

# Methodology for Successful Undergraduate Recruiting in Computer Science at Comprehensive Public Universities

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## ABSTRACT

This paper presents a methodology for increasing undergraduate Computer Science (CS) major enrollment at comprehensive public universities, particularly those that have first generation college students or students from underrepresented populations in professional computer science in the United States. While there has been significant prior discussion of undergraduate recruiting to increase major enrollment in CS, this is the first identification of a systematic approach to recruiting distinct undergraduate student populations into the CS major. Nationally, highly selective and selective universities and colleges have worked within their student populations to increase major enrollments, while CS departments at comprehensive public universities primarily focused on regional recruiting have also worked to identify and increase CS major enrollments. The approach outlined here addresses regional recruiting for undergraduate majors in CS and has been used at two public universities. The resulting methodology serves as a template for any department or faculty member seeking to increase undergraduate enrollment in CS.

## Categories and Subject Descriptors

K.3.2 [Computers and Education]: Computer Science Education

## General Terms

Human Factors.

## Keywords

CS Enrollments, Wider Access, Outreach, Recruiting.

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## 1. INTRODUCTION

The decline in computer science (CS) majors in the United States has been well documented [1, 2]. This paper does not presume to address the causes of the decline in CS enrollments. Rather, given the current operating environment, increasing CS enrollments has been the objective. Few departments at the non-doctoral granting, or ‘teaching intensive’ public university level engage in the targeted, methodical effort outlined here to recruit students to the discipline, followed by a dedicated assessment of outcomes. The focus and attention to recruiting students in CS and the identification of ‘best practices’ methods that yield results, has not been formalized prior to this. Retention in the major, addressed by others [3, 4, 5], is outside the scope of the effort described here. The objective of the work presented here was to identify recruiting methods to increase the number of undergraduates coming to public comprehensive universities to study CS.

This research was strongly motivated by two factors. First, the most significant element of the decline of CS enrollments, as voiced by numerous colleagues is that ‘the students aren’t coming to us anymore.’ This sentiment was an expression of the state of the field in the mid-1980s and through much of the 1990s. Between 1980 and 1986, undergraduate CS production quadrupled to 42,000 degrees, a pattern repeated in the late 1990s [6]. Students flocked to newly created CS programs at all colleges and universities. Public comprehensive universities were significantly impacted, as returning students sought new skills and incumbent students requested additional courses and curriculum offerings. CS departments at Ph.D.-granting universities experienced a 43% drop in CS Bachelor degrees awarded between 2003/04 and 2006/07 and a 49% decline in enrollments from 2001/02 to 2006/07, with comparable declines observed at non-PhD. granting universities. The number of new CS majors in Fall 2007 (7,915) was half of what it was in Fall 2000 (15,958) [1]. In developing the methodology presented here, given these declining trends, we adopted a business-oriented perspective in which incoming students were viewed as customers who no longer queued up expecting services.

The second motivating factor was the incentive provided by NSF S-STEM awards. The National Science Foundation has

encouraged Scholarships in Science, Technology, Engineering, and Mathematics by awarding funds to a range of colleges and universities funds to select and encourage students to seek degrees in a variety of fields. The experiences faculty have had recruiting students to CS majors for S-STEM awards provide a basis for this research. The recruiting was not limited to only S-STEM awardees however, as the outreach methodology encouraged many students to select CS as a major, not just S-STEM eligible awardees. The S-STEM awards strongly encouraged faculty to actively develop methods to successfully recruit students to study CS at the university level. The outreach to prospective students encouraged by S-STEM was met by the need to locate interested students in a manner not previously used by universities.

When considering the problem of declining undergraduate enrollment in CS with a business perspective, the problem can be restated as twofold: first, students (customers) no longer come to CS Departments in the numbers seen in prior years, and second, faculty (business owners) need to locate capable, qualified students to keep their departments (business) going. In order to address this problem, programmatic marketing and outreach were used to address the first part of the problem, and faculty were incentivized by the scholarship opportunities presented by the second part of the problem. The resulting methodology serves as a template for any department or faculty member seeking to increase undergraduate enrollment in CS.

## 2. PREVIOUS WORK

Previous work on successful recruiting approaches has addressed both the high-school environment [5, 7] and community college transfers [8, 9]. Additionally, recruiting experiences for NSF S-STEM awards in CS is discussed [10].

The work at Georgia Tech [5], a comparative study of those that chose to stay in the CS major (Stayers) through graduation and those that left the CS major (Leavers) for another major prior to graduation, is very useful. Leavers were more likely to not have had any exposure to CS in high school. This finding provides a strong guideline in determining where to devote limited faculty resources in any high school recruiting effort. A secondary finding in the study found that loss of interest in a computing career was a large factor in the Leaver’s decision to drop CS as a major.

A study of undergraduate CS majors from sixteen departments [7] at a range of U.S. universities and colleges, including public, private, urban, non-urban, Ph.D.-granting, Masters-only and Bachelor’s-only agreed with the more recent detail provided by the Georgia Tech study. Early exposure to computing, a perceived match between the student’s self-assessed abilities, and knowledge of computing careers were found to be the strongest indicators of selecting CS as a major in college. A similar multinational study aimed at predominantly undergraduate computing programs was conducted in 2008 [11]. Surveyed students also indicated that exposure to computing and information technology at an earlier age along with a strong role model within family or friends were the most important factors motivating the students to pursue a CS degree. The results of these three studies were incorporated in the methodology developed and presented here.

Community college transfers into scientific and engineering disciplines, including CS, have been extensively studied [8] and an approach has been detailed [9] for CS. The identification of a specific group of community colleges by university faculty, and having articulation agreements with the target community colleges is vital. The approach outlined for freshman recruiting presented here can be used, with the focus on a select group of community colleges, in contrast to a select group of high schools.

Finally, specific research on the recruiting of STEM students for scholarship awards in CS concludes that intensive recruitment is crucial for success [10]. This corresponds to previous work on CS recruiting, but what was surprising is that, even with scholarship money to give away, recruiting for majors in CS was very time consuming. Scholarship funds impact *retention* in the program more than initial student recruitment. Therefore, for CS recruiting, the availability of NSF S-STEM scholarship money appears to initially impact the faculty through programmatic incentive, which then results in increasing undergraduate majors in CS. The methods identified here are applicable to all undergraduate CS recruiting efforts and are not specific to NSF S-STEM recruiting

## 3. METHODOLOGY AND TIMELINE

Three distinct student populations were identified for recruiting: high school students, transfer students, and incumbent university students. Incumbent university students were recruited in the traditional manner: freshmen seminars along with general education and service courses. For the remaining two groups, prospective freshmen and transfer students, a different methodology was developed. Generally, faculty interviewed their existing majors and reviewed corresponding enrollment and recruitment information to see where the improvement in recruiting might occur and approached that student population first. It is important to keep in mind that high school and transfer students need to be recruited *both* to the university and to the CS program, while incumbent students need only be recruited to the major. Transfer student populations at public comprehensive universities are often modest, but once the opportunities at the university are shared with targeted community school administration, faculty and students, the pipeline of students from the community college to the university can remain active with less university faculty effort, as the recruiting is self-propagating through increased faculty and student interaction.

Building on prior research [7, 11] that showed that early exposure to computing, a perceived match between the student’s self-assessed abilities, and knowledge of computing careers were found to be the strongest indicators of selecting CS as a major in college, these characteristics have been used to develop a targeted personalized approach to high school students and community college and university faculty (Table 1).

**Table 1. Target student populations for the CS major and the audience University faculty should address to reach them**

<i>To turn these students into future CS majors:</i>	<i>University faculty should work with:</i>
High School Students	Guidance Counselors /Teachers
Transfer students	Community College Faculty
University students	Department and College Peers

Prior exposure to computing can be assessed by the high-school or community college curriculum, or courses that incumbent university students have already taken. Addressing the perceived match in the student’s self-assessed abilities was accomplished by a high degree of personalization in the faculty outreach, using names and small group communication, rather than non-personalized correspondence or addressing large groups of students. Peer and ‘near peer’ recruiting, taking a current university student back to the high school, community college, or freshman seminar at the university, was useful in providing the prospective students with a perceived reflection of their own skills and abilities. Finally, all faculty discussions and correspondence with students, guidance counselors, teachers and faculty included quantitative information about the national need for computer scientists along with their average starting salaries, and local employers who had hired recent graduates. The objective was to create a specific desire for majoring in CS, with details including potential future employers in the region. The visualization of post-graduation success in the profession is particularly important to first-generation and under-represented students [8].

### 3.1. High School Students

The timeline for recruiting (Table 2) with the approach outlined here begins one year before initial enrollment at the university.

**Table 2. Annual Recruiting Timeline with Activity by Semester for Prospective Freshman**

	Fall	Spring	Summer
Introduction Letter	x		
High School Visit	x	x	
Reciprocal University Visit	x	x	
Personalized Letter to Student from Faculty			x

A short list of regional high schools that have previously sent students who became CS majors to the University or have CS courses in their curriculum can be prepared in the summer of the year before enrollment. Once prepared, this list serves as a guideline to effective high school outreach in years to come. Additionally, a departmental brochure [12] should be developed for mailing and distribution during school visits.

After the start of the high school academic year, a letter of introduction can be sent to Guidance Counselors at the target high schools. This letter can include information about CS scholarships, including opportunity and merit-based scholarships. Additionally, public comprehensive universities, particularly those that recruit the majority of the student population within 150 miles of campus, and their CS faculty can use this opportunity to

- *present recent accomplishments* and recognitions of the university department, include grants and equipment received, as well as student recognition and honors,
- *update information on the CS opportunities* after graduation, including the national need for computer scientists, and

- *mention current or past students* who are doing well, include summer internships, research awards, or post-graduate positions.

If the initial letter to the guidance counselor does not provide results, approaching the CS teacher, if there is such a curriculum offering in the high school or the teacher(s) with advanced math students can be useful. The objective of this correspondence is to obtain an invitation to come and meet with students that would like more information about the university and majoring in CS.

Once the faculty is invited to visit the high school and meet with students, recruiting begins. Our experience has shown that an engaging undergraduate, preferably an alum of the high school, is an asset to a faculty member on a high school visit. Rather than meeting with a large group of students, smaller groups of ‘interested’ students are preferred, as the self-selection of the students to attend supports the personalization goal of the visiting university faculty member.

While the inclination is to take an academically outstanding student, faculty have found more success with students who can recruit by finding common ground with the high school students. In several fortunate cases, the student recruiter, a peer or ‘near-peer’ of the students in the high school audience, is also an academic superstar, making the student selection for the visit much easier. This visit to the high school provides prospective students with the opportunity to meet faculty, student(s) and importantly, to observe the interaction between university faculty member and university student(s) – a very important observation for potential first-generation college students. Such visits are a good opportunity to distribute the departmental brochure and discuss internships and career opportunities in CS. Our experience shows that specific examples and stories of student success after graduation help engage high schools students in a conversation. Names and addresses of students who attend the high school informational visits can be used for follow-up correspondence, which is vital for keeping students interested.

Reciprocal campus visits can be arranged, or the ubiquitous Open House can be used as a starting point for a follow-up visit to campus, to meet other faculty and observe the department first hand. Site visits are important to answer questions regarding parking and housing, getting around on campus, and feeling at ease in the university environment.

During spring and summer preceding the fall enrollment, a targeted mailing to prospective freshmen, students who have applied to attend the university in the coming fall semester is a good marketing opportunity for CS department to present itself to quality students who may be thinking about attending the University and/or undecided about choosing CS as a major. By working with the Admissions Department to obtain the names and addresses of students that fit department criteria, a pool of names can be developed. The department brochure should be included in Admission Office mailings sent to prospective freshmen.

### 3.2. Transfer Students

The identification of a targeted community college population, usually composed of the community colleges co-located in the region of the university, is the first step to successful recruitment of transfer students. Once a geographical focus area has been

identified and articulation agreements are in place for transferring credits from the community college environment to the university, faculty effort in recruiting can begin. As with the high school students, a letter of introduction should be sent to the chairs of the community college departments, or if a more informal approach is desired, to a colleague in the community college department. The purpose of this letter is threefold: to *present* any new developments at the university, *update* the community college faculty on job opportunities for students after receiving the university degree in CS, and to *mention* current or past students from the community college who transferred to the university, and have been successful. Even if university faculty sit on the Advisory Board of the Community College Department or vice versa, a written update of events at the University that might be of interest to Community College faculty and their students is needed. This can serve as the basis for a more detailed conversation during university faculty visits to community colleges, and the reciprocal visit of Community College faculty and students to the University. The objective of this informational letter is to obtain an invitation for university faculty to visit the community college and speak directly to students in small group settings about opportunities for completing their 4-year degree in CS at the University. Once in the community college classroom, the university faculty member uses the essentially the same approach as that which was made to the high school students, with an emphasis on why a 4-year degree is important and what positive impact it will have on the future of the community college student who transfers to the university and completes the degree in CS. Again, the construction of the community college visit, followed by university campus visit, and personalized follow-up where possible parallels the approach used in recruiting high school students (Table 2).

**Table 2. Annual Recruiting Timeline with Activity by Semester for Prospective Transfer Students**

	Fall	Spring
Community College Visit	x	
Reciprocal University Visit		x

## 4. RESULTS

### 4.1. Recruiting to the CS Major

The approach outlined here has been used with both high school and transfer student recruiting by two comprehensive public universities in different states. The methodology presented for recruiting high school students to university for CS study has yielded an increase in incoming freshmen choosing to major in CS. The combination of presenting an updated image of the university and the CS department, through reciprocal campus visits and information exchange, coupled with personalized mailings, has resulted in at least a 10% increase in undergraduate CS majors, after prior years of declining or stagnant major enrollment numbers. The correspondence between targeted faculty outreach efforts and enrolled students in the CS major is clear by the reciprocal visits and personal communication with the students prior to their enrollment on campus.

An effort to develop a quantitative relationship between recruitment at high schools and the corresponding increase in the number of majors has many variables, such as the number and selection of high schools visited by university faculty and the size of the prospective student mailing after such visits and as a result of information provided by the Admissions Department. Generally, at CS departments with approximately 120-150 majors, which could represent about 1% of the entire public comprehensive university student population, graduate and undergraduate, approximately a 10% increase in majors is to be expected if a personalized targeted mailing of 2% of the prospective freshman students (240-300) occurs in the summer before freshman enrollment begins for fall semester, and if recruiting visits by faculty and university students to targeted high schools occur in the academic year prior to freshman enrollment. The number of high school visits can vary, but the universities involved in this work try to visit the number of high schools equal to 5% of their majors. For a department of 120 students, this would mean 6 high school visits; for 160 students, 8 high school visits. This guideline, developed to maximize the brevity of time available for visits and faculty conversation with prospective students, cannot be much larger than 6-8 visits per semester, unless several faculty are devoted to the effort. Scheduling on the high school side is as challenging as finding time in the university faculty and student schedule.

A linear correspondence between community college visits and transfers to the CS major at the university is not yet available. This is partly due to the fact that new department majors who are not freshman can be identified either as incumbent university students or transfer students. Work is underway to clearly and quickly identify incoming transfer students who chose to major in CS. The definition of geographical focus areas, which in one case includes seven community colleges, has assisted in narrowing the range of transfer student populations to be addressed. Both universities using this methodology have long-standing articulation agreements with regional community colleges. The presentation of updated information on the university and the CS department to community college faculty and students, through reciprocal campus visits and information exchange and discussion of post-graduation opportunities for 4-year degree recipients has resulted in a better understanding of the value of 4-year degrees to community college faculty. Additionally, regular communication by university faculty with community college peers has increased understanding of university degree expectations and community college student preparation levels, which is increasing the success of the community college transfers once they arrive at the university.

### 4.2. Less Effective Strategies

Significant results have not been found from mass mailings to students, without personalization. Prospective freshmen in a regional recruiting market are inundated with material, and appear to disregard materials not specific to them. Also, mailing of generic promotional materials, such as departmental posters, to high school guidance departments does not encourage recruiting to the specific major.

Initially, the informational mailing to prospective freshmen was targeted at the 'top-tier' of students, as defined by SAT scores and high school GPAs. This targeted recruiting produced modest

positive results, but it did not work as well as hoped. Subsequent years have resulted in smaller mailings, but to a more selected 'second-tier' of students, again as defined by SAT scores, good high school GPAs and the track record of prior interaction and interest with the university, which provided better results. It is the personal pitch, the meet-and-greet either at the community college, as a guest in a colleague's classroom, or on the university campus, during an open house or special departmental event, such as a programming contest, which works most effectively.

**Table 3. Best Practices for Effective CS Major Recruiting**

	High School Student	Community College Student
Faculty Visit to Students	VE	VE
Reciprocal Campus Visit	E	E
Personalized Letter to Student from Faculty	VE	E

VE=Very Effective; E=Effective

Particularly in the public comprehensive university, personalized recruiting, before the student's college career begins, or after the student arrives on campus, is of great significance. Whether it is due to the size of the campus, or the potential anonymity of the university experience, a faculty member that reaches out to select a student by name and recalls previous interest expressed or questions asked stands a very good chance of recruiting that student to the major. As shown in Table 3, all of the best practices for recruiting students into CS major involve a personalized approach.

## 5. CONCLUSION

The methodology outlined here has been effective in increasing enrollment in undergraduate CS majors at two public comprehensive universities. In addition to recruiting from the pool of incumbent students, it involves a series of visits and personalized interactions with students and faculty at high schools and community colleges. The approach used here requires additional work to locate and inform students prior to having them appear in CS classrooms of their own volition as they did in years past. However, the results from a focused approach in a regional area can be highly beneficial both to the university department and to the recruited students. While in years past, high school recruiting was never regarded as part of a university faculty member's job, the tangible benefits which can be obtained today by some active recruiting merit consideration. Furthermore, 'high yield' interactions, which result in the greatest return for the effort, are identified here. The recruiting methods outlined and the personalized approach, seen as ideal, is comparable to the effort traditionally used to get the best graduate students into advanced study in CS.

The effort outlined here addresses recruiting students to the CS major. We continue to refine our approach to recruit the largest number of student from the most diverse pool. We are now seeking to determine if there is any correlation with retention in the major for students who have been recruited in this personalized way.

## 6. REFERENCES

- [1] Vegso, J. "Enrollments and Degree Production in US CS Departments Drop Further in 2006-2007", *Computing Research News*, Volume 20, Number 2, March 2008, p.4.
- [2] Lazowska, E. "Computing Research and Human Resources: The Current Situation", *CRA Computing Leadership Seminar*, February 2005,
- [3] Binkerd, C., "Women/Minorities in Computer Science: Where are they? No Attention No Retention", *Journal of Computing Sciences in Colleges*, Volume 17, Issue 5, April 2002, pp. 8-12.
- [4] Peckham, J., P. Stephenson, J. Herve, R. Hutt, and M. Encarnacao, "Increasing Student Retention in Computer Science through Research Programs for Undergraduates", *Proceedings of the 38<sup>th</sup> SIGCSE Technical Symposium on Computer Science Education*, Covington, Kentucky, March 2007, pp. 124-128.
- [5] Biggers, M., A. Brauer, and T. Yilmaz, "Student Perceptions of Computer Science: A Retention Study Comparing Graduating Seniors vs. CS Leavers", *Proceedings of the 39<sup>th</sup> SIGCSE Technical Symposium on Computer Science Education*, Portland, Oregon, March 2008, pp. 402-406.
- [6] <http://www.cra.org/info/education/us/bs.html>
- [7] Tillberg, H. and J. Cohoon, "Attracting Women to the CS Major" in *Frontiers: A Journal of Women Studies, Special Issue: Gender, Race, and Information Technology*, Editors: D. Haynes, D. Keyek-Franssen, and N. Molinaro, Johns Hopkins University Press, Volume 26, Number 1, 2005, pp. 126-140.
- [8] Mattis, M. and Sislin, J, editors. *Enhancing the Community College Pathway to Engineering Careers*, National Academy of Engineering and National Research Council, The National Academies Press, Washington, D.C. 2005.
- [9] Morreale, P., G. Chang and L. Wittenberg, "Transitioning from a Community College to a Four-year University", *IEEE Computer*, Volume 41, Number 3, March 2008, pp. 89-91.
- [10] Yue, K. and S. Hall, "Reflections on Proposal Writing and Management of a NSF STEM Scholarship Grant Program", *Journal of Computing Sciences in Colleges*, Volume 22, Issue 4, April 2007, pp. 244-251.
- [11] Carter, J., Jenkins, T., Tymann, P., Fraser, K., Kurkovsky, S., Lang, C., and Beheshti, M. "Can We Entice More Students Into CS: Why Don't Girls Apply?" *SIGCSE Bulletin*, forthcoming.
- [12] <http://www.kean.edu/~pморreal/docs/CSBrochure/CSBrochure021208.pdf>