connected teaching self-management skills to a particular major. Much of the literature pointed toward first-year programs to address these issues because students participating in these programs graduated at higher rates (Lotkowski, et al., 2004).

Studies dating back to the late 1970s had emphasized the important role freshman learning communities (FLC) and social integration played in improving the quality of the freshman year experience for students (Pascarella & Terenzini, 1979, 1980; Tinto, 1988; Cabrera, Amaury, & Castaneda, 1993). An FLC is "a mechanism by which college freshmen can develop a small community of peers who have an area of common interest" (Hotchkiss, Moore, & Pitts, 2006, p.205). As Tinto had pointed out, one cannot underestimate the importance of involving students in a small community early in the college career as a means to improve student performance and retention (Tinto, 1997). One study showed that the GPA for FLC students was on average 0.78 points higher than those who did not belong (Hotchkiss et al., 2006). African American males were found to benefit most, showing average GPAs over a full letter grade higher than controls. Hotchkiss, et al. (2006) suggested that participation in an FLC improves retention for all students -- African American students of both genders in particular. Socially

familiar peers have also shown to be a strong predictor of persistence in the STEM fields (Astin & Astin, 1992 as cited by McGrath Cohoon, 2002). Was it possible that an FCL could serve the dual purpose of helping Marist work toward its diversity goals and at the same time help to address the high dropout rate in the CS major in the first two years?

Tuition cost was still another issue, underscored by the fact that the country was nearly two years into an economic recession with no end in view. Studies had shown that scholarships cannot be ignored as an effective tool for both recruitment and retention (Yue & Hall, 2007) because they directly influence a student's decision to attend college as well as their decision to stay or leave (Tinto, 1982). Yet, the results of a controlled study found that financial aid without academic support failed to retain students at a higher rate than those in a control group. While scholarship incentives were found to reduce student dropout rates, it was not at the level of combined support systems, and students who received both scholarship and academic support maintained a GPA roughly 3 points higher than controls (on a 100-point scale) (Glenn, 2007). If Marist was going to attract a diverse incoming class of CS and IT majors, it had to find a way to offer substantial scholarships to eligible students.

A viable recruitment and retention plan needed to incorporate academic and nonacademic factors, but other obstacles loomed large. Systemic obstacles in the schools and public misconceptions about the CS were perhaps among the strongest deterrents to student enrollment and retention in the major. Most US K-12 schools did not (and still do not) recognize CS as central to the K-12 academic curriculum, and few K-12 teachers are formally prepared to teach it (Margolis, Holme, Estrella, Goode, Nao, & Stumme, 2003; Goode & Margolis, 2004; Carter, 2006; Margolis et al., 2008). As a result, many students had only a general knowledge about CS and were ill prepared for the undergraduate major. This was (and still is) a pervasive problem – ranging from public misconceptions about CS -- *what* it is and *who* should *do* computer science -- to misunderstandings about the broad career possibilities (Goode, 2007; Margolis et al., 2008). Such misconceptions were key contributors to the escalating decline of the CS and IT major.

Given the very public misconceptions about CS and IT majors and careers, students lack of preparation in high school, and the challenges of a rigorous major, it should have come as no surprise that Marist had low enrollments, an attrition rate of 50%, and a student demographic that did not reflect the "underrepresented majority" of minority and female students.

WHAT WAS DONE

An overriding goal was to recruit and retain a diverse cohort of academically-talented students who were interested in the CS major. The following steps were taken to address that goal.

NSF S-STEM Proposal for Recruitment and Retention of CS and IT Majors

A team from Marist's School of Computer Science and Mathematics, Dr. Ron Coleman, Associate Professor of Computer Science, Dr. Roger Norton, Dean, and Ms. Mary Ann Hoffman,

Assistant Dean, collaborated on preparing an interdisciplinary proposal to the NSF S-STEM program with Dr. Donna Berger, Director of Academic Grants and a part-time faculty member in Marist's School of Social and Behavioral Science. Research-based strategies and existing college resources were identified and integrated into a recruitment plan and learning community design to directly address many of the obstacles in attracting and retaining a diverse cohort of CS and IT majors. The recruitment plan was focused on attracting students who demonstrated academic talent and interest in the major as well as financial need.

Retention initiatives focused on a proposed learning community for a cohort of CS and IT majors, which included three common freshman courses (two in CS and one in self-management with a CS/IT focus) as well as a special orientation, common cohort housing, career mentoring, and social events. The team brought their diverse areas of expertise to the project plan. Principal investigator, Dr. Ron Coleman's background in game design research and 10 years of teaching CS became the impetus for his proposed development of a two-course sequence in game design, which would introduce the cohort students to CS through active learning, while exposing them to programming and high-level CS concepts. Co-Principal investigator (Co-PI) Dr. Donna Berger's research on teaching self-management to college students and its impact on student persistence and retention contributed to the rationale for the freshman course in self-management. The introduction of a self-management course with an IT focus would link these problem solving skills directly to the discipline. Co-PI, Ms. Mary Ann Hoffmann's corporate experience in software engineering and project management was instrumental in coordinating the many offices across campus involved in establishing and evaluating the many and varied aspects of the learning community. Her coordination of other offices was not only critical during proposal development, but would continue throughout the project period. Co-PI, Dr. Roger Norton's expertise in teaching CS and his leadership in both college administration and on several successful NSF grants contributed to a solid leadership plan and a competitive NSF proposal. The request to the NSF included $120,000 in scholarship money for each of four years for 12 students to complete the program, in addition to recruitment, administrative, and programmatic expenses. Marist committed additional funding so that the scholarships covered tuition, room and board. In March 2009, the NSF notified the PIs and the College that the five-year proposal was funded. The task now was to reach out to selected high schools across the US to advertise the program, recruit the cohort, and initiate the proposed learning community.

Outreach, Recruitment, and Admission

High schools with a high percentage of underrepresented students in STEM, including women, African-Americans, Hispanics and native Hawaiian islanders, were targeted and given information about the program prior to the actual recruitment visits. This literature communicated factual information about the opportunities a CS/ITS major and career afford, directly addressing misconceptions about CS/ITS. Outreach material was also distributed to thousands of high school students, guidance counselors, parents, and a website was developed www.marist.edu/nsfgrant with a video presentation by technology executives and PIs Coleman

and Norton to generate interest in CS and IT and in game software development. This information was included in correspondence to over 30,000 high schools in the US and the scholarship opportunity was publicized through search engine marketing and targeted school visits to schools with a technology focus. Faculty was involved in recruitment visits with admissions staff to the high schools, in identifying student qualifications, and selecting the students for admission. The following steps were followed to select a cohort of twelve CS and IT majors who would receive full tuition scholarships after all grants were applied.

- The Admissions Office identified all CS and IT applicants meeting acceptance criteria.
- Faculty generated a list of potential candidates. A list of the 15 top scholarship candidates was developed. Consideration was given to academic achievement, ability in mathematics, diversity, financial need, extracurricular activities, and demonstrated interest in CS and IT.
- 15 finalists for the scholarships were invited with their parents to Marist College in March 2010 for a special informational meeting with the PIs.
- 12 attended the informational meeting and were offered the scholarships.
- All 12 students accepted within a few weeks.
- In fall 2010 scholarship students and parents arrived at Marist a day ahead of the other freshmen for a special dinner and orientation session for the cohort.
- Each student was asked to sign a Letter of Agreement that stated the terms and conditions associated with their scholarships.
- The students were pre-enrolled in a special software game design course and lab period, and a special section of self- management with a CS/IT focus.

Freshman Learning Community (FLC)

Knowing that many STEM majors drop out of the major during the first two years of college, the PIs initiated a framework for a freshman learning community centered on the major and also provided students with practical skills and services to support them through the challenges CS and IT majors often face. The framework included a sequence of two active learning introductory game development courses in the major, a self-management course with a focus on the major, two advisors (one in the major and a secondary advisor), tutoring, housing in the same residence halls, and career mentors. PI Ron Coleman acted as academic advisor to all of the students and Ms. Jane Fiore, Director of the Marist College Academic Learning Center, acted as a secondary advisor.

The Cohort Model

The cohort model was chosen as both a recruitment and retention strategy and in many ways provided its own support structure for the learning community. The FLC was initiated through an orientation program when students arrived on campus. Students became familiar with the campus and the cohort requirements and support services. Students were given their fall semester schedule and were housed together on the same dormitory floor so they would have ample opportunity to get to know each other. They also formed their own group on a well-

known social networking site. As part of the FLC, faculty involved students in optional out-of-class learning experiences such as visits to IBM manufacturing facilities, holiday dinners at Ms. Fiore's home. Marist's small class size also ensured a high level of student-faculty interaction and enabled students to get to know their professors.

Self-management Course

Marist College had long recognized the influence of nonacademic factors on student success and retention and had offered a self-management course for nearly three decades that was recognized in 1999 by the Templeton Foundation (Templeton Foundation, 1999). What was different about this course offering was the pairing of self-management skills with the major and the introduction of the course instructor, Ms. Jane Fiore, as the students' second advisor

Self-management is defined as the ability to manage one's feelings, thoughts, and behaviors in the direction of one's goals. Factors associated with student persistence were addressed directly in this class. For example, students learned

- skills to manage affect (e.g. anxiety related to tests, grades; frustration with roommates, homesickness, stress, etc.)
- skills to manage behaviors and activities (e.g. class participation, sleep and study habits, following a schedule, alcohol consumption, etc.);
- skills to manage cognitive processes essential to goal achievement and conflict resolution (e.g. problem solving skills, relating goals to daily activities, and developing critical thinking and coping skills essential to success).

The core of this personal development course teaches students how to identify and manage feelings, thoughts, and behaviors that foster goal achievement. This understanding is then applied to self-motivation, time management, problem solving, goal achievement, communication skills, self-esteem, and overall goal achievement in the major.

The course was offered to the cohort students during their freshman year and included a focus on issues particular to CS/ITS majors and careers. A junior IT major acted as a resource in the course for the students and helped to make relevant connections between course material and challenges in the major. The course incorporated case studies that integrated real life examples of academic and career challenges for CS/ITS majors. The student assistant was assigned to work with the students on class projects; attend all self-management classes; and to work with the instructor on assignments and course discussions that related directly to the CS/ITS major.

Freshman Game Design Course Sequence

A two-semester course sequence in game design was developed by Dr. Coleman to provide an engaging game design and programming freshman experience. Students used special software technology that allowed stronger students to pursue more advanced concepts and weaker students to be introduced at a more gradual pace. Dr. Coleman had developed a game

development concentration for CS majors (Coleman, Krembs, Labouseur, & Weir, 2005) along with tools for teaching games (Coleman, Grayson, & Roebke, 2005) for the Summer Game Institute, which he directs. The new courses built upon this work and were adapted for regular classroom delivery and use. Students used state-of-the-art game-maker software. They began the course sequence by creating simple games initially, and then advanced to more sophisticated ones. Students created, tested, and debugged different types of games such as scrolling shooters, maze games, platform games, and 3D parallax games. While no prior programming experience was required, the advanced features were suited to stronger students.

Industry Mentoring and Internships

Members of the School Board of Advisors (from companies such as Goldman Sachs, IBM Corporation, EMC², Fiserv, NYC Health and Hospitals Corporation, Morgan Stanley, Vicom Infinity, Verizon, and Cisco Systems, Inc.) agreed to work with Marist faculty, mentor an individual cohort student, and to present at the students' orientation. Students had the opportunity to meet the industry mentors in fall of their junior year, and decided if they would like to continue contact with them either in-person, via conference calls, email, or through Marist College's on-line collaboration site. Industry mentors served as informal advisors to interested students on career opportunities and job requirements. They also agreed to advise on a variety of topics such as industry trends and technology advances as well as job etiquette, interviewing, and internship and career opportunities.

THE RESULTS

In 2010, a highly qualified and diverse cohort comprised of 9 males (2 African Americans, 2 Hispanic, 1 Hawaiian, 4 Caucasians) and 3 females (1 Hawaiian, 1 Hispanic, and 1 Indian/Asian) was recruited. While recruitment and retention was vastly improved, of the 395 applicants for the CS/ITS 2010 freshman class 89% was male. The percentage of female applicants was only 11%, even with the potential of full scholarships available. One Caucasian male withdrew after freshman year due to a death in his family, and was replaced by a Hispanic female freshman.

At the time of this writing, the 11 students from the original cohort are entering their second semester senior year. The cohort retention rate is 91% (compared to the college's average retention rate of 50% for CS/ITS majors over the last decade). All cohort students remained in either CS or IT (eight are CS and three are IT majors). As of June 2013, their average overall GPA and GPA in the major was 3.3 on a 4 point scale.

Six cohort students of the eleven students participated in individual interviews at the end of their first semester, senior year (Dec. 2013). Students commented on why they chose the program; their cohort experience and impressions of the common courses in self-management and game development; as well as their overall experiences in the program. All six students had an interest in CS or IT before learning of the program. Several mentioned that their guidance counselors told them about the cohort program and had influenced their decision to

apply. Five of the six said the full scholarship had a strong influence on their final decision. However, the positive reputation of Marist's CS and IT programs, the location of the college, previous experience at Marist, the game development program, and ability to continue on to graduate school were also important factors. For one student, the scholarship had little, if any, influence. This student applied for the scholarship only after acceptance to the program. The following comments capture the spirit of the students' views on key components of the cohort learning community.

Cohort Experience

All agreed that being a part of a cohort learning community provided valuable support. The cohort learning community was cited as being helpful in getting through course work; facilitating a social life and friendships; and adjusting to college.

- *It was pretty cool. [The cohort members] have been major friends throughout school.*
- *The first year we all had the same courses. We were all talking about what internships we were planning on.*
- *We didn't have to worry about meeting people.*
- *With a group of people, it's really easy to ask questions--like how do I make this program work? Some students already had a CS AP class and they would be able to help me.*
- *We had the same problems. We had to work together. We all had to figure out how to pass the same classes together. I liked how we had the same classes so we could learn off of each other. That was definitely good.*
- *Common housing - that was great – that's why we became friends.*
- *I've learned a lot from everybody*.
- *Being a minority, the social life was the most challenging [in freshman year]. After that, I made a lot more friends.*
- *Freshman year the cohort was a big thing – all 12 of us hung out. We were very much involved with one another, sophomore year less so, junior and senior year, while I am friends with people in the cohort, all my good friends are not in the cohort.*
- *Freshman year you really need that group of friends to be that support structure because it's hard to find friends and so if you have this group of friends already established, it makes the transition to college easier.*
- *Freshman year it was very much a learning community; we studied together.*
- *Living together was great…We pretty much claimed the basement of the dorm.*
- *Being part of the NSF group was amazing.*
- *The housing helped and [common] classes had a lot to do with how I made friends.*
- *I most definitely did [see myself as part of a learning community]. We had some people that were so technically knowledgeable and they were certainly willing to share that*

knowledge. Being someone that didn't know too much about programming-- that was definitely helpful.

Game Development Courses

The game design courses introduced students to CS.

- *That course was fun, so I can't imagine anyone not liking the class.*
- *For some, they didn't want to do gaming, but for me and two others, we wanted to do gaming.*
- *That was a fun course. It definitely gave the standard of programming JAVA – one of the most elemental things, and once l learned that I could start building from there.*
- *It taught me that I did not want to do game design.*
- *The best thing about programming a game is that you can see what you've been working on so you can obviously tell if something is going wrong and it's easy to check and see why it's broken.*
- *It was kind of nice because there are a few concepts in CS you see much later in the major, but we were able to see those right off the bat because they were necessary for gaming, so I think that was very, very good in that sense. We got some of these advanced concepts that we normally wouldn't see until one or two years down the road.*
- *We ended up losing some basic concepts we should have learned within the first year…Time complexity and space complexity -- analyzing how fast the program is and how much space it takes up on your computer...In addition we missed out on sorting lists, and on searching through the lists... We also missed out on a data structure called trees…We also gained also gained a lot of good things – we learned a lot of advanced concepts, so there's a balance.*
- *Some students [with a CS background] when presented with these tougher concepts, just couldn't understand these deeper concepts.*
- *I learned a bunch in freshman year.*

Self-management

All students mentioned that they found time management and the four-year schedule they created in freshman year useful through senior year. Two students mentioned that at first that they did not think they needed to take a self-management course either because it was "just an elective" or because motivation was not a problem, but they later found it helpful.

- *It made you focus and be self-aware – it made it easier to manage your skills and time.*

- *I actually kind of liked that class because we had a bunch of computer science classes and then we had that class to get used to college and manage ourselves. It helped in prioritizing and scheduling.*
- *[Setting] long-term goals and using short-term goals as stepping stones. I use that for a lot of my hard projects. I still use that approach, but not as often.*
- *I think the things we learned go in the back of your head and now you just do it.*
- *A lot of it was being aware of your emotional responsibility and how to manage your stress and that I think stuck with a lot of the students.*
- *[I used material from the class] when I came across a difficult choice. There was this one thing when you weigh your costs and benefits. So you could have a ton of fun now playing with your friends, but then you had to stay up all night writing this essay. Since I value sleep, I'd think, I better write this essay.*
- *I learned a lot about myself. There were some techniques. It solidified my understanding of those techniques [time management, how I learn, how to handle certain problems].*
- *At first I thought it was useless, then later, I found myself leveraging the techniques I learned… I ended up using them. I'm like wow that's a really good thing. I guess it wasn't so useless!*
- *We learned a lot of ways to deal with higher stress, so if you're really nervous or upset, breathing is one thing, but another thing is changing the voice that's in your head. So you could be telling yourself one thing, but it is not reflecting how reality actually is.*
- *[With problems] I found I was able to change my inner voice and that in turn changed how I felt… I actually realized I started doing that and thought wow, okay, cool.*
- *Every time I make a calendar or a to-do list, I am basically using self-management*.
- *It was a good way to have a class where it was just us – it was combination of learning self-management and a place where we could ask questions.*
- *I am really glad I took that class and that they made us take it.*

Overall the cohort program was seen as a positive experience. On a scale of 1 to 10, with 10 being the highest, the average student rating was 9, with a range from 7.5 to 10. Some recommended more options in the discipline (a security track, for example), a formal IT advisor for IT majors, and more formal cohort activities beyond freshman year. Every student interviewed mentioned the positive benefits of having a second advisor in Ms. Fiore, the instructor of the self-management course, and all were continuing to meet with her. While some students interviewed mentioned that they lost contact with their career mentors over time, others had only praise for the career mentorship program. Of the eleven cohort members, many participated in summer internships with Fortune 500 companies, including Goldman Sachs, Morgan Stanley, and Intel. Several of these students have already been offered full-time employment after their graduation in May 2014.

EPILOGUE

In 2012 the PIs submitted a second NSF S-STEM proposal modeled on the first, and in fall 2013, learned that it was awarded. The learning community framework will be replicated with slight modifications. Dr. Coleman plans to broaden the scope of the introductory CS courses based on an IBM Innovation Award he received for instruction in mobile computing (Coleman, 2011). These courses will require no prior programming experience, and will engage students through hands-on projects for a variety of hand-held applications that students can run on cell phones, tablets, and desktop computers. The computing model will be based on cloud-computing and a visual, "plug-in" interactive development environment. Game concepts will be enfolded within the larger context of interactive media applications with which many students are already familiar. Based on recommendations from the first cohort, other cohort activities will include refresher self-management workshops, additional social activities, and follow-up student focus groups or interviews in sophomore year, as well as a review of career mentor communication in junior year.

REFERENCES

Berger, D. S. (2003). The effects of learning self-management on student desire and ability to self-manage, self-efficacy, academic performance, and retention.(Doctoral dissertation, University at Albany, State University of New York, 2003).

Cabrera, A. F., Amaury, N., & Castaneda, M. B. (1993). College persistence: Structural equations modeling test of an integrated model of student retention. *Journal of Higher Education*, *64*, 123-139.

Carter, L. (2006). Why Students with an Apparent Aptitude for Computer Science Don't Choose to Major in Computer Science. *SIGCSE*, 27-31.

Coleman, R., Krembs, M., Labouseur, A., & Weir, J. (2005). Game design & programming concentration within the computer science curriculum. *Proceedings of the 36th Annual SIGCSE technical symposium on computer science education,* St. Louis, MO.

Coleman, R., Grayson, L., & Roebke, S. (2005). GEDI: A game engine for teaching videogame design and programming. *The Journal of Computing Sciences in Colleges, 21,* 3.

Coleman, R. (2011) Introduction to Cloudy Mobile App Development, IBM Innovation Award

Coley, J. (2008, April 2). *Video game scholarships for women: Sony, ESA offering money for minorities entering games industry.* Retrieved May 5, 2008 from http://videoonlinegames.suite101.com/article.cfm/video_game_scholarships_for_women.

Committee on STEM Education National Science and Technology Council. (2013). Federal science, technology, engineering, and mathematics (STEM) education 5 year strategic plan. Retrieved from http://www.whitehouse.gov/sites/default/files/microsites/ostp/stem_stratplan_2013.pdf

Frieze, C. (2005). *Diversifying the images of computer science: undergraduate women take on the challenge!* ACM SIGCSE Bulletin, *37,* 1. Retrieved May 5, 2008 from http://www.cs.cmu.edu/~cfrieze/women@scs/sigcseRoadshow.pdf.

Glenn, D. (2007). Study finds mix of academic and financial aid improves student retention. *Chronicle of Higher Education, 53*, A18.

Goode, J., & Margolis, J. (2004). What is computer science, anyway? Deepening urban teachers' understandings of computer science and working towards an engaging

pedagogy. *Proceedings of Society for Information Technology and Teacher Education International Conference 2004,* 814-819.

Goode, J. (2007). If you build teachers, will students come? Professional development for broadening computer science learning for urban youth. *Journal of Educational Computing Research,* 36(1), pp. 65-88.

Goode, J. (2008). Reprogramming high school computer science. *Communications of the ACM,* 51(11).

Hotchkiss, J. L., Moore, R. E., & Pitts, M. M. (2006). Freshman learning communities, college performance and retention. *Education Economics, 14*, 197-210.

Huang, T. (2001). *Strategy game programming projects*. Middlebury College: Middlebury, VT.

John Templeton Foundation. (1999). Part 1: Exemplary programs: Marist College. In John Templeton Foundation (Eds.), Colleges that encourage character development. (p.16). Philadelphia: Templeton Foundation Press.

Jonides, J. (1995). *Evaluation and dissemination of an undergraduate program to improve retention of at-risk students.* University of Michigan: Ann Harbor, MI.

Langdon, D., McKittrick, G., Beede, D., Khan, B., & Doms, M. (2011 July 14). Stem: good jobs now and for the future (Issue Brief #03- 11*) U.S Department of Commerce, Economics and Statistics Administration.* Retrieved October 1, 2013, from http://www.esa.doc.gov/sites/default/files/reports/documents/stemfinalyjuly14_1.pdf

Lang, M. (2001). Student retention in higher education: Some conceptual and programmatic perspectives. *Journal of College Student Retention, 3*, 217-229.

Lotkowski, V. A., Robbins, S. B., & Noeth, R. J. (2004). The role of academic and non academic factors in improving college retention ACT policy report. *American College Testing.*

Margolis, J., Estrella, R., Goode, J., Holme, J.J., & Nao, K., Stumme, S. (2003). The computer science pipeline in urban high schools: access to what? For whom? *Technology and Society Magazine, IEEE, 22, 3, 12-19*

Margolis, J., Estrella, R., Goode, J., Holme, J.J., & Nao, K. (2008). *Stuck in the Shallow End.* Cambridge, MA: MIT Press.

McGrath Cohoon, J. (2002). *Women in CS and biology*. Covington, KY.

National Research Council (2000). *How People Learn*. Washington,DC: National Academy Press.

National Science Board, *Science and Engineering Indicators – 2002.* Arlington, VA: National Science Foundation, 2002 (NSB-02-1).

National Science Foundation, Division of Science Resources Statistics. (2011). *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2011* (NSF 11-309). Arlington, VA

O'Keefe, E. J., & Berger, D. S. (1999). *Self-management for college students: The ABC approach.* 2nd ed. Hyde Park, NY: Partridge Hill Publishers.

O'Keefe, E. J., & Berger, D. S. (2014). *Self-management for college students: The ABC approach.* 3rd ed. Hyde Park, NY: Partridge Hill Publishers.

Pascarella, E. T., & Terenzini, P. T. (1979). Interaction effects in Spady's and Tinto's conceptual models of college dropout. *Sociology of Education, 52,* 197-210.

Pascarella, E. T., & Terenzini, P. T. (1980). Predicting freshman persistence and voluntary dropout decisions from a theoretical model. *Journal of Higher Education, 51,* 1, 60-75.

Reardon, R. F., Traverse, M. A., Gibbs, K. A., Feakes, D. A., & Rohde, R. E. (2010). Discovering the determinants of chemistry course perceptions in undergraduate students. *Journal of Chemical Education*, *63*, 6. Retrieved October 4, 2013, from http://pubs.acs.org/doi/pdf/10.1021/ed100198r

Sloan, R. H., & Troy, P. (2008). Proceedings of the 39th SIGCSE technical symposium on Computer science education '08: *CS 0.5: A better approach to introductory computer science for majors.* Portland, Oregon.

SMU News. (2005, January 7). First-ever women's video game scholarship awarded. [Msg 04092-1-7-2005-rb]. Message posted to http://www.smu.edu/newsinfo/Releases/04092.html.

Tinto, V. (1982). Limits of theory and practice in student attrition. *Journal of Higher Education, 53*, 6, 687-700.

Tinto, V. (1988). Stages of student departure: Reflections on the longitudinal character of student leaving. *Journal of Higher Education, 59,* 6, 438-455.

Tinto, V. (1997). Classrooms as communities: Exploring the educational character of student persistence. *Journal of Higher Education, 68*, 4, 599-623.

Walker, M. H. (2003). Do computer games have a role in the computing classroom? *The SIGCSE Bulletin, 35*, 18-20.

Whalen, D., & Shelley, M. (2010). Academic success for STEM and non-STEM majors. *Journal of STEM Education*, *11*, 1, 45-60

Yue, K., & Hall, S. P. (2007). Reflections on proposal writing and management of a NSF stem scholarship grant program. *Consortium for Computing Sciences in Colleges,* 244-251.