EVALUATION OF THE EMERGING SCHOLARS PROGRAM IN COMPUTER SCIENCE (ESP-CS) 2005 - 2007

Prepared by KD Evaluation Consultants (2008)

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INTRODUCTION

The following report details the evaluation of the Emerging Scholars Program–Computer Sciences (ESP-computer science). The intervention program was first awarded grant funding through Microsoft and was piloted at the University of Wisconsin-Madison in 2004. Additional grant funding was obtained through the National Science Foundation (NSF) to implement the program at UW-Madison and pilot the program at seven additional institutions. In 2005, the ESP-CS continued at UW-Madison and was piloted at Beloit College, Duke University, Georgia Institute of Technology, Loyola College, and Rutgers University. In 2006, University of Wisconsin-Milwaukee piloted their program, and in 2007, Purdue University added their ESP section.

As stated in the overview in the original project proposal, the ESP-CS was developed by combining educational concepts from two successful programs: the Peer-Led Team Learning and Emerging Scholars Programs. The ESP-CS utilizes concepts from these two programs to enhance the experiences of students in computer science courses, particularly those students from under-represented populations. The target under-represented groups for ESP-CS program are defined as female and/or students listing ethnic affiliation as Black or African American; American Native Indian or Native Alaskan, Cambodian, Laotian or Vietnamese; Hispanic, Latino or Puerto Rican or a combination including any of these affiliations.

The implementation goal of the program is to provide a supportive and collaborative, yet challenging environment, where a more diverse student group can explore computer science through interesting problem solving activities in small groups. This educational support mechanism is an additional one to two hour component, attached to an entry-level college programming course (referred to hereafter as the "main" course). During that additional component, ESP-CS students meet to work together in small groups, usually of 5-8 students. The groups are supervised by undergraduate peer leaders, who are in turn trained and supervised by faculty. The desired outcomes of the ESP-CS are to:

- increase the number of targeted students who enroll in the main course,
- facilitate more substantive learning and understanding of computer science,
- improve student performance to achieve higher grades in the main course
- instill confidence and encourage students to pursue additional computer science (or related) coursework, and
- increase retention in the main course.

Ultimately, the program hopes to encourage more students from under-represented groups (females and under-represented ethnic groups) to go into the field of computer science.

In 2004, the LEAD Center, at the University of Wisconsin-Madison was contracted to conduct an on-going evaluation of the ESP-CS. The LEAD Center established an evaluation plan, developed instrumentation, and conducted the program evaluation from 2004 through 2005, at which time it closed and ceased operations. In September of 2006, KD Consultants was contracted to complete the evaluation. The following evaluation questions that are answered in this paper include (adapted from the original questions developed in the grant proposal to the NSF):

Enrollment in ESP: Who enrolls in ESP and why?

- How successful were the strategies used to recruit participants in the ESP-CS sections?
- Were the recruiting strategies more successful with some demographic groups than others, and if so, why?
- What were the reasons invited students (in particular, female/minority students) chose to participate or not participate?

Evaluation of the Main Course and ESP-CS:

- How does the main-course experience of ESP students differ from that of non-ESP students?
- How do ESP students evaluate their experience in the program? Are there differences between perceptions of the ESP by gender?

Impact on subsequent COMPUTER SCIENCE course enrollment:

- After four years of ESP-CS courses at UW-Madison and two to three years at other universities, how have computer science course enrollments and major declarations changed for underrepresented students targeted by ESP-CS?

EVALUATION METHODS

Surveys – During the fall semesters of 2005–2007, baseline surveys were administered during the first week of courses to all students registered in the main course associated with the ESP-CS (for brevity sake, we will refer to this group as "ESP" hereafter). At the end of the semester (typically during the last week of class), a similar survey was administered to all students registered in the course. These surveys inquired about general demographic and attitudinal information regarding computer science, as well as evaluative questions. Students who were enrolled in ESP were asked to answer additional questions regarding their experience in the intervention.

Interviews – In 2004, ESP students were interviewed, focusing on their experience with the program and in the main course, and their interest in taking more CS courses or pursuing a major in CS (see report UW Madison Formative Feedback 2004), however, attempts to interview ESP students were less successful following that. Therefore, student feedback in this report comes directly from suggestions and comments given in the surveys. In 2005 and 2006 interviews were conducted with co-principal Investigators and peer leaders. The interviews were conducted to better understand how the ESP was implemented, what types of changes were made to the program at each institution, and to understand the effects it had on peer leaders.

Existing resources – During 2006 and 2007, co-PIs submitted data for all students enrolled in the main course. Student data includes gender, ethnicity, final course grades, and retention numbers. In 2006, all PIs also submitted institutional data regarding the demographics of the general population of the institution and computer science department statistics. In 2008, all institutions submitted data regarding course enrollment patterns for these former Fall 2005-2007 students, as well as the number of students declaring computer science as their major.

SURVEY RESPONSE RATES

Based on the data analysis plan, it is difficult to provide an overall survey response rate. For example, questions regarding prior experience were asked on the baseline survey, which shows approximately 1857 responses. Evaluation of the main course, on the other hand, was obviously collected on the exit surveys only, which had approximately 1125 responses. Finally, attitudinal and interest items were asked on both the baseline and exit survey and the analysis of these items depends on matched surveys. For those, we have the much lower response rate of approximately 853 matched responses. Tables 1-5 lists response rates for each institution by year.

To complicate the survey response rate further, baseline response rates include some students who may have later dropped the course, or those students who completed the course but opted not to complete an exit survey. Some institutions had years where only the ESP group completed surveys, and some only administered an exit survey. Regardless, the following tables should provide a general idea of the approximate response rates for both surveys.

In 2005 and 2006, baseline survey response rates were adequate, with most institutions indicating over a 50% response rate. Exit survey response rates were less than adequate with three out of six institutions showing less than 50% response rate. In 2007, the response rates were more encouraging, with most reporting institutions showing well over a 50% response rate.

Table 1: 2005 Survey Response Rates by Institution

2005 Survey Response Rates by Institution

		Baseline responses		Exit responses	
Institution	Enrolled	#	%	#	%
Beloit	26	11	42.3%	4	15.4%
Duke*	14	8	57.1%	0	0.0%
GA Tech*	35	31	88.6%	13	37.1%
Loyola	39	31	79.5%	20	51.3%
Madison	274	238	86.9%	151	55.1%
Rutgers	175	161	92.0%	64	36.6%
Totals	793	480	60.5%	252	31.8%

Source: LEAD center data

** ESP respondents only*

Table 2: 2006 ESP Survey Response Rates by Institution

2006 ESP Survey Response Rates by Institution

	Baseline Responses			Exit responses			Matched Surveys	
Institution	Enrolled	#	%	Enrolled	#	%	#	%
Beloit	2	2	100.0%	2	2	100.0%	2	100.0%
Duke	8	6	75.0%	8	6	75.0%	6	75.0%
GA Tech	31	16	51.6%	31	6	19.4%	5	16.1%
Loyola	9	5	55.6%	7	7	100.0%	5	71.4%
Madison	58	53	91.4%	49	38	77.6%	35	71.4%
Milwaukee	24	19	79.2%	24	4	16.7%	4	16.7%
Rutgers	15	5	33.3%	13	5	38.5%	5	38.5%
Total	147	106	72.1%	134	68	50.7%	62	46.3%

Source: Baseline and Exit Surveys, Yearly PI Demographic Reports

Table 3: 2006 Non-ESP Survey Response Rates by Institution

2006 Non-ESP Survey Response Rates by Institution

	Baseline Responses			Exit Responses			Matched Surveys	
Institution	Enrolled	#	%	Enrolled	#	%	#	%
Beloit	24	18	75.0%	19	17	89.5%	16	84.2%
Duke	55	24	43.6%	55	22	40.0%	19	34.5%
GA Tech	259	95	36.7%	245	33	13.5%	19	7.8%
Loyola	48	24	50.0%	25	25	100.0%	23	92.0%
Madison	227	206	90.7%	177	113	63.8%	103	58.2%
Milwaukee	189	104	55.0%	157	63	40.1%	56	35.7%
Rutgers	154	100	64.9%	132	44	33.3%	35	26.5%
Total	956	571	59.7%	810	317	39.1%	271	33.5%

Source: Baseline and Exit Surveys, Yearly PI Demographic Reports

Table 4: 2007 ESP Survey Response Rates by Institution

2007 ESP Survey Response Rates by Institution

Institution	Baseline Responses			Exit Responses			Matched Surveys	
	Enrolled	#	%	Enrolled	#	%	#	%
Beloit	25	25	100.0%	24	23	95.8%	21	87.5%
Duke	11	9	81.8%	11	6	54.5%	6	54.5%
GA Tech*	17	6	35.3%	17	10	58.8%	0	0.0%
Loyola**	N/A	N/A	N/A	4	4	100.0%	0	0.0%
Madison	38	35	92.1%	35	23	65.7%	21	60.0%
Milwaukee	22	17	77.3%	22	16	72.7%	15	68.2%
Purdue	19	16	84.2%	19	14	73.7%	12	63.2%
Rutgers	16	14	87.5%	16	16	100.0%	14	87.5%
Total	147	122	83.0%	148	112	75.7%	89	60.1 %

Source: Baseline and Exit Surveys, Yearly PI Demographic Reports

** Exit surveys did not request student IDs, therefore no matches were possible*

***Loyola students were not surveyed at the beginning of the semester*

Table 5: 2007 Non-ESP Survey Response Rates by Institution

2007 Non-ESP Survey Response Rates by Institution

Institution	Baseline Responses			Exit Responses			Matched Surveys	
	Enrolled	#	%	Enrolled	#	%	#	%
Beloit	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Duke	71	49	69.0%	69	21	30.4%	20	29.0%
GA Tech*	224	54	24.1%	200	37	18.5%	0	0.0%
Loyola**	N/A	N/A	N/A	15	15	100.0%	0	0.0%
Madison	295	240	81.4%	260	131	50.4%	105	40.4%
Milwaukee	198	138	69.7%	183	122	66.7%	87	47.5%
Purdue	47	43	91.5%	46	26	56.5%	22	47.8%
Rutgers	186	109	58.6%	170	47	27.6%	35	20.6%
Total	1021	530	51.9%	943	399	42.3%	269	28.5%

Source: Baseline and Exit Surveys, Yearly PI Demographic Reports

** Exit surveys did not request student IDs, therefore no matches were possible*

***Loyola students were surveyed at the beginning of the semester*

INSTITUTIONAL DEMOGRAPHIC PROFILES

The 2006 institutional and computer science department data demonstrates one way in which the participating institutions varied. Three of the institutions, Beloit, Duke, and Loyola are private colleges with smaller total student populations ranging from 1,317 to 6,247 (*Table 6*). Three of the institutions, the University of Wisconsin-Milwaukee, Rutgers, and the Georgia Institute of Technology (GA Tech) are mid-sized public institutions where student populations range from 18,747 to 28,351. Finally, two of the

participating institutions, the University of Wisconsin – Madison and Purdue University are large, public institutions with undergraduate populations of approximately 40,000.

The particular under-represented ethnic base for each institution is typically less than 10%, some as low as 6%, some as high as 16%[1]. Under-represented ethnic females (*3.5-9.0%*) constitute typically more than males (*2.3-6.4%*). Females (not of specified under-represented ethnicities) also tended to be in the majority with the exception of GA Tech (*28.4%*), Rutgers (*41%*), and Purdue (*42%*).

Table 6: 2006 Institutional Demographics

2006 Institutional Under-Represented Ethnic (URE) Demographic Breakdown by Institution

	Females*		URE** Females		Males*		URE** Males		Total	
Institution	#	%	#	%	#	%	#	%	#	%
Beloit	716	54.4%	50	3.8%	521	39.6%	30	2.3%	1317	100%
Duke[2]	UR ethnicities: 16.0%; Non-UR ethnicities: 84.0%								6247	100%
GA Tech[3]	UR ethnicities: n=2135, 11.4%; Non-UR ethnicities: n=16612, 88.6% Females: 5319, 28.4%; Males: 13428, 71.6%								18747	100%
Loyola[4]	UR ethnicities: 7.0%; Non-UR ethnicities: n=93.0% Females: 55.0%; Males: 45.0%								3500	100%
Madison	20464	49.1%	1445	3.5%	18560	44.5%	1209	2.9%	41678	100%
Milwaukee	13479	47.5%	1908	6.7%	11731	41.4%	1233	4.3%	28351	100%
Purdue[5]	UR ethnicities: n=4680, 12.0%; Non-UR ethnicities: n=34422, 88.0% Females: 16382, 41.9%; Males: 22729, 58.1%								39102	100%
Rutgers	10943	41.0%	2412	9.0%	11626	43.6%	1710	6.4%	26691	100%

Source: 2006 PI Demographic Report

** Includes White or Caucasian, (non-target) Asian, Pacific Islands, 'International' and non-reporting students.*

***UR = Under-represented ethnic groups including Black or African American, Latino, Hispanic or Puerto Rican, Cambodian, Laotian or Vietnamese.*

Departmental demographics were more difficult to obtain and, at times, there was an unclear representation for computer science alone. Many departments' information was contained within a larger school (e.g. a School of Engineering or a Department of Science) and therefore we were unable to ascertain specifics regarding enrollment of students in computer science. As well, some institutions do not track departmental descriptive information.

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[1] *From Duke's quick facts page. Ethnic groups included in this count are likely to include some groups that may not be a target group of in this program.*

[2] *Duke demographics source: http://www.dukenews.duke.edu/resources/quickfacts.html#students*

[3] *GA Tech demographics source: http://www.usg.edu/research/students/enroll/fy2008/fall07.pdf*

[4] *Loyola: http://www.loyola.edu/about/about.html, www.loyola.edu/campuslife/studentservices/studentdevelopment/Diversity.doc*

[5] *Includes undergraduate and graduate students - http://www.purdue.edu/enrollmentmanagement/student/standrpts/enrollsum/files/FINAL%20Summary%20Fall%202007%20Load%20Night.pdf*

Based on information obtained from four of the eight institutions, majority populations are males from non-targeted ethnic groups, demonstrating the need for increased representation of females and under-represented ethnic groups. Data are shown in Table 7.

Table 7: 2006 Computer Science Departmental Demographics

2006 Computer Science Departmental Under-Represented Ethnic Demographic Breakdown by Institution

Institution	Females*		URE** Females		Males*		URE** Males		Total	
	#	%	#	%	#	%	#	%	#	%
Beloit	0	0.0%	0	0.0%	10	100%	0	0.0%	10	100%
Duke	14	14.7%	5	5.3%	68	71.6%	8	8.4%	95	100%
GA Tech	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Loyola	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Madison	15	9.7%	0	0.0%	134	87.0%	5	3.2%	154	100%
Milwaukee	19	4.8%	6	1.5%	338	85.8%	31	7.9%	394	100%
Purdue – *Dept of Science*	NA	NA	NA	NA	NA	NA	NA	NA	1064	100%
Rutgers	67	14.3%	11	2.4%	342	73.1%	48	10.3%	468	100%

Source: 2006 PI Demographic Report
** Includes White or Caucasian, (non-target) Asian, Pacific Islands, 'International' and non-reporting students.*
***UR = Under-represented ethnic groups including Black or African American, Latino, Hispanic or Puerto Rican, Cambodian, Laotian or Vietnamese.*

IMPLEMENTATION OF ESP AT PARTICIPATING INSTITUTIONS

Implementation of the ESP meetings varied slightly between institutions. Alterations often involved individual institutional policy and procedures or access to resources (e.g., the hiring of peer leaders).

Generally, sessions were held either weekly or biweekly for 1-2 hours per session. Some provided food or snacks at every session, whereas other PIs decided not to involve food. Activities involved logic-building skill sets such as algorithms, coding verification, and logic problem solving. Special events, such as dinners with panel discussions, and field trips were used as opportunities to generate enthusiasm and a better understanding of computer-science related jobs and/or to dispel some common concerns about the field.

Physical space logistics: At least one co-PI mentioned having trouble with arrangements: availability during a time period convenient to the group, as well as in a convenient physical location.

Peer leaders:

- The ideal peer leader would have been a former ESP participant who was particularly enthusiastic and able to handle the responsibility. However, this would have been difficult to achieve due to the short time span of the project, let alone numbers of students available.
- Aside from their own student base, recommendations came from other professors/instructors.
- The ability to, and how to, hire undergraduate students was one consideration that was institutionally dependent. Differences included institutional policies regarding undergraduates

working without an instructor present (one institution was required to have the instructor present, somewhat changing the proposed peer led dynamic) and hiring of students who were also TAs (discussed later in the Peer Leader section below)

Format:

Length: Most of the eight institutions held 1-2 hour weekly sessions. Shorter and more frequent sessions (one hour, twice a week as opposed to 2 hours once a week) would have been preferred according to several of the 1-minute feedback reports submitted by students at UW-Madison, as well as in interviews with several peer leaders from other institutions. Finally, depending on the experience levels within the group, some activities were not appropriate to the time frame available – whether too long or too short.

Group Format: All the institutions programs based their sessions on paired or small group activity, occasionally convening as a whole group for discussion or answer sharing.

Activities and goals: At least half the institutions specifically sought to help students improve their performance in class, some specifying that the main purpose was supplemental and not remedial. Some activities included algorithm design, code verification, logical thinking, and object manipulation.[6] These were based on a set of exercises developed and honed over the years, but altered to best meet the needs of the individual groups.

Special Events: Visits to work environments and virtual reality labs provided opportunities to encounter computer-science professionals in action with the hopes of encouraging enthusiasm and dispelling some common concerns. Speakers invited to the institution in a panel discussion provided opportunities to ask questions and hear what working life looks like after graduation. Feedback from some of these events are shown in the section called *"What ESP extracurricular activities were most appreciated and why?"* and in Table 29.

Weekly prep/peer leader meetings:

At least six of the eight co-PIs met directly with peer leaders on a weekly basis. At some of the larger institutions, PIs chose to be less involved. One of the institutions' peer leaders met on their own. These were mostly peer leaders who were also TAs and, according to their interviews, felt comfortable organizing themselves. At this institution, the PI and instructor made themselves available when the peer leaders needed assistance. Regardless of the level of involvement by the PI and/or instructor, all peer leaders who were interviewed indicated they felt they were given adequate opportunities to receive support when needed.

Language used:

[6] Examples available at: http://www.cs.wisc.edu/wes-cs/, http://beloit.edu/~huss/BECSMaterials.html, http://swiki.cc.gatech.edu/cs1801-fa07, http://www.cs.loyola.edu/~lcs-es/exercises/,

Most of the ESP sessions focused on problem and logic solving rather than actual programming. However, some exercises were adjusted based on the format of the main course. Half the institutions' courses were based mostly around Java, however a few others used Alice, Python and/or C++.

RECRUITMENT FOR THE ESP AT PARTICIPATING INSTITUTIONS

Most of the institutions began their pilot year using an initial selective recruitment process, sending early invitations to members of the targeted populations. Some PIs started their recruitment efforts by contacting students who met certain academic qualifications (based on high-school GPAs and ACT or SAT math scores). Some smaller schools went so far as to send invitations to all prospective students (who met the ESP qualifications) inquiring about the institution, with follow up letters to those applying and/or admitted. These Co-PIs tended to find little gain for the amount of effort and discontinued this particular recruiting strategy. Policies and procedures limited at least one institution's recruitment efforts to only students already enrolled in the course, rendering recruitment of underrepresented groups (who typically do not enroll) more difficult. According to PIs and student feedback the most successful recruitment strategies included, letters to advisors, email/letter invitations to incoming freshmen, and/or providing information at freshman orientation sessions.

The number of students enrolling and dropping before initial lectures and/or official course census caused difficulty in getting people to commit to participating in the ESP sections. By the beginning of lectures, most opened the invitation to all students by way of an announcement in the first few lectures. One Co-PI noted that coursework becomes more of a reality as lectures begin, and it was at this point that students approached with more serious inquiries. This co-PI, along with the course instructor, also felt that word-of-mouth (by other students and former participants) regarding the benefits of the program had spread enough to grab students' attention.

Beloit departmental overhaul also influenced and afforded some manipulation of the way this program was administered. As one of the smallest institutions attempting to incorporate this program into their course, shear access to population, let alone interest and enrollment led co-PI Huss-Lederman to get creative in how he administered the program. In Fall 2006, he split the lab component into two groups, randomly assigning students into two groups: a peer led lab or an instructor led lab. By 2007, the decision was made to incorporate the peer-led aspect into the lab component for all students. Thus, by default, all students in the major course were considered to be participating in ESP.

At Milwaukee, institutional policies do not allow faculty and/or staff to contact students based on any intellectual qualifications (e.g. high ACT math scores). Additionally, co-PI Munson was only allowed to contact students who had already registered in the main course and who had not declared a major. However, the criteria for enrolling in the main course included a math ACT score of over 30. Thus, essentially, this qualification was intact for anyone interested in enrolling in the ESP.

At Purdue, incoming freshmen must declare a major, and computer science freshmen enroll in one of two freshmen courses. One of them is considered a CS0-level course and students enrolled in this course are invited into the ESP program. As the CS graduation rate for students in the CS0 course is very low (below 15%), the ESP program serves an important purpose.

Peer leaders at some institutions noted that the amount of support from other departments and institutional staff seemed directly related to the amount of time, energy and enthusiasm of the co-PI. However, one other peer leader noted the difficulty in getting this support from their institution, despite attempts by the co-PI.

ENROLLMENT IN THE EMERGING SCHOLARS PROGRAM (ESP)

What types of students enroll in ESP and why?

In 2006 and 2007, at the end of the semester, PIs submitted student demographics, grade, and drop information[7]. A base line survey was also administered to all students enrolled in the course, regardless of participation in the ESP, for information regarding demographics such as gender, ethnicity, college rank, and their prior experiences in computer science and/or programming. The following are results from combined data of all eight institutions over three fall semesters describing the trends among the types of student that opted to participate in the ESP.

What percent of targeted populations enrolled?

Combined institutional data shows 18.2% (*Table 8*) of females enrolling in the Introductory course also enrolled in the ESP, a slightly higher percentage than males (*12.5%*). This slightly higher percentage plays out at the vast majority of institutions (*7 of 8*) and reflects the recruitment efforts focusing on enrolling females as a target group for the ESP intervention.

Table 8: Enrollment by Gender

Enrollment by Gender; All Institutions (2005-2007)

	ESP		Non-ESP		Total	
	#	%	#	%	#	%
Female	161	18.2%	725	81.8%	886	100%
Male	279	12.5%	1961	87.5%	2240	100%
Total	440	14.1%	2686	85.9%	3126	100%

Source: Outcomes Data (2005-2007)

[7] *Tables 8-11 are based on Yearly PI Demographic Reports. However, these are in direct conflict with data reported in Tables 12-14 (received by institutional support, often registrars, in 2008 regarding outcomes of the course).*

With the exception of Beloit and Purdue, percentages of students in the main course enrolling in the ESP sections ranged between 9% and 28%, data are shown in Table 9. Beloit appears to have the highest student enrollment (*46.8%*); however, this high number reflects the change in program structure \described previously in the Recruitment for the ESP section. Purdue also appears to have higher percentages of enrollments; however, numbers are lower, thereby creating some distortion to the percentages, and are based only on one year (2007).

Table 9: Enrollment by Gender and Institution

Enrollment by Gender and Institution (2005-2007)

Institution	Group	ESP		Non-ESP		Total	
		#	%	#	%	#	%
	Female	16	59.3%	11	40.7%	27	100%
	Male	21	40.4%	31	59.6%	52	100%
Beloit	All	37	46.8%	42	53.2%	79	100%
	Female	18	15.8%	96	84.2%	114	100%
	Male	18	17.5%	85	82.5%	103	100%
Duke	All	36	16.6%	181	83.4%	217	100%
	Female	40	11.8%	298	88.2%	338	100%
	Male	47	10.0%	422	90.0%	469	100%
GA Tech	All	87	10.8%	720	89.2%	807	100%
	Female	13	28.9%	32	71.1%	45	100%
	Male	10	18.5%	44	81.5%	54	100%
Loyola	All	23	23.2%	76	76.8%	99	100%
	Female	37	20.8%	141	79.2%	178	100%
	Male	102	13.8%	637	86.2%	739	100%
Madison	All	139	15.2%	778	84.8%	917	100%
	Female	9	16.7%	45	83.3%	54	100%
	Male	41	11.4%	320	88.6%	361	100%
Milwaukee	All	50	12.0%	365	88.0%	415	100%
	Female	3	75.0%	1	25.0%	4	100%
	Male	16	25.8%	46	74.2%	62	100%
Purdue	All	19	28.8%	47	71.2%	66	100%
	Female	25	19.8%	101	80.2%	126	100%
	Male	24	6.0%	376	94.0%	400	100%
Rutgers	All	49	9.3%	477	90.7%	526	100%

Source: Outcomes Data (2005-2007)

Combined data show that approximately 18.4% (*Table 10)* of the students from under-represented ethnic groups who enrolled in the main course also enrolled in the ESP program, as compared to 13.9% of non-targeted groups.

Table 10: Targeted Ethnic Group Enrollment

Targeted Ethnic Group Enrollment; All Institutions (2005-2007)

Institution	ESP		Non-ESP		Total	
	#	%	#	%	#	%
Target	58	18.4%	257	81.6%	315	100%
Non-Target	372	13.9%	2310	86.1%	2682	100%
No Report*	9	7.0%	119	93.0%	128	100%
Total	439	14.1%	2686	86.0%	3125	100%

Source: Outcomes Data (2005-2007)

** Did not report ethnicity*

Disaggregate institutional data shows that the percentage of under-represented ethnic groups in the main course who enrolled in ESP ranges from around 13% to 31% (*Table 11;* this range excludes Beloit and Purdue for the reasons listed above). The percentage of non-target ethnic groups ranges from around 8.5 to 21.7. This slightly higher percentage of enrolling targeted ethnic groups compared to non-target most likely reflects the active recruitment of specific groups. (NB. The total numbers of ESP and Non-ESP students, labeled ALL, for each institution is higher than the sum of the number of target and non-target students because it includes students who did not report their ethnicity).

Table 11: Targeted Ethnic Group Enrollment by Institution

Targeted Ethnic Group Enrollment by Institution (2005-2007)

Institution	Group	ESP		Non-ESP		Total	
		#	%	#	%	#	%
	Target Group	3	50.0%	3	50.0%	6	100%
	Non-Target Group	29	46.8%	33	53.2%	62	100%
Beloit	All*	37	46.8%	42	53.2%	79	100%
	Target Group	4	13.3%	26	86.7%	30	100%
	Non-Target Group	31	17.5%	146	82.5%	177	100%
Duke	All*	36	16.6%	181	83.4%	217	100%
	Target Group	11	12.9%	74	87.1%	85	100%
	Non-Target Group	76	10.9%	623	89.1%	699	100%
GA Tech	All*	87	10.8%	720	89.2%	807	100%
	Target Group	5	31.3%	11	68.8%	16	100%
	Non-Target Group	18	21.7%	65	78.3%	83	100%
Loyola	All*	23	23.2%	76	76.8%	99	100%
	Target Group	11	24.4%	34	75.6%	45	100%
	Non-Target Group	127	15.7%	684	84.3%	811	100%
Madison	All*	139	15.2%	778	84.8%	917	100%
	Target Group	12	22.6%	41	77.4%	53	100%
	Non-Target Group	35	10.3%	305	89.7%	340	100%
Milwaukee**	All*	77	17.4%	365	82.6%	442	100%
	Target Group	2	14.3%	12	85.7%	14	100%
Purdue**	Non-Target Group	17	32.7%	35	67.3%	52	100%

Targeted Ethnic Group Enrollment by Institution (2005-2007)

Institution	Group	ESP		Non-ESP		Total	
		#	%	#	%	#	%
	All*	19	28.8%	47	71.2%	66	100%
	Target Group	10	15.2%	56	84.8%	66	100%
	Non-Target Group	39	8.5%	419	91.5%	458	100%
Rutgers	All*	59	11.0%	477	89.0%	536	100%

Source: Outcomes Data (2005-2007)

** Students who did not report ethnicity are included in the All total and will be higher than totals for two groups.*

*** Milwaukee participated in 2006 and 2007 only, and Purdue only in 2007*

Diversity within ESP Sections

According to the proposal submitted to the NSF, the project aimed to achieve a diverse student group in the ESP sections. Specifically, the proposal aimed to achieve around a 50% representation of females. The program also aimed to achieve some level of representation from under-represented ethnic groups but no exact percentage was specified. Data regarding outcomes of the ESP were used to examine diversity within ESP sections (not including students who dropped the section and/or course).

In 2006, most schools achieved the goal of 50% representation by females in the ESP group. The percentage of females in each group decreased in 2007, with only two schools achieving 50% or more of females in the class. Data are shown in Table 12.

Relative to institutional and departmental statistics of under-represented groups, recruitment efforts of these groups were fairly successful. In 2007, Loyola's only three ESP males were all of under-represented ethnicities with the other two ESP members being female. Rutgers achieved the greatest diversity in 2006, when 35.7% of the ESP section consisted of under-represented ethnic groups, and other females represented 21.4%. Combined with non-targeted males, the mix presented the ideal as proposed. GA Tech and the University of Wisconsin-Milwaukee were the most consistent in maintaining ethnic diversity during each year, achieving between 15% and 26% of the ESP sections represented by targeted ethnic groups. These slightly higher percentages coincide with slightly more diverse general populations as compared to some of the other institutions that have largely majority populations (e.g. Loyola, Madison). Overall, all the institutions were successful in obtaining some level of diversity each year.

To provide a further comparison, Tables 13 and 13a show the composition of the Non-ESP groups and of the whole main course sections (ESP and Non-ESP students) by institution and semester. The following analysis focuses largely on the differences between the ESP section and the whole main section to give a better sense of what students encountered in the classroom, in terms of diversity.

As might be expected, the ESP sections were slightly more diverse in gender than were the main course sections. Percentagewise, ESP sections had about a 4-5% higher representation of females (*ESP = 33.5%; Non-ESP = 28.3%; Whole Course = 29.1%*). Looking across institutions, percentages varied more, ranging from roughly 2% to 40% more representation by females in the ESP sections.

Similarly, when combining all years and institutions ESP sections had approximately 2% higher representation by under-represented ethnic males (*ESP: 8.2%, Non-ESP: 5.9%, Whole class: 6.3%*). However, while aggregate data shows that the ESP overall looks good in its representation, this was not necessarily the case in all sections or semesters. When examining semester by semester, institution by institution, there were largely varying group consistencies (of all URE/gender groups) per section. Eleven of the 21 sections over the course of the project showed similar URE group representation between ESP and Non-ESP groups, but the other half had a slightly higher representation in the ESP section ranging from 3% to 25%.

Table 12: ESP Group Diversity by Institution and Year

	ESP Students								
Institution	n	URE Male		URE Female		Males		Females	
	#	#	%	#	%	#	%	#	%
Beloit (2005)	6	0	0.0%	1	16.7%	0	0.0%	5	83.3%
Beloit (2006)	3	0	0.0%	0	0.0%	1	33.3%	2	66.7%
Beloit (2007)	24	2	8.3%	0	0.0%	16	66.7%	6	25.0%
Duke (2005)	14	1	7.1%	0	0.0%	6	42.9%	7	50.0%
Duke (2006)	11	1	9.1%	0	0.0%	6	54.5%	4	36.4%
Duke (2007)	11	0	0.0%	2	18.2%	4	36.4%	5	45.5%
GA Tech (2005)	34	1	2.9%	1	2.9%	25	73.5%	7	20.6%
GA Tech (2006)	29	2	6.9%	2	6.9%	12	41.4%	13	44.8%
GA Tech (2007)	20	0	0.0%	3	15.0%	6	30.0%	11	55.0%
Loyola (2005)	9	2	22.2%	0	0.0%	1	11.1%	6	66.7%
Loyola (2006)	7	0	0.0%	0	0.0%	3	42.9%	4	57.1%
Loyola(2007)	5	3	60.0%	0	0.0%	0	0.0%	2	40.0%
Milwaukee (2006)	25	6	24.0%	0	0.0%	17	68.0%	2	8.0%
Milwaukee (2007)	24	4	16.7%	2	8.3%	14	58.3%	4	16.7%
Madison (2005	43	2	4.7%	2	4.7%	28	65.1%	11	25.6%
Madison (2006)	49	2	4.1%	0	0.0%	36	73.5%	11	22.4%
Madison (2007)	32	2	6.3%	0	0.0%	24	75.0%	6	18.8%
Purdue (2007)	19	2	10.5%	0	0.0%	14	73.7%	3	15.8%
Rutgers (2005	12	1	8.3%	1	8.3%	0	0.0%	10	83.3%
Rutgers (2006)	14	2	14.3%	3	21.4%	6	42.9%	3	21.4%
Rutgers (2007)	16	1	6.3%	0	0.0%	12	75.0%	3	18.8%
All Years Total	365	30	8.2%	13	3.6%	213	58.4%	109	29.9%
All Years Total (gender combined)		URE total		43	11.8%	Non URE total		322	88.2%

Source: PI Report (Outcomes Data)

Table 13: Non-ESP Group Diversity by Institution and Year

Institution	Non-ESP Students								
	n	URE Male		URE Female		Males		Females	
	#	#	%	#	%	#	%	#	%
Beloit (2005)	20	1	5.0%	1	5.0%	12	60.0%	6	30.0%
Beloit (2006)	18	0	0.0%	1	5.6%	14	77.8%	3	16.7%
Beloit (2007)	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Duke (2005)	49	1	2.0%	3	6.1%	23	46.9%	22	44.9%
Duke (2006)	53	5	9.4%	3	5.7%	19	35.8%	26	49.1%
Duke (2007)	71	7	9.9%	6	8.5%	24	33.8%	34	47.9%
GA Tech (2005)	218	10	4.6%	7	3.2%	144	66.1%	57	26.1%
GA Tech (2006)	248	16	6.5%	13	5.2%	117	47.2%	102	41.1%
GA Tech (2007)	201	13	6.5%	6	3.0%	95	47.3%	87	43.3%
Loyola (2005)	28	1	3.6%	2	7.1%	15	53.6%	10	35.7%
Loyola (2006)	23	2	8.7%	1	4.3%	10	43.5%	10	43.5%
Loyola(2007)	24	2	8.3%	3	12.5%	13	54.2%	6	25.0%
Milwaukee (2006)	157	14	8.9%	2	1.3%	128	81.5%	13	8.3%
Milwaukee (2007)	176	13	7.4%	7	4.0%	140	79.5%	16	9.1%
Madison (2005	188	5	2.7%	3	1.6%	148	78.7%	32	17.0%
Madison (2006)	177	7	4.0%	1	0.6%	143	80.8%	26	14.7%
Madison (2007)	254	6	2.4%	1	0.4%	207	81.5%	40	15.7%
Purdue (2007)	46	12	26.1%	0	0.0%	33	71.7%	1	2.2%
Rutgers (2005	138	8	5.8%	7	5.1%	105	76.1%	18	13.0%
Rutgers (2006)	120	7	5.8%	3	2.5%	91	75.8%	19	15.8%
Rutgers (2007)	154	19	12.3%	3	1.9%	108	70.1%	24	15.6%
All Years Total	1951	115	5.9%	60	3.1%	1285	65.9%	491	25.2%
All Years Total (gender combined)		URE total		175	9.0%	Non URE total		1776	91.0%

Source: PI Report (Outcomes Data)

Table 13a: Main Course Diversity by Institution and Year

Institution	Whole Course Composition								
	n	URE Male		URE Female		Males		Females	
	#	#	%	#	%	#	%	#	%
Beloit (2005)	26	1	3.8%	2	7.7%	12	46.2%	11	42.3%
Beloit (2006)	21	0	0.0%	1	4.8%	15	71.4%	5	23.8%
Beloit (2007)	24	2	8.3%	0	0.0%	16	66.7%	6	25.0%
Duke (2005)	63	2	3.2%	3	4.8%	29	46.0%	29	46.0%
Duke (2006)	64	6	9.4%	3	4.7%	25	39.1%	30	46.9%
Duke (2007)	82	7	8.5%	8	9.8%	28	34.1%	39	47.6%
GA Tech (2005)	252	11	4.4%	8	3.2%	169	67.1%	64	25.4%
GA Tech (2006)	277	18	6.5%	15	5.4%	129	46.6%	115	41.5%
GA Tech (2007)	221	13	5.9%	9	4.1%	101	45.7%	98	44.3%
Loyola (2005)	37	3	8.1%	2	5.4%	16	43.2%	16	43.2%
Loyola (2006)	30	2	6.7%	1	3.3%	13	43.3%	14	46.7%
Loyola(2007)	29	5	17.2%	3	10.3%	13	44.8%	8	27.6%
Milwaukee (2006)	182	20	11.0%	2	1.1%	145	79.7%	15	8.2%
Milwaukee (2007)	200	17	8.5%	9	4.5%	154	77.0%	20	10.0%
Madison (2005	231	7	3.0%	5	2.2%	176	76.2%	43	18.6%
Madison (2006)	226	9	4.0%	1	0.4%	179	79.2%	37	16.4%
Madison (2007)	286	8	2.8%	1	0.3%	231	80.8%	46	16.1%
Purdue (2007)	65	14	21.5%	0	0.0%	47	72.3%	4	6.2%
Rutgers (2005	150	9	6.0%	8	5.3%	105	70.0%	28	18.7%
Rutgers (2006)	134	9	6.7%	6	4.5%	97	72.4%	22	16.4%
Rutgers (2007)	170	20	11.8%	3	1.8%	120	70.6%	27	15.9%
All Years Total	2316	145	6.3%	73	3.2%	1498	64.7%	600	25.9%
All Years Total (gender combined)		URE total		218	9.4%	Non URE total		2098	90.6%

Source: PI Report (Outcomes Data)

What recruitment strategies were more successful?

On the 2005 and 2006 baseline survey, respondents who indicated they enrolled in ESP were asked how they were recruited into the program. Out of a potential 302 respondents, 125 opted to answer this question. The question was eliminated after 2006 because most institutions felt they had their recruitment policies and procedures in place.

The majority of females (*60.5%, Table 14*) indicated they heard about ESP and enrolled because they received an invitation by mail or email. A little more than one-third of all ESP males indicated they found out and enrolled because of an invitation and a similar percentage indicated a class announcement. This is most likely a reflection of the recruitment process, as most males would not have received a letter/email about the program, but would have heard the class announcement. Interestingly, although many institutions indicated a presence at freshman orientations this response category was infrequently selected by any group of students (roughly 12% for each gender group).

Some may note that while almost one-quarter of males indicate that an academic advisor recommended ESP, only 10% of females selected this as a reason. When looking at disaggregate institutional data, although five institutions had students who selected this response category, one institution skewed these numbers where 11 out of 27 males selected this option and none of the females selected it. Therefore, it does not appear to be a trend among institutions but an isolated occurrence. Although we do not consider this a significant trend, program planners may want to keep this in mind when speaking with academic advisors about the intervention and its goals.

From the small amount of data collected, it appears that a personal invitation through the mail or email may be the most effective recruitment strategy at most schools.

Table 14: Reasons for Enrolling in ESP

Reasons for Enrolling in ESP; All Institutions Combined (2005-2006)

	ESP Female		ESP Male		Total	
	n=41		n=84		n=125	
Enrollment Strategy	#	%*	#	%*	#	%*
Academic Advisor recommended	4	9.8%	20	23.8%	24	19.2%
Friend recommended	0	0.0%	1	1.2%	1	0.8%
Parent/guardian recommended	2	4.9%	3	3.6%	5	4.0%
Orientation	5	12.8%	11	13.1%	16	13.0%
Class Announcement	4	9.8%	32	38.1%	36	28.8%
Mail/email invitation	26	60.5%	30	37.5%	56	45.5%
Enrolled with a friend	0	0.0%	0	0.0%	0	0.0%
Other	6	14.6%	9	11.4%	15	12.6%

Source: Baseline Surveys (2005-2007)

**Percentages will not total 100 because students were asked to check all that apply*

Who chose not to participate and why

Respondents who indicated they did not choose to enroll in ESP were asked if they would provide comments about their reasons. Of the 176 reasons provided, more than half (*62%*) indicated some type of issue with scheduling (*n=67, 38%*) or lack of time (*n=43, 24.4%*). Six of the respondents categorized under scheduling conflicts indicated they could not get into the ESP section they wanted.

Almost a quarter of the respondents (*n=42, 23.9%*) did not have an interest, felt it was not necessary, or that it was irrelevant to their major/interests. Ten (*5.7%*) respondents indicated they were concerned it would involve too much work or dedication; a few of those also specified this was their freshman year and a few indicated they had no experience and/or did not feel they would be good enough. Eight (*4.6%*) respondents said they had no specific reason for their decision to not enroll. The themes for not enrolling are shown in Table15.

Table 15: Reasons for Not Enrolling in ESP

Reasons for Not Enrolling in ESP; Institutions Combined (2005-2007)

	Females		Males		Total	
Reason	#	%	#	%	#	%
Scheduling Conflict	17	42.5%	50	36.8%	67	38.1%
Not enough time	8	20.0%	35	25.7%	43	24.4%
No interest or reason	7	17.5%	24	16.6%	31	17.6%
Didn't feel ESP applied to their intended major	5	12.5%	6	4.4%	11	6.3%
Too much work	2	5.0%	8	5.9%	10	5.7%
Other single (non-trend) items	1	2.5%	13	9.6%	14	8.0%
Total	40	100.0%	136	100.0%	176	100.0%

Source: Baseline Surveys (2005-2007)

College Rank

Across institutions, the majority of ESP respondents indicated their college rank as freshman (*ESP Males, 76.6%; ESP females, 79.3%*) or to a much lesser extent sophomore (*ESP males, 13.6%; ESP females, 9.4%*). Although similar percentages of Non-ESP respondents indicated the same entry level college ranks they were more spread between first and second year status. Nearly equal percentages of non-ESP males reported a freshman (*32.8%*) or sophomore (*32.3%*) rank. Similarly, non-ESP females were fairly evenly spread indicating freshman (*23.5%*) or sophomore (*30.1%*) rank. Disaggregate institutional data deviated little from this trend. At most institutions, the percentage of ESP respondents indicating a rank of freshman is slightly higher. This would stand to reason considering that it is an entry-level main course and most ESP respondents were recruited as incoming freshman through a mailed or emailed invitation or class announcement.

No consistent pattern between non-ESP males and females indicating higher college ranks were revealed, percentages were low and varied among institutions. Combined data are shown in Table 16.

Table 16: Student College Rank

Student College Rank, All Institutions Combined

	ESP females		Non-ESP Females		ESP Males		Non-ESP Males		Total	
Rank	#	%	#	%	#	%	#	%	#	%
Freshman/First Yr	84	79.3%	79	23.5%	164	76.6%	378	32.8%	705	39.0%
Sophomore/Second Yr	10	9.4%	101	30.1%	29	13.6%	372	32.3%	512	28.3%
Junior/Third Yr	5	4.7%	84	25.0%	11	5.1%	213	18.5%	313	17.3%
Senior/Fourth Yr	5	4.7%	44	13.1%	4	1.9%	98	8.5%	151	8.4%
Fifth Yr, Special, Grad, Other Combined	2	1.9%	28	8.3%	6	2.8%	91	7.9%	127	7.0%
Total	106	100%	336	100%	214	100%	1152	100%	1808	100%

Source: Baseline Surveys (2005-2007)

Prior Computer Science or Programming Experience

Students were asked to indicate what, if any, prior Computer Science or programming experience they had. A higher percentage of females indicated having no prior computer science or programming experience. Over 60% of ESP females and 49% of Non-ESP females indicated no prior experience whereas only one-third of either male group indicated no computer science experience. Data are shown in Table 17.

Table 17: Prior Experience with Computer Science or Programming

Prior Experience with CS or Programming; All Institutions Combined

	ESP Female		Non-ESP Female		ESP Male		Non-ESP Male		Total	
	n=112		n=357		n=217		n=1171		n=1857	
Experience	#	%	#	%	#	%	#	%	#	%
No prior experience/ no responses selected*	70	62.5%	175	49.0%	70	32.3%	388	33.1%	703	37.9%
High school	21	18.8%	74	20.7%	83	38.2%	433	37.0%	611	32.9%
College CS course	4	3.6%	45	12.6%	26	12.0%	221	18.9%	296	15.9%
Object oriented course	4	3.6%	11	3.1%	23	10.6%	151	12.9%	189	10.2%
Object oriented on own	10	8.9%	12	3.4%	45	20.7%	190	16.2%	257	13.8%
Non-object oriented programming on own, or in other type course	17	15.2%	56	15.7%	90	41.5%	358	30.6%	521	28.1%
Other prior experience	5	4.5%	30	8.4%	9	4.1%	43	3.7%	87	4.7%

Source: Baseline Surveys (2005-2007)

** In 2006, there was no specific option to select "no prior experience," numbers for 2006 are based on no selected response and the those respondents noting 'none' in the Other category.*

Of the respondents who did indicate prior experience, a good percentage selected programming experience on their own or in a non-formal course. While non-formal prior experience is an important form of learning, it is more difficult to measure the depth or extent of those experiences. For example, upon reviewing "other prior experience" response data, a wide range of experiences were described ranging from 'dabbling in' or using basic HTML to examples of advanced software programming.

When considering only High School or College Courses as a qualified prior experience the number of students *without* prior experience rises by around 20%, indicating just over half of all males (*Non-ESP males 53.5%; ESP males 57.6%*) and well over half of females (*Non-ESP females, 70%; ESP females 80.4%*) had no prior coursework in computer science. There were only modest differences in prior experience patterns between institutions. In general, the majority of institutions confirmed the trends described above. The combined data are shown in Table 18.

Table 18: Prior High School and/or College Courses in Computer Science or Programming

Prior High School and/or College Course in Computer Science or Programming; All Institutions Combined (2005-2007)

	ESP Female		Non-ESP Female		ESP Male		Non-ESP Male		Total	
Coursework	#	%	#	%	#	%	#	%	#	%
No Course Selected	90	80.4%	250	70.0%	125	57.6%	627	53.5%	1092	58.8%
High School Course Selected	18	16.1%	62	17.4%	66	30.4%	323	27.6%	469	25.3%
College Course Selected	1	0.9%	33	9.2%	9	4.1%	111	9.5%	154	8.3%
HS and College Course Selected	3	2.7%	12	3.4%	17	7.8%	110	9.4%	142	7.6%
Total	112	100%	357	100%	217	100%	1171	100%	1857	100%

Source: Baseline Surveys (2005-2007)

Reasons for Enrollment in the Main Course

Students were asked to indicate why they opted to enroll in the main course at their institution. Across institutions, the most commonly selected reasons for enrolling in the main course included:

- Have an interest in computer science (CS)
- Intend to major in computer science
- Wanted to see whether they enjoyed computer science
- Fulfill a requirement of their intended major

What differences for enrolling in the main course existed between groups?

With the exception of ESP males, combined data show a large percentage of respondents (*Non-ESP males 57.6%, Non-ESP Females, 69.6%; ESP males, 17.5%, ESP females, 42.3%, Table 19*) indicated one reason they enrolled in the main course was to meet a requirement of their intended major[8]. For some institutions, larger percentages of students selected this response as compared to other institutions.

There appear to be some differences between gender groups in reasons for enrolling. Most notably, 42% of ESP males and 28.6% of Non-ESP males indicate they intend to major in computer science, as compared to only 10% of Non-ESP females and 15% of ESP females. A higher percentage of males also indicate they are interested in computer science (*Non-ESP males 49.3%; Male ESP, 69.8%; Non-ESP females, 23.3%; ESP females, 32.7%).* However, at some of the institutions, ESP females had equal percentages for selecting interest (Milwaukee, Duke and Loyola) when compared to percentages within male groups.

[8] *Two response categories (Plan to major in computer science and Required for Intended Major) are not mutually exclusive. To eliminate any possibility that the double-barreled response items were skewing the numbers, all respondents indicating both were located and the "requirement" selection was removed. The percentages changed minimally for three groups, but dropped drastically among ESP males (46% down to 18%; Non-ESP Males: 57.6% adjusted to 40.6%; Non-ESP Females 69.6% adjusted to 62.9%; ESP females: 42.3% adjusted 34.6%). Table 20 reflects this adjustment.*

Differences emerge between female enrollment groups, as well. At the majority of institutions, a higher percentage of ESP females indicated they are testing whether they enjoy computer science (*ESP females = 48.1%; Non-ESP females = 25.1%*), whereas non-ESP females indicated more frequently that they enrolled to fulfill a degree requirement (*ESP females = 34.6%; Non-ESP females = 62.9%*).

Table 19: Reasons for Enrolling in Main Course

Reasons for Enrolling in Main Course; All Institutions Combined (2005-2007)

	Female ESP		Female Non-ESP		Male ESP		Male Non-ESP		Total	
	n=104*		n=343*		n=212*		n=1125*		n=1784*	
Reason	#	%**	#	%**	#	%**	#	%**	#	%**
I know I am interested in CS or programming	34	32.7%	80	23.3%	148	69.8%	555	49.3%	817	45.8%
It meets a requirement for my intended major	36	34.6%	215	62.9%	37	17.5%	457	40.6%	745	41.8%
Knowing how to program is a useful skill in the job market	34	32.7%	100	29.2%	76	35.8%	354	31.5%	564	31.6%
To see whether I enjoy CS or programming	50	48.1%	86	25.1%	85	40.1%	269	23.9%	490	27.5%
I plan on majoring in CS	16	15.4%	35	10.2%	98	46.2%	322	28.6%	471	26.4%
It was recommended to me by an academic advisor	19	18.3%	48	14.0%	49	23.1%	155	13.8%	271	15.2%
Parent/guardian thought I should take the course	16	15.4%	19	5.5%	17	8.0%	37	3.3%	89	5.0%
Convenient to Schedule	1	1.0%	20	5.8%	11	5.2%	62	5.5%	94	5.3%
Enrolled with Friend	0	0.0%	14	4.1%	4	1.9%	37	3.3%	55	3.1%
A friend recommended the course (n = 1629) ǂ	n=100		n=325		n=199		n=1005		n=1629	
	6	6.0%	31	9.5%	9	4.5%	60	6.0%	106	6.5%
Other Reason (n = 1644) ǂ ǂ	n=99		n=333		n=181		n=1031		n=1644	
	9	9.1%	22	6.6%	15	8.3%	50	4.8%	96	5.8%
	n=31		n=63		n=49		n=204		n=347	
I was encouraged to enroll by one of the CS consultants at orientation (n = 347) ǂ ǂ ǂ	5	16.1%	2	3.2%	12	24.5%	3	1.5%	22	6.3%
I received an Invitation to enroll (n = 347) ǂ ǂ ǂ	22	71.0%	4	6.3%	11	22.4%	1	0.5%	38	11.0%
I plan to minor in CS (n = 708) ǂ ǂ ǂ ǂ	n=20		n=107		n=72		n=509		n=708	
	0	0.0%	6	5.6%	3	4.2%	24	4.7%	33	4.7%

Source: Baseline Surveys (2005-2007)

** Except where otherwise indicated*

*** Percentages will not total 100% because respondents were asked to select all that apply.*

ǂ *Option not offered at Milwaukee in 2007*

ǂ ǂ *Option not offered at Milwaukee in 2006*

ǂ ǂ ǂ *Invitation and orientation only asked in 2005*

ǂ ǂ ǂ ǂ *Minor only offered at Madison (2005-2007), Rutgers (2006-2007), and Purdue (2007)*

Was active recruiting successful at attracting under-represented students to enroll in a Computer-Science course?

A goal of the ESP program was to attract women and minority students who would not otherwise have taken a CS course; i.e., to increase participation of those students in the main course. To judge success in this area, a survey conducted in the fall of 2005 included a list of possible reasons for enrolling in the main course, and students were asked to select all that apply. Results for ESP students are summarized in Table 20.

Table 20: ESP Student Reasons for Enrolling in the Main Course, 2005 ESP only

	Female ESP		Male ESP		Total	
	n=31		n=49		n=80	
	#	%	#	%	#	%
I know I am interested in CS or programming	8	25.8%	39	79.6%	47	58.8%
I plan on majoring in CS	5	16.1%	28	57.1%	33	41.3%
It meets a requirement for my intended major	9	29.0%	20	40.8%	29	36.3%
To see whether I enjoy CS or programming	21	67.7%	14	28.6%	35	43.8%
It was recommended to me by a friend	2	6.5%	1	2.0%	3	3.8%
It was recommended to me by an academic advisor	6	19.4%	15	30.6%	21	26.3%
My parent/guardian thought I should take the course	6	19.4%	9	18.4%	15	18.8%
It was convenient to my schedule	0	0.0%	1	2.0%	1	1.3%
Knowing how to program is a useful skill in the job market	6	19.4%	9	18.4%	15	18.8%
I have friends who were also enrolling in the course	0	0.0%	0	0.0%	0	0.0%
I received an invitation to enroll in the mail or my orientation folder	22	71.0%	11	22.5%	33	41.3%
I was encouraged to enroll by one of the computer science consultants at orientation	5	16.1%	12	24.5%	17	21.3%
Other reason	3	9.7%	3	6.1%	6	7.6%

Source: Baseline Surveys (2005)

Over all institutions, the reason most often selected by female ESP-PLTL students (chosen by 71.0%) was ``I received an invitation to enroll''. In other words, for 71% of the women in ESP that semester, being invited to participate in that program was a factor in their decision to register for a CS course. The next most popular reason (selected by 67.7% of the female students) was ``To see whether I enjoy CS or programming.'' By contrast, the most popular reason for male ESP students was ``I know I am interested

in CS or programming'' (79.6%). From this data, we conclude that active recruiting for ESP did increase the number of women who enrolled in the main course.

Summary: Who Enrolls in ESP and Why?

When attempting to answer the question "Who enrolls in ESP and why?" the following trends begin to emerge from demographic data gathered at eight institutions from 2005 – 2007.

ESP students tended to be primarily freshmen (*ESP males = 76.6%; ESP females = 79.3%*), and to a lesser extent sophomores (*ESP males = 13.6%; ESP females 9.4%*). Most females who enrolled in ESP did so because they were sent a personal invitation through mail or email (*60.5%*). At most institutions, ESP females tended to indicate having little or no prior experience in computer science (*62.5%*) but indicated they were curious about whether they would like it (*48.1%*) and/or recognized it as a useful skill to have in the workplace (*32.7%*).

Male ESP students, tended to be from non-targeted ethnic groups, indicated they had prior experience in computer science (*67.7%*) and many intend(ed) to major in computer science (*46.2%*).

This difference between gender groups did not appear to pose any problems (as shown below in the evaluation of the ESP sections). From the data gathered, non-target, highly experienced males who opt to enroll in ESP appear to appreciate, value and engage in the collaborative spirit of the sessions.

ESP GROUP PERCEPTIONS

How do ESP experiences differ in terms of gender and ethnicity?

ESP students were asked to evaluate their program experience on the exit survey. Mann-Whitney tests (the non-parametric equivalent to two sample t-tests) were used to determine if any differences existed between gender groups. Across institutions, respondents were generally favorable in their assessments of the ESP sessions and only two significant differences were found between gender groups in their evaluation of the ESP. Even when combining institutional data, there are insufficient numbers of responses from under-represented ethnic groups (*n=33*). To extrapolate a generalized experience from such a diverse few respondents would not be prudent.

What were perceptions of the ESP sessions?

Students were asked to rate their peer leader and the ESP sessions on a six-point scale, with "0" representing "strongly disagree" and "5" representing "strongly agree." Respondents, across institutions, found their peer leader was:

- an important part of the class (*Male ESP: M = 4.30; Female ESP: M = 4.32, Table 21,*
- knowledgeable about the course material *(Male ESP: M = 4.50; Female ESP: M = 4.56*) ,
- able to adequately answer their questions (*Male ESP: M = 4.32; Female ESP: M = 4.30*).

ESP respondents also indicated they felt comfortable asking the peer leader questions (*Both Groups: M = 4.50*), felt he/she encouraged everyone to participate (*Both groups: M = 4.35*) and managed classroom discussions effectively (*Male ESP: M = 4.11; Female ESP: M = 4.06*).

Table 21: ESP Peer Leader Ratings

ESP Peer Leader Ratings

Peer leader evaluation	Group	n	*M*	*SE*	*SD*	*Mdn*	*U*	*Sig.*
Peer leader was an important part of class	Females	54	4.32	0.14	1.03	5.0	3222.5	0.645
	Males	112	4.30	0.09	0.94	5.0		
	All	166	4.31	0.07	0.96	5.0		
Peer leader was knowledgeable about the course material	Females	70	4.56	0.08	0.63	5.0	5858.5	0.939
	Males	150	4.50	0.06	0.74	5.0		
	All	220	4.52	0.05	0.71	5.0		
Peer leader was able to adequately answer questions	Females	70	4.30	0.11	0.92	5.0	5820	0.867
	Males	150	4.32	0.07	0.87	5.0		
	All	220	4.31	0.06	0.88	5.0		
Peer leader had trouble getting us back on track when we got off on a tangent	Females	54	1.70	0.18	1.3	1.0	3988	0.385
	Males	112	1.88	0.14	1.49	1.0		
	All	166	1.83	0.11	1.43	1.0		
Peer leader encouraged everyone to participate	Females	80	4.35	0.1	0.87	5.0		
	Males	156	4.35	0.08	0.95	5.0	6751	0.658
	All	236	4.35	0.06	0.92	5.0		
Comfortable asking the peer leader questions	Females	80	4.50	0.1	0.9	5.0	6701	0.503
	Males	157	4.50	0.06	0.76	5.0		
	All	237	4.50	0.05	0.81	5.0		
Peer leader managed the discussion effectively	Females	80	4.06	0.12	1.1	4.0	6989	0.910
	Males	158	4.11	0.08	0.95	4.0		
	All	238	4.09	0.06	1.00	4.0		

Source: Exit Surveys (2005-2007)

A Mann-Whitney test revealed a statistically significant difference between gender groups regarding whether the ESP sessions should have more computer "hands on" time. However, this difference between gender groups appears to be isolated to one institution where ESP males agreed more frequently and strongly than females that more "hands on" time should have been included.

In general, respondents tended to slightly disagree that sessions were dominated by one or two students (*ESP males M = 2.28; ESP Females M = 2.03, Table 22*) and males more than females wanted more "hands on" with the computer (*ESP Males M = 3.41; ESP Females 2.96*). Respondents also

generally agreed that ESP was a lot of fun (*ESP Males M = 3.84; ESP Females M = 3.93*) and were neutral about the sessions being a lot of work (*ESP Males M = 2.38; ESP Females M = 2.50*).

Table 22: ESP Sessions Evaluations

ESP Sessions Evaluations; All Institutions Combined (2005-2007)

ESP group meetings evaluation	Group	*n*	*M*	*SE*	*SD*	*Mdn*	*U*	*Sig.*
Meetings were typically dominated by one or two students	Females	80	2.03	0.16	1.47	2.0	6384	0.224
	Males	158	2.28	0.12	1.5	2.0		
	All	238	2.19	0.10	1.49	2.0		
Group meetings should include more "Hands on" time at the computers	Females	80	2.96	0.17	1.51	3.0	5916	0.035
	Males	158	3.41	0.10	1.30	4.0		
	All	238	3.26	0.09	1.39	3.0		
Meetings were a lot of work	Females	32	2.50	0.19	1.05	2.0	1123	0.836
	Males	66	2.38	0.17	1.37	3.0		
	All	98	2.42	0.13	1.27	2.0		
Meetings were a lot of fun	Females	30	3.93	0.17	0.94	4.0	1029.5	0.616
	Males	67	3.84	0.16	1.32	4.0		
	All	97	3.87	0.12	1.21	4.0		

Source: Exit Surveys (2005-2007)

ESP students were also asked to rate the utility of the sessions in relation to the main course. On average, students agreed that the sessions were useful for completing assignments (*Males M = 3.76; ESP Females M = 3.59, Table 23*) and for doing better on exams (*ESP Males M = 3.97; ESP Females M = 3.82*).

Respondents also indicated that the ESP moderately contributed to their success in the main course (*ESP Males M = 3.55; ESP Females M = 3.57*). In disaggregate institutional analysis, Mann Whitney tests reveal several institutions with statistically significant differences in ESP students' perception of the contribution of the ESP sessions as compared to the contribution of the lab session. At those schools, mean scores suggest the respondents viewed the ESP sessions as contributing more than the labs.

Combined institutional data comparing these two items show no statistically significant differences. However, this set of inquires may be somewhat irrelevant when applied to aggregate data because at some institutions the ESP program's focuses and goals were not geared towards supplementing the main course. Instead, their goals were to provide experiences unrelated to the course material, strengthening student knowledge bases rather than strengthening knowledge in the course content area. Therefore, we would not expect to see students at these institutions considering the ESP course to be a major contributor to their success in the main course.

How does the ESP contribute to desire to continue exploring the field of computer science?

In 2007, students were asked to indicate the degree to which the ESP sessions influenced their decision to major in computer science. A statistically significant difference between ESP gender groups was revealed regarding the influence of the sessions on students' decisions to major or not major in computer science. Across institutions, males tended to agree more (*M = 2.63*) than females (*M = 1.65*) that the ESP influenced their decision to pursue or not pursue a degree in computer science (U *= 524.5, p = 0.017*).

However, regardless of gender, mean scores indicate that respondents did not perceive the ESP sessions as having a particularly large influence on their decision to major in computer science. To determine the direction that the influence (positive or negative) had on those who indicated it contributed a great deal to their decision, we looked at how people responded to that question in relation to indicating if they would pursue computer science or not.

Of the 82 respondents, 33 indicated the course had some influence on their decision to pursue a degree in computer science (rank scores of 3 -5). Of those indicating a degree of influence by the ESP, more than half (*69%*) also indicated they would pursue a major or minor. From this, we can conclude that the majority were positively influenced by the sessions to pursue more education in computer science.

Table 23: Student Perception of the Utility of ESP

Student Evaluation of the Utility of ESP Sessions; All Institutions Combined (2005-2007)

ESP group meetings evaluation	Group	*n*	*M*	*SE*	*SD*	*Mdn*	*U*	*Sig.*
Attending meetings were useful prep. for completing assignments	Females	80	3.59	0.15	1.37	4.0	6459	0.461
	Males	157	3.76	0.11	1.32	4.0		
	All	237	3.70	0.09	1.33	4.0		
Attending meetings helped me to do better on exams	Females	76	3.82	0.16	1.39	4.0	5631	0.461
	Males	139	3.97	0.11	1.29	4.0		
	All	215	3.92	0.09	1.33	4.0		
Contribution of meetings in helping to succeed in main course	Females	67	3.57	0.16	1.31	4.0	5039	0.881
	Males	134	3.55	0.11	1.28	4.0		
	All	201	3.55	0.09	1.28	4.0		
ESP influence on decision to major or not in CS	Females	23	1.65	0.34	1.61	2.0	524.5	0.017
	Males	59	2.63	0.2	1.54	3.0		
	All	82	2.35	0.18	1.61	3.0		

Source: Exit Surveys (2005-2007)

Session feedback:

At the end of each session, Madison's groups were asked to submit a "one-minute paper" review of that session. A semester's worth of student reviews were tallied and it was found that the most commonly appreciated aspects of the ESP sessions was course related review, practice and assistance (*Table 24*). As well, exam review was greatly appreciated. Non course-specific activities most mentioned were the logic puzzles used as exercises.

Table 24: ESP Activity Feedback

ESP Activity Feedback; Madison, 2006	#
Class associated - review, practice, assistance	120
Exam Review	67
Logic puzzles	75
Other exercises	57
Code writing	48
Everything	51
Food, dinners, snacks, candy	49

Source: Madison ESP sections 2006

Expectations:

On the exit survey, ESP students were asked to select any expectations they might have had for the ESP sessions. Respondents selected a variety of expectations, as can be seen in Table 25. Regardless of gender, respondents indicated in large numbers they hoped for "a more comprehensive understanding of computer science (*78%*)," to "learn material in small groups (*63%*)," and to get a "better grade" in the main course (*63%*).

A slightly higher percentage of males, compared to females, indicated they joined to meet new friends (*ESP males, 49%; ESP females, 40%*), and find people to work and study with outside of class (*ESP Males, 46.0%; ESP females, 40.0%*). Although the differences in percentages are minimal it demonstrates that males joined the ESP equally, if not more frequently, because they were interested in the social aspects of the extra-curricular activities.

The biggest difference between gender groups regarded earning extra credit, where almost half of all males selected this response category but less than a quarter of females indicated this as an expectation (*ESP Males: 42%, ESP Females: 15 %.*).

Table 25: Student Expectations of ESP

Students Expectations of the ESP Course; All Institutions Combined (2005-2007)

	ESP Females		ESP Males		Total	
	n=81		n=149		n=230	
Expectations of the ESP	#	%	#	%	#	%
More comprehensive understanding of programming	63	77.8%	117	78.5%	180	78.3%
Opportunity to learn programming in smaller groups	48	59.0%	97	65.1%	145	63.0%
A better grade	53	65.0%	93	62.0%	146	63.0%
To make friends	32	40.0%	73	49.0%	105	46.0%
To meet people to work and study with outside of class	32	40.0%	69	46.0%	101	44.0%
Good preparation for future coursework*	n=32		n=68		n=100	
	14	43.8%	42	61.8%	56	56.0%
Extra credit**	n=45		n=99		n=144	
	7	15.6%	42	42.4%	49	34.0%
Other***	n=75		n=145		n=215	
	1	1.3%	8	5.7%	9	4.2%

Source: Exit Surveys (2005-2007)

**Asked only in 2007*

***Asked only at schools which offered extra credit*

****Option was not offered at all schools*

The majority of respondents indicated that their expectations were met (*69.7%, Table 26*) or somewhat met (*23.6%*) by the ESP. This combined 93.3% provides another strong indicator that ESP students appreciated their experience in the ESP.

Table 26: Fulfillment of Expectations for ESP Students

Fulfillment of Expectations by the ESP Program; All Institutions Combined (2005-2007)

	Females		Males		Total	
Expectations met	#	%	#	%	#	%
Yes	38	60.3%	86	74.8%	124	69.7%
Somewhat	20	31.8%	22	19.1%	42	23.6%
No	5	7.9%	7	6.1%	12	6.7%
Total	63	100%	115	100%	178	100%

Source: Exit Surveys (2005-2007)

"If you were to do it all over, how would you enroll?"

The combined data also shows that nearly three quarters of the respondents would enroll in both the ESP section and the main course if they were able to do it over again (*73.2%, Table 27*).

One-quarter of all females indicated they would not enroll in either the ESP or the main course if they had it to do over again. When looking at disaggregate institutional data, the majority of these women

were located at two institutions, during two distinct years. To explore more fully why they might have decided not to reenroll in either the ESP or the main course, some of their other data was isolated. Items in common for these females include:

- 12 of the 14 did not have prior experience
- 10 of 14 indicated they enrolled in the main course to see "whether they enjoyed computer science or programming" and selected few other response categories.
- 11 of the 14 females indicated on the exit-survey they would not pursue computer science because they "didn't feel very good at [computer science]."
- Six of 14 also indicated they would not pursue computer science because they "just didn't enjoy [computer science]."
- Six of seven indicated they enrolled in ESP because they received an invitation or were consulted at orientation.

Never the less, the females were varied in their grades ranging from Cs to As. Additionally, all 15 females rated their ESP experiences highly favorably with median ratings of 4's and 5's and provided these six comments:

- *"It's a fun class, especially the logic thinkings, and the bouncy-blinking thingy."*
- *"Because if you get some certain lectures, I think [the ESP section] will be the only means of learning the material because the lecture was inadequate."*
- *"It was not a lot of work very beneficial and rather enjoyable. Though I didn't enjoy the class as a whole so I would only recommend it if someone was already going to take [the main course]."*
- *"It's a really good way to confirm that you understand what's going on - or if you don't, it's more time to learn it, in a smaller group (so you don't feel bad about holding up your whole lecture). If you don't have great discipline, [the ESP section] will 'force' you to spend more time learning the material."*
- *"It can be helpful at times, and you get to ask one on one questions."*
- *"[The main course] went very fast and assumed that everyone in the class would be a comp sci major. I would see if there was an easier course out there that satisfied the prerequisite I needed to fulfill."*

Table 27: ESP Student Perception of Re-Enrollment in ESP and Course

ESP Response to If They Were Re-Enrolling; All Institutions Combined (2005-2007)

	Females		Males		Total	
Choose to enroll again?	#	%	#	%	#	%
Not enroll in either ESP or main course	15	20.3%	11	7.9%	26	12.2%
Enroll in main course but not ESP	6	8.1%	14	10.1%	20	9.4%
Enroll in both	47	63.5%	109	78.4%	156	73.2%
Unsure	6	8.1%	5	3.6%	11	5.2%
Total	74	100%	139	100%	213	100%

Source: Exit Surveys (2005-2007)

Recommendation of the program:

The majority of ESP respondents indicated they would recommend the course to a friend (*94.9%*), albeit with half indicating only if they were already enrolling in the main course[9] (*47.9%, Table 28*).

Table 28: ESP Student Recommendation of ESP to a Friend

Recommending ESP to a Friend; All Institutions Combined (2005-2007)

	Females		Males		Total	
	#	%	#	%	#	%
Yes	36	48.7%	64	46.0%	100	47.0%
Yes, but only if enrolling in main course	33	44.6%	69	49.6%	102	47.9%
No	4	5.4%	6	4.3%	10	4.7%
Unsure	1	1.4%	0	0.0%	1	0.5%
Total	74	100%	139	100%	213	100%

Source: Exit Surveys (2005-2007)

When respondents were asked why they would or would not recommend ESP to a friend, open-ended comments suggested several themes (*Table 29)*. Only a few responses were given regarding why one would not recommend ESP (this coincides with the low number who indicated they would not recommend ESP to a friend). Reasons for not recommending the course were primarily because they felt the ESP was too hard or took too much time (4 males), or that the ESP section was dominated by one or person and/or was too small a section (1 male and 2 females).

[9] *Some institutions offered students the choice to only enroll in the ESP section.*

Table 29: Reasons for Recommending or Not Recommending ESP to a Friend

Reasons why ESP Would Recommend ESP; All Institutions Combined (2005-2007)

	ESP Females		ESP Males		Total	
Theme	#	%	#	%	#	%
helps if one is majoring in CS	0	0.0%	3	3.4%	3	2.5%
is fun	2	6.3%	8	9.2%	10	8.4%
Helps with understanding course material or getting a better grade	24	75.0%	42	48.3%	66	55.5%
Has a small group setting	3	9.4%	5	5.7%	8	6.7%
Has a different approach and is supplemental to the main course	1	3.1%	10	11.5%	11	9.2%
Is an extra credit (sometimes easy)	1	3.1%	5	5.7%	6	5.0%
General positive comments	1	3.1%	14	16.1%	15	12.6%
Total	32	100%	87	100%	119	100%

Source: Exit surveys (2005-2007)

What ESP extracurricular activities were most appreciated and why?

One secondary goal of the ESP was to address potential concerns that student might have about the field of computer science and expose them to opportunities that computer science has to offer. Four of the institutions offered additional outings or special events for ESP students.

- Duke hosted a speaker, pizza socials, and a trip to a virtual reality lab. Unfortunately, exit surveys yielded no feedback by the respondents.[10]
- GA Tech offered a social outing, with a few comments from survey respondents indicating they enjoyed themselves.
- Madison held two dinners: the 2006 group heard speakers talk about their experience in the field, and the 2007 group viewed videos about working in computer science. Madison also hosted a field trip to Epic Systems, a nationally recognized developer of medical software, each fall semester during the past two years. (Outcomes/feedback shown below.)
- Rutgers held a "Career Night" each year, inviting several computer science graduates from Rutgers to speak about their work experiences. (Because feedback the first time around was so positive, the invitation was extended to others outside of the ESP in following years.) (Outcomes/feedback shown below.)

[10] *Two exit surveys were administered following the Fall 2006/Spring 2007, as Duke's program is a year-long and some events were not held until the second semester.*

Of the respondents who indicated they did not attend the events, those who gave explanations indicated most commonly that schedule and time were a factor. Eight respondents from one school indicated they were not interested, three said they forgot.

Only one or two females at either institution attended the events and provided feedback. To ensure no possible breach of confidentiality, disaggregate data by gender will not be shown.

Madison:

Overall, evaluations of the events were positive, with most of the attending respondents indicating the events were 'very' or 'somewhat' worthwhile (*Table 30*). Only one person (in 2006) did not feel the event they attended was worthwhile (dinner with speakers).

The Epic Systems visits were evaluated most favorably, with 97.1% of all respondents indicating it was very worthwhile (*87.1%*) or somewhat worthwhile (*10.0%*) and only one person indicating it was not worthwhile (*3%*). Nearly all respondents indicated they enjoyed seeing an actual work environment (*96.8%*), and 87.1% said they got a better idea about what type of computer science jobs might be available to them. Nearly three quarters of the respondents indicated the visit gave them a better idea about why they might want to study computer science (*74.2%*). No one indicated the visit was too long.

Dinner events with speakers or videos and discussions also received only one response indicating they were not worthwhile (*2%*), with 53.3% indicating they were very worthwhile. Regardless of the format (live speakers or videos), approximately 80% of the event participants enjoyed getting together with other ESP students and found the information presented interesting. Fewer respondents from 2007 felt the videos (*43.8%*) or discussion following (*37.5%*) gave them a better idea about why they would want to study computer science, as opposed to the live speakers in 2006 (*72.4%*). One person in 2006 indicated the speeches went on too long, and one person in 2007 indicated he/she would have rather have had live speakers than videos.

A look into these respondents' concerns on the baseline survey compared to their concerns on the exit survey suggests that concerns regarding computer science careers remain relatively constant (*Table 31*). Observed increases had little to do with career choices but rather general interest in computer science. Additionally, it may be quite possible that because such events increase awareness about computer science careers it might actually raise concerns that students had not had previously. This should not necessarily be viewed as negative since a healthy understanding of a career choice should include concerns.

Table 30: Madison Special Events Evaluation

Madison Special Events 2006-2007

Dinners with Speakers 2006 (n=29)/Dinners with Videos with discussion 2007 (n=16) *		%
Please select any of the following statements you would agree with regarding the special event you attended:		
I enjoyed getting together with other WES-CS students (n=45*)	36*	80.0%
I found the speakers/video(s) interesting (n=45*)	38*	84.4%
The speakers gave me a better idea of why I might want to study CS	21	72.4%
I found videos gave me a better idea of why I might want to study CS	7	43.8%
I found discussion following the videos gave me a better idea of why I might want to study CS	6	37.5%
There were too many speakers	1	3.4%
The speeches were too long	6	20.7%
I would rather have had live speakers than videos	1	6.3%
** The two years are combined on the first two statements as similar percentages of students selected those items.*		
Overall, the dinner/video event was…	n=45*	%
…very worthwhile	24*	53.3%
… somewhat worthwhile	20*	44.4%
… not worthwhile	1*	2.0%
** The two years are combined as both had similar students ratings*		
Visit to Epic Systems	n=45	%
I enjoyed seeing an actual work environment for CS professionals	30	96.8%
The visit gave me a better idea of what CS jobs are available	27	87.1%
The visit gave me a better idea of why I might want to study CS	23	74.2%
The visit was too long	0	0.0%
Overall, the visit to epic was …	n=45	%
…very worthwhile	27	87.1%
…somewhat worthwhile	3	10.0%
… not worthwhile	1	3.0%
Comments/reflections regarding special events		
"I really liked visiting Epic because it showed me what kind of work environment I could expect if I decided to major in Computer Sciences. Hearing from the programmer there was useful too."		
"They were very good at putting Computer science in perspective. Students rarely see much of computer science beyond the dinky little programs we spend hours doing as assignments. Seeing the kind of things that computer scientist really do with that knowledge makes the class much more interesting."		
"More events/different times (was only able to attend the Epic trip because rest of planned events were scheduled during a class I couldn't skip)"		
"Along with the guidance of my Team Leader, the video influenced me to take more CS classes"		
"It was frick sweet!"		
"I thought the campus was really really cool. Working there must be great."		
"I really liked seeing how a real work environment near Madison. The tour was very informative."		
"I like the food a lot."		
"Would have liked more dinners"		
"Excellent Food"		
"Pizza FTW"		

Source: Madison exit surveys (2006-2007)

Table 31: Baseline and Exit Concerns, Special Events Participants only UW Madison 2006-2007

	Baseline (n=42)		Exit (n=45)	
UW Madison Concerns	#	%	#	%
I am not very interested in CS	2	4.8%	8	17.8%
I want to do something that helps people	3	7.1%	9	20.0%
I don't want to sit in front of a computer alone all day	8	19.0%	11	24.4%
CS is not exciting	0	0.0%	4	8.9%
CS is too competitive	7	16.7%	9	20.0%
CS wouldn't pay enough	5	11.9%	2	4.4%
CS work tends to be outsourced to other countries	11	26.2%	10	22.2%
The job market for CS graduates is uncertain	0	0.0%	0	0.0%
I have no concerns about majoring or a career in CS	17	40.5%	14	31.1%

Source: UW Madison 2006-2007 Baseline and Exit surveys

Rutgers:

The majority of respondents at Rutgers (*88.2%, Table 32*) indicated that the events were very (*58.8%*) or somewhat (*29.4%*) worthwhile. Additionally a majority found the speakers interesting (*88.2%*) and that it gave them a better idea of why they might want to study computer science (*76.5%*). A few respondents left comments indicating that the special events gave them a better idea of what was involved in a career in computer science.

Table 32: Rutgers Special Events Evaluation

Rutgers Special Events 2007

Career Night Evaluation	(n=17)	%
Select any of the following statements you would agree with regarding the special event you attended:		
I enjoyed getting together with other CS students	10	58.8%
I found the speeches interesting	15	88.2%
The speeches gave me a better idea of why I might want to study computer science	13	76.5%
Overall, this event was …		
… very worthwhile	10	58.8%
… somewhat	5	29.4%
… not worthwhile	2	11.8%
Comments/reflections regarding the events		
It gave me a good idea of the possibilities you could go with from computer science.		
Gave me an idea of what I should be aiming for, and what I could expect when joining the workforce with a CS degree.		

Source: Rutgers Exit Surveys (2007)

Table 33: Baseline and Exit Concerns, Special Events Participants only Rutgers 2006-2007

	Baseline (n=14)		Exit (n=17)	
Rutgers Concerns	#	%	#	%
I am not very interested in CS	1	7.1%	4	23.5%
I want to do something that helps people	3	21.4%	4	23.5%
I don't want to sit in front of a computer alone all day	4	28.6%	5	29.4%
CS is not exciting	0	0.0%	0	0.0%
CS is too competitive	4	28.6%	8	47.1%
CS wouldn't pay enough	2	14.3%	2	11.8%
CS work tends to be outsourced to other countries	8	57.1%	8	47.1%
The job market for CS graduates is uncertain	4	28.6%	6	35.3%
I have no concerns about majoring or a career in CS	2	14.3%	2	11.8%

Source: Rutgers 2006-2007 Baseline and Exit surveys

Peer leader experiences

In 2006, fourteen peer leaders agreed to telephone interviews about their experience with the ESP. At least one peer leader from each institution participated. Most of their experiences were nearly indistinguishable from one another and all extremely positive.

Demographics:

Slightly more female than male peer leaders were interviewed, the majority of them white and 19-20 years old, with a few more advanced in age and/or college experience, and a few being from under-represented ethnic populations. At least four mention being former ESP members themselves. College rankings were scattered from second year to fifth year, but the majority were second year students. Most peer leaders were also declaring computer science as their major or minor at the time of the interviews, taking an average of 14-16 credit hours and working part time jobs. Most were receiving monetary compensation for their position as peer leader, with one mentioning the option for extra credit.

Those peer leaders who were from the targeted populations (female and the specific ethnic affiliations) often mentioned their attraction to the position as having stemmed from their own experience in the program, and/or experience as a member of the under-represented population. Several mentioned respecting the importance the setting/experience the ESP program provided people of under-represented groups.

Even those peer leaders who were not from targeted populations often either had their own experiences within other marginalized situations or had a close friend in such a situation. Knowing that

perspective increased their enthusiasm about the goals for the program. However, three other peer leaders each from different institutions also talked about how this type of setting would benefit anyone interested in programming and/or computer science, regardless of gender or ethnicity, but who might be intimidated or need the extra encouragement to stick with it.

Personal gains:

Several common themes regarding experience as peer leaders emerged over the course of the interviews.

Appreciation for the opportunity to test enjoyment or skill in leadership role: Five interviewees mentioned having current or prior experience as a TA or other leadership positions. For some of those, the difference of this peer role was refreshing. The gratification came from the aspects of the peer-to-peer relationships, feeling less responsibility to lecture other students and ensure their comprehension, but rather assisting peers to problem solve their own answers. Two of the more experienced TAs mentioned their preference for this role because they felt the relationship was more conducive to comfort levels and accepting assistance from another student was less intimidating than approaching a TA or instructor.

Regardless, most peer leaders felt the opportunity for camaraderie and being able to assist their peers was personally satisfying. One of the most commonly mentioned personal gains was the sense of satisfaction they felt as they watched students ”get it”, particularly after a struggle with the material, and knowing they may have had a part in that.

Building career skills. Meetings with other peer leaders, organizing their time and session time, developing curriculum or activities, and leading a group in an organized activity were also aspects mentioned as beneficial to them personally, as well as good for their resume and future careers. A few also mentioned that learning to explain the concepts to others also helped solidify or refresh their own knowledge base.

Special Events: Peer leaders also mentioned experiencing benefits and opportunities themselves by attending the special events held. Encounters with professionals within the computer science field during dinner/speaker engagements afforded at least two mentorship connections. Additionally, the special events encouraged one peer leader to consider switching to a computer science major and inspired another to incorporate computer science into his/her major. Three also specifically mentioned “feeling encouraged by” and “enjoying the opportunity” to see workplaces in action. Friendships with students, including with other peer leaders, was another added benefit many said was unexpected.

Training:

Training was provided for peer leaders each spring as part of another meeting that brought all of the PIs together. When evaluating the training sessions, the ice breakers and role playing exercises were most commonly mentioned as the most useful/used activity (despite also often initially being the most difficult, because of the need to interact socially). Often mentioned by first-timers, was the opportunity to hear from peer leaders who were coming back for their second semester. Several people also mentioned that learning about personality styles helped them, two added that the benefits of this exercise will easily extend beyond the realm of this experience (e.g.: the workforce, personal relationships). The games and logic puzzles used as sample exercises were often mentioned as being the most fun, engaging, and challenging.

Generally, there were no suggestions for improving the training, as most found all the exercises to be beneficial. Two people mentioned feeling overwhelmed as the PI level program intricacies were being explained, and did not feel some of that information was necessary for the peer leaders.

Peer-Leader Role:

Most interviewees understood their role as being present to provide stimulation to the group, motivation to keep the exercises moving, and helping the group to stay on-task. Most also understood their responsibility was not to provide answers, but facilitate students to, as one peer leader put it, "organize their thoughts" and "help them see the problem in a more simplified manner." Only a few peer leaders, who were also TAs, talked about their experience in a manner that suggested they had not been able to step out of the TA role.

Recommendations:

All of the interviewees said they would recommend the experience of being a peer leader, with only a few clarifying that they would only recommend the experience *if* the person was interested in a leadership position. All explained their reasoning was due to the previously discussed benefits.

They all also indicated they would recommend the program to students who were enrolling in the main course. Most commonly, their reasons for recommending the ESP was because it was a great opportunity to get a more in-depth experience with programming, computer science and/or opportunities for clarification and solidification of course material/basic concepts/theories.

MAIN COURSE PERCEPTIONS: INSTRUCTOR, COMPONENTS, LAB RATINGS

How do main course perceptions differ between ESP/Non-ESP?

On exit surveys administered during 2005–2007, students were asked to rate their experience in the main course section. Three areas were explored: the instructor and instruction of the course, various course components (i.e. lectures, assignments, textbook), and associated labs or recitations.

Due to the variance in population, the data was not normally distributed. Hence, non-parametric testing was utilized to provide a more conservative look at the data outcomes. Because the distributions were not normal, median scores are also provided to get a better sense of the average adjusted to accommodate the distribution.

Mann-Whitney tests were conducted to determine if there were any differences between ESP and Non-ESP groups. The tests revealed significant differences between ESP and Non-ESP groups regarding instruction and the lab.

As mentioned earlier in the ESP evaluation section, there were too few completed surveys from under-represented ethnic groups to do a substantive analysis of differences between those groups (33 ESP respondents, 155 Non-ESP respondents).

Instructor Evaluation

Respondents rated their agreement with the following five items on a six-point scale where '0' indicates "Strongly disagree" and '5' "Strongly agree":

1. The instructor explained concepts clearly during class time
2. The instructor covered the material too quickly
3. The instructor adapted his or her teaching to accommodate students without prior programming experience
4. The instructor adequately communicated goals and expectations to students
5. I feel uncomfortable asking the professor questions during class time

Two items show revealed statistically significant differences between groups, with the ESP group being more favorable in their evaluation of the instruction they received. ESP group mean scores indicate that they disagreed more strongly than Non-ESP respondents that the instructor covered the material too quickly (*ESP: M = 1.93, SD = 1.50; Non-ESP M = 2.15, SD = 1.51; Mdn = 2, Table 34*). Additionally, there was a significant difference between groups regarding whether the instructor adequately communicated goals and expectations to students (*ESP: M = 4.03, SD = 0.99; Non-ESP M = 3.81, SD =*

1.04; Mdn = 4), with the ESP respondent mean score indicating stronger agreement. Despite these mean score differences, median scores were not different between groups.

Although not statistically significant, the same trend is seen regarding whether the instructor adapted his or her teaching to accommodate students without prior programming experience (*ESP: M = 3.61, SD = 1.38; Non-ESP M = 3.51, SD = 1.27; Mdn = 4*), with ESP students agreeing more strongly than non-intervention counterparts.

Both groups disagreed that they felt uncomfortable asking their instructor questions during class time (*ESP: M = 1.93, SD = 1.69, Mdn = 1.5; Non-ESP: M = 1.92, S = 1.73, Mdn = 1*).

Table 34: Evaluation of Main Course Instruction by Enrollment Groups

Evaluation of Main Course Instruction by Enrollment; Institutions Combined (2005-2007)

Instruction statement	Group	n	*M*	*SE*	*SD*	*Mdn*	*U*	*Sig.*
The instructor explained concepts clearly during class time	ESP	237	4.09	0.07	1.02	4.0		
	Non-ESP	887	4.03	0.03	1.00	4.0	101067.5	0.327
The instructor covered the material too quickly*	ESP	238	1.93	0.10	1.50	2.0		
	Non-ESP	887	2.15	0.05	1.51	2.0	96462.5	0.037
The instructor adapted his or her teaching to accommodate students without prior programming experience	ESP	236	3.61	0.09	1.38	4.0		
	Non-ESP	880	3.51	0.04	1.27	4.0	96245	0.077
The instructor adequately communicated goals and expectations to students	ESP	237	4.03	0.06	0.99	4.0		
	Non-ESP	882	3.81	0.04	1.04	4.0	91676.5	0.002
I feel uncomfortable asking the professor questions during class time*	ESP	236	1.93	0.11	1.69	1.5		
	Non-ESP	881	1.92	0.06	1.73	1.0*	103454.5	0.910

Source: Exit Surveys (2005-2007)

** Negatively-worded item*

Kruskal-Wallis tests, the non-parametric equivalent test for ANOVA, were also conducted to determine if there were any significant differences between gender groups. Significant differences were found in four areas pertaining to instruction and in six areas pertaining to the lab. Results are shown in Table 35.

Table 35: Evaluation of Main Course Instruction by Gender and Enrollment

Evaluation of Main Course Instruction by Enrollment; Institutions Combined (2005-2007)

							Kruskal-Wallis result		
	Group	n	*M*	*SE*	*SD*	*Mdn*	*H*	*DF*	*Sig.*
The instructor explained concepts clearly during class time	ESP Females	79	3.91	0.11	1.02	4.0			
	Non-ESP Females	195	3.73	0.08	1.11	4.0			
	ESP Males	158	4.18	0.08	1.01	4.0			
	Non-ESP Males	692	4.12	0.04	0.95	4.0	27.04	3	0.000
The instructor covered the material too quickly	ESP Females	79	2.24	0.15	1.30	2.0			
	Non-ESP Females	195	2.50	0.11	1.46	3.0			
	ESP Males	159	1.77	0.12	1.56	1.0			
	Non-ESP Males	692	2.05	0.06	1.51	2.0	25.62	3	0.000
The instructor adapted his or her teaching to accommodate students without prior programming experience	ESP Females	79	3.39	0.15	1.35	4.0			
	Non-ESP Females	195	3.33	0.10	1.42	4.0			
	ESP Males	157	3.73	0.11	1.38	4.0			
	Non-ESP Males	685	3.56	0.05	1.22	4.0	10.48	3	0.013
The instructor adequately communicated goals and expectations to students	ESP Females	79	3.92	0.11	0.97	4.0			
	Non-ESP Females	193	3.80	0.07	1.02	4.0			
	ESP Males	158	4.08	0.08	1.00	4.0			
	Non-ESP Males	689	3.82	0.04	1.05	4.0	11.52	3	0.010
I feel uncomfortable asking the professor questions during class time	ESP Females	78	1.92	0.18	1.54	1.0			
	Non-ESP Females	194	2.07	0.12	1.73	2.0			
	ESP Males	158	1.93	0.14	1.77	1.5			
	Non-ESP Males	687	1.88	0.07	1.73	1.5	1.84	3	0.611

Source: Exit Survey (2005-2007)

** Negatively-worded item*

To reveal where differences between groups were, additional post-hoc analyses were performed (Mann-Whitney tests, the non-parametric equivalent of the two-sample t-test, and a Bonferroni correction were used[11]). While analysis revealed no differences between ESP and Non-ESP females, differences did appear between males in ratings of instruction (*Table 36*). ESP males tended to rate instruction more positively than their male non-intervention counterparts in that the

- Instructor did *not* cover material too quickly (*ESP Male M = 1.77, Mdn = 1; Non-ESP Males, M = 2.05, Mdn = 2; U = 46127.5, p=0.002*)
- Instructor adapted his/her instruction for people without prior programming experience (*ESP Male M = 3.73, Mdn = 4; Non-ESP Males, M= 3.56, Mdn = 4, U = 47379.5, p=0.018*).
- Instructor adequately communicated goals and expectations (*ESP Male M = 4.08, Mdn = 4; Non-ESP Males M = 3.82, Mdn = 4; U = 46127.5, p = 0.000*).

[11] *The Bonferroni correction reduces the chance of Type 1 errors by adjusting the level at which an observation can be determined as significant.*

Table 36: Evaluation of Main Course by Enrollment, Males only

Evaluation of Main Course Instruction by Enrollment; Institutions Combined (2005-2007)

Males only							Mann Whitney results	
	Group	n	*M*	*SE*	*SD*	*Mdn*	*U*	*Sig*
The instructor covered the material too quickly	ESP Males	159	1.77	0.12	1.56	1.0		
	Non-ESP Males	692	2.05	0.06	1.51	2.0	46127.5	0.002
The instructor adapted his or her teaching to accommodate students without prior programming experience	ESP Males	157	3.73	0.11	1.38	4.0		
	Non-ESP Males	685	3.56	0.05	1.22	4.0	47379.5	0.018
The instructor adequately communicated goals and expectations to students	ESP Males	158	4.08	0.08	1.00	4.0		
	Non-ESP Males	689	3.82	0.04	1.05	4.0	46127.5	0.000

Source: Exit Survey (2005-2007)

Lab Evaluation

Respondents rated their agreement with several statements regarding their lab or recitation experience. The scale was again, '0' indicating "Strongly disagree" and '5' "Strongly agree."

Setting gender differences aside, all mean scores and medians suggested favorable rating of the lab but it appears that ESP respondents were more favorable under these circumstances.

Two items revealed statistically significant differences between ESP and Non-ESP groups. ESP respondents tended to find their lab instructor or TA more knowledgeable (*ESP M = 4.37, Mdn = 5; Non-ESP M = 4.21, Mdn = 4; U = 75899, p = 0.016*) and able to adequately answer their questions (*Mdn: ESP M = 4.14, Mdn = 4; Non-ESP M =3.99, Mdn = 4; U = 80803.5, p = 0.018*).

There were no significant differences between groups regarding the contribution of the labs to their success in the course, with both groups indicating that it moderately contributed to their overall success in the course (*Mdn: ESP M = 3.43, Mdn = 4; Non-ESP M = 3.32, Mdn = 3*). Data are shown in Table 37.

Only two of three schools showed significant differences with more than one item in common, thereby suggesting no specific trends between institutions. Overall, ESP respondents tended to indicate slightly more appreciation for the lab/recitations sessions than the non-intervention group.

Table 37: Evaluation of Main Course Lab/Recitation by Enrollment

Evaluation of Main Course Lab/Recitation by Enrollment; Institutions Combined (2005-2007)

	Group	n	*M*	*SE*	*SD*	*Mdn*	*U*	*Sig.*
Our lab instructor/TA was knowledgeable about the lab material	ESP	200	4.37	0.06	0.86	5.0		
	Non-ESP	843	4.21	0.03	0.93	4.0	75899	0.016
Our lab instructor/TA was able to adequately answer my questions	ESP	207	4.14	0.07	1.07	4.0		
	Non-ESP	867	3.99	0.04	1.07	4.0	80803.5	0.018
Our lab sessions were useful preparation for completing the assignments	ESP	207	3.54	0.09	1.28	4.0		
	Non-ESP	868	3.48	0.04	1.31	4.0	87694	0.580
Attending the lab sessions helped me to do better on exams	ESP	208	3.40	0.10	1.40	4.0		
	Non-ESP	868	3.38	0.05	1.42	4.0	89509.5	0.853
I am comfortable asking my lab instructor/TA questions	ESP	207	4.21	0.08	1.10	5.0		
	Non-ESP	867	4.12	0.04	1.13	4.0	85277.5	0.232
The lab sessions were a lot of work*	ESP	187	2.84	0.10	1.40	3.0		
	Non-ESP	809	2.72*	0.05	1.34	3.0	71264	0.203
The lab sessions were fun	ESP	187	2.98	0.10	1.36	3.0		
	Non-ESP	812	2.76	0.05	1.37	3.0	68998	0.048
The lab sessions should include more "Hands on" time	ESP	114	2.79	0.14	1.54	3.0		
	Non-ESP	455	2.58	0.07	1.49	3.0	23904	0.189
Overall Lab Contribution	ESP	204	3.43	0.09	1.23	4.0		
	Non-ESP	803	3.32	0.05	1.30	3.0	77945	0.273

Source: Exit Survey (2005-2007)

** Negatively-worded item.*

Again, Kruskal-Wallis tests were performed, and five areas of interest were revealed when separating males and females by participation (*Table 38*).

Mann Whitney post hoc analyses were performed and found differences only within female groups with regards to labs and none between male groups (*Table 38)*. No significant differences between male groups were revealed regarding lab instruction. ESP females tended to agree more strongly that:

- The TA was knowledgeable (*ESP females M = 4.45, Mdn = 5.0; Non-ESP females M = 4.03; Mdn = 4.0; U = 4513.0, p = 0.003*)
- The TA answered questions adequately (*ESP females M = 4.30, Mdn = 5.0; Non-ESP females M = 3.88; Mdn = 4.0; U = 4915.0, p= 0.000*)
- They were comfortable asking the TA questions (*ESP females M = 4.38, Mdn = 5.0; Non-ESP females M = 3.95, Mdn = 4.0; U=5221.0, p = 0.001*)

Table 38: Evaluation of Main Course Lab/Recitation by Gender and Enrollment

Evaluation of Main Course Lab/Recitation by Enrollment; Institutions Combined (2005-2007)

	Group	n	*M*	*SE*	*SD*	*Mdn*	*H*	*DF*	*Sig.*
Our lab instructor was knowledgeable about the lab material	ESP Females	65	4.45	0.09	0.71	5.0	13.72	3	0.003
	Non-ESP Females	180	4.03	0.08	1.02	4.0			
	ESP Males	135	4.33	0.08	0.93	5.0			
	Non-ESP Males	663	4.25	0.04	0.90	4.0			
Our lab instructor was able to adequately answer my questions	ESP Females	69	4.30	0.12	0.99	5.0	12.22	3	0.006
	Non-ESP Females	193	3.88	0.08	1.07	4.0			
	ESP Males	138	4.07	0.09	1.10	4.0			
	Non-ESP Males	674	4.02	0.04	1.08	4.0			
Our lab sessions were useful preparation for completing the assignments	ESP Females	69	3.38	0.14	1.18	4.0	3.79	3	0.292
	Non-ESP Females	193	3.46	0.09	1.29	4.0			
	ESP Males	138	3.62	0.11	1.33	4.0			
	Non-ESP Males	675	3.49	0.05	1.31	4.0			
Attending the lab sessions helped me to do better on exams	ESP Females	69	3.17	0.18	1.49	3.0	5.27	3	0.149
	Non-ESP Females	193	3.24	0.10	1.42	3.0			
	ESP Males	139	3.52	0.11	1.34	4.0			
	Non-ESP Males	675	3.42	0.05	1.42	4.0			
I am comfortable asking my lab instructor questions	ESP Females	69	4.38	0.12	0.97	5.0	9.48	3	0.023
	Non-ESP Females	192	3.95	0.09	1.21	4.0			
	ESP Males	138	4.12	0.10	1.15	4.0			
	Non-ESP Males	675	4.16	0.04	1.10	4.0			
The lab sessions were a lot of work	ESP Females	57	2.83	0.16	1.21	3.0	2.07	3	0.561
	Non-ESP Females	183	2.77	0.10	1.36	3.0			
	ESP Males	130	2.85	0.13	1.48	3.0			
	Non-ESP Males	626	2.70	0.05	1.34	3.0			
The lab sessions were fun	ESP Females	57	2.79	0.18	1.36	3.0	12.66	3	0.004
	Non-ESP Females	182	2.55	0.10	1.29	3.0			
	ESP Males	130	3.07	0.12	1.35	3.0			
	Non-ESP Males	630	2.83	0.06	1.39	3.0			
The lab sessions should include more "Hands on" time	ESP Females	38	2.66	0.25	1.55	3.0	2.27	3	0.522
	Non-ESP Females	95	2.58	0.14	1.37	3.0			
	ESP Males	76	2.86	0.18	1.55	3.0			
	Non-ESP Males	360	2.58	0.08	1.52	3.0			
Contribution of Lab to Success in the Course	ESP Females	68	3.52	0.13	1.06	4.0	1.29	3	0.732
	Non-ESP Females	185	3.31	0.10	1.30	3.0			
	ESP Males	136	3.39	0.11	1.31	4.0			
	Non-ESP Males	618	3.32	0.05	1.30	3.0			

Source: Exit Survey (2005-2007)

Table 39: Evaluation of Main Course Lab/Recitation by Enrollment, Females only

Evaluation of Main Course Lab/Recitation by Enrollment and Gender; Institutions Combined (2005-2007)

	Group	n	*M*	*SE*	*SD*	*Mdn*	*U*	*Sig*
Our lab instructor was knowledgeable about the lab material	ESP Females	65	4.45	0.09	0.71	5.0		
	Non-ESP Females	180	4.03	0.08	1.02	4.0	4513.00	0.003
Our lab instructor was able to adequately answer my questions	ESP Females	69	4.30	0.12	0.99	5.0		
	Non-ESP Females	193	3.88	0.08	1.07	4.0	4915.00	0.000
I am comfortable asking my lab instructor questions	ESP Females	69	4.38	0.12	0.97	5.0		
	Non-ESP Females	192	3.95	0.09	1.21	4.0	5221.00	0.001

Source: Exit Survey (2005-2007)

Value of Course Components

Respondents rated the value of course components on a scale where '0' indicates "Not valuable at all" and '5' "Highly valuable." No significant differences were revealed between group rankings. Lectures show slightly higher mean scores from the non-intervention group (*ESP: M = 3.84; Non-ESP M = 3.74, Table 40*), however the median is the same (*Mdn: 4*). Recitations did score a more favorable median rating by the ESP (*Mdn: ESP = 4; Non-ESP = 3*). Furthermore, upon item-by-item examination we see that whenever the two groups did *not* arrive at the same mean score, the ESP tended to rate more value in course components (when mean score differed by >0.10 of a point). Only two individual institutions showed significant differences, both with more favorable responses from the ESP group.

Table 40: Value of Course Components

Value of Main Course Components by Enrollment; Institutions Combined (2005-2007)

	Group	n	*M*	*SE*	*SD*	*Mdn*	*U*	*Sig.*
Lectures	ESP	235	3.74	0.09	1.38	4.0		
	Non-ESP	867	3.84	0.04	1.29	4.0	98618	0.433
Recitations	ESP	45	3.33	0.23	1.51	4.0		
	Non-ESP	137	3.06	0.14	1.63	3.0	2797.5	0.338
Labs	ESP	133	3.97	0.10	1.14	4.0		
	Non-ESP	460	3.96	0.05	1.02	4.0	29589.5	0.541
Code Labs	ESP	141	3.55	0.11	1.34	4.0		
	Non-ESP	543	3.45	0.06	1.31	4.0	36281	0.328
Assignments	ESP	230	4.09	0.07	1.07	4.0		
	Non-ESP	847	3.93	0.04	1.18	4.0	90578	0.085
Text	ESP	235	2.60	0.10	1.51	3.0		
	Non-ESP	856	2.60	0.05	1.56	3.0	10033.5	0.952
Review	ESP	48	2.98	0.25	1.72	3.0		
	Non-ESP	204	2.87	0.12	1.72	3.0	4743	0.731
Working individually with the instructor	ESP	118	3.36	0.16	1.74	4.0		
	Non-ESP	502	3.44	0.07	1.61	4.0	29426.5	0.910
Working individually with TA	ESP	80	3.46	0.19	1.71	4.0		
	Non-ESP	338	3.50	0.08	1.49	4.0	13010	0.593
Working with other students	ESP	196	3.69	0.08	1.19	4.0		
	Non-ESP	719	3.43	0.05	1.46	4.0	65080.5	0.091

Source: Exit Survey (2005-2007)

SHORT TERM OUTCOMES

Ability, Interests, Teamwork Ratings

A major goal of the ESP program was to provide students with supplementary challenging activities to improve problem-solving skills, enhance learning, and increase confidence levels in computer science. One approach to evaluate whether this has occurred is by measuring perceived abilities and attitudes about computer science. The goal of the activity is not to gauge actual levels of learning or behaviors; there are better metrics for measuring those variables such as grades and student declarations. Rather, the activity allows us to determine what shifts occur over the course of the semester in attitudes and how they might vary between ESP and Non-ESP groups.

Self- perceived Abilities

Respondents were asked to rate their current level of ability on seven computer science related tasks at the beginning of the semester, then again at the end. Aggregate data was broken down into four categories of respondents, Male Non-ESP, Female Non-ESP, Male ESP, Female ESP to examine any differences that lie within and the Wilcoxon signed ranks test was used to determine if there were shifts in perceived abilities from the beginning of the semester to the end. The tests to measure shifts in perceived ability changes over the course of the semester yielded few significant broad findings but confirmed that all groups self-rated ability to perform several programming related tasks increase.

Math/ Programming Abilities

Respondents were asked to rate their current level of ability on seven computer science-/programming-related items (scale: '0' low ability -'5' high ability).

1. Understand mathematical concepts
2. Explain mathematical concepts to others
3. Read computer programming and predict what it will do
4. Catch mistakes in computer programming someone else has written
5. Write error-free programming on their own
6. Solve challenging programming problems
7. Succeed in a university computer science course

As would be expected for an Introductory Programming course, the large-scale comparison of baseline and exit self-rated ability levels on basic programming skills overall for items #3 - #6 above: read/predict programming; catch errors within programming; write error-free programming; and solve challenging programming problems, show statistically significant gains.

Overall, mean scores for the ESP group indicate that they arrive to the course generally rating themselves slightly lower in ability than the non-intervention group, and leave continuing to rate themselves lower in ability. However, this picture changes when disaggregate data is examined. Data are shown in Table 41.

Table 41: Perceived Computer Science Abilities by Enrollment

Perceived Computer Science Ability by Enrollment; Institutions Combined (2005-2007)

Abilities by Participation			Baseline				Exit				Wilcoxon signed ranks test	
	Group	n	*M*	*SD*	*SE*	*Mdn*	*M*	*SD*	*SE*	*Mdn*	*Z*	*Sig.*
Ability to read computer programming and predict what it will do	ESP	192	2.07	1.54	0.11	2.0	3.54	0.98	.07	4.0	-9.925	0.000
	Non-ESP	646	2.16	1.54	0.06	2.0	3.53	1.04	.04	4.0	-17.269	0.000
Ability to catch errors in a program someone else has written	ESP	190	1.69	1.49	0.11	1.5	3.24	1.05	.08	3.0	-10.264	0.000
	Non-ESP	648	1.86	1.48	0.06	2.0	3.18	1.12	.04	3.0	-17.388	0.000
Ability to write error-free programming	ESP	192	1.60	1.46	0.11	1.0	3.12	1.21	.09	3.0	-9.537	0.000
	Non-ESP	648	1.77	1.54	0.06	2.0	3.08	1.27	.05	3.0	-16.458	0.000
Ability to solve challenging programming problems	ESP	192	1.95	1.58	0.11	2.0	3.03	1.28	.09	3.0	-8.036	0.000
	Non-ESP	649	1.98	1.60	0.06	2.0	3.08	1.30	.05	3.0	-14.805	0.000

Source: Baseline and Exit Survey (2005-2007)

When separating males and females by participation, female ESP respondents generally come in just slightly less confident in their abilities than female Non-ESP respondents, and leave with similar or slightly higher ratings (i.e. more gain). Their median ratings also indicate similar trends.

Male ESP and Non-ESP show less mean score difference coming in, but ESP respondents leave with slightly higher median scores. Mean score differences were within a few tenths of a point of each other, but given the large standard deviation and error, medians are best examined for a more accurate picture. Tendency for splits to occur in abilities is often a reflection of the segment of the students who had prior experience or are majoring in computer science versus those who are not. Data are shown in Table 42.

Table 42: Perceived Computer Science Ability by Gender and Enrollment

Perceived Computer Science Ability by Gender and Enrollment; Institutions Combined (2005-2007)

			Baseline				Exit					
	Group	n	*M*	*SE*	*SD*	*Mdn*	*M*	*SE*	*SD*	*Mdn*	*Z*	*Sig.*
Ability to read computer programming and predict what it will do	Female ESP	60	1.57	0.19	1.48	1.0	3.28	0.13	1.03	3.0	-5.90	0.000
	Female Non-ESP	133	1.80	0.12	1.34	2.0	3.15	0.10	1.09	3.0	-7.49	0.000
	Male ESP	132	2.30	0.13	1.52	2.0	3.65	0.08	0.94	4.0	-7.96	0.000
	Male Non-ESP	513	2.26	0.07	1.58	2.0	3.63	0.04	1.00	4.0	-15.62	0.000

Perceived Computer Science Ability by Gender and Enrollment; Institutions Combined (2005-2007)

			Baseline				Exit					
	Group	n	*M*	*SE*	*SD*	*Mdn*	*M*	*SE*	*SD*	*Mdn*	*Z*	*Sig.*
Ability to catch errors in a program someone else has written	Female ESP	60	1.20	0.16	1.27	1.0	2.83	0.12	0.96	3.0	-6.05	0.000
	Female Non-ESP	134	1.54	0.11	1.24	2.0	2.78	0.10	1.11	3.0	-7.87	0.000
	Male ESP	130	1.92	0.13	1.53	2.0	3.43	0.09	1.04	4.0	-8.30	0.000
	Male Non-ESP	514	1.94	0.07	1.53	2.0	3.29	0.05	1.10	3.0	-15.51	0.000
Ability to write error-free programming	Female ESP	60	1.12	0.17	1.33	1.0	2.52	0.16	1.21	3.0	-4.94	0.000
	Female Non-ESP	134	1.37	0.11	1.21	1.0	2.52	0.11	1.24	3.0	-7.08	0.000
	Male ESP	132	1.83	0.13	1.47	2.0	3.39	0.10	1.11	4.0	-8.18	0.000
	Male Non-ESP	514	1.88	0.07	1.59	2.0	3.23	0.06	1.24	3.0	-14.86	0.000
Ability to solve challenging programming problems	Female ESP	60	1.33	0.17	1.34	1.0	2.33	0.16	1.20	2.0	-4.28	0.000
	Female Non-ESP	131	1.32	0.12	1.32	1.0	2.45	0.11	1.27	3.0	-7.10	0.000
	Male ESP	132	2.23	0.14	1.60	2.0	3.34	0.10	1.19	3.0	-6.78	0.000
	Male Non-ESP	518	2.15	0.07	1.63	2.0	3.24	0.06	1.26	3.0	-13.01	0.000

Source: Baseline and Exit Survey (2005-2007)

Aside from these four programming questions, the three other ability items pertaining to math and problem solving have shown wide variability between institutions and across years. Examining the two groups overall, the first item "Ability to understand mathematical concepts" remains the same over the course of the semester for both intervention and Non-ESP (*ESP Baseline/Exit: M =4.11, Non-ESP Baseline/Exit: M = 4.16*). A statistically significant increase was revealed regarding the "ability to explain math concepts to others" in aggregate analysis, but only for the non-intervention group (*Baseline: M =3.62, SD = 0.98, Exit: M = 3.74, SD = 1.05, p = 0.001*). The intervention group mean scores rose from Baseline (*M = 3.45, SD = 1.02)* to Exit (*M = 3.58, SD = 1.05, p = 0.091)* but not significantly. Data are shown in Table 43.

Table 43: Perceived Ability in Math Concepts by Enrollment

Perceived Ability Math Concepts by Enrollment

			Baseline				Exit				Wilcoxon signed ranks test	
	Group	n	*M*	*SE*	*SD*	*Mdn*	*M*	*SE*	*SD*	*Mdn*	*Z*	*Sig.*
Ability to understand math concepts	ESP	191	4.10	0.06	0.87	4.0	4.11	0.07	0.91	4.0	-0.017	0.989
	Non-ESP	654	4.17	0.03	0.83	4.0	4.16	0.04	0.91	4.0	-0.011	0.996
Ability to explain math	ESP	192	3.45	0.07	1.02	4.0	3.58	0.08	1.05	4.0	-1.690	0.091
	Non-ESP	651	3.62	0.04	0.98	4.0	3.74	0.04	1.05	4.0	-3.302	0.001

Source: Baseline and Exit Survey (2005-2007)

When "ability to explain math" was examined by gender groups, both male groups (ESP and non-intervention) show increases, but only the Non-ESP were significant (*p = 0.001*) when applying the Bonferroni correction significance level (*p > 0.025)* (*ESP males: p = 0.038*). Data are shown in Table 44.

Table 44: Perceived Ability in Math Concepts by Gender and Enrollment

Perceived Ability in Math Concepts by Gender and Enrollment; Institutions Combined (2005 – 2007)

			Baseline				Exit					
		n	*M*	*SE*	*SD*	*Mdn*	*M*	*SE*	*SD*	*Mdn*	*Z*	*Sig.*
Ability to understand math concepts	Female ESP	60	4.13	0.12	0.89	4.0	4.03	0.11	0.84	4.0	-0.09	0.442
	Female Non-ESP	134	4.07	0.08	0.93	4.0	4.01	0.09	0.10	4.0	-0.08	0.431
	Male ESP	131	4.08	0.08	0.87	4.0	4.15	0.08	0.95	4.0	-0.07	0.492
	Male Non-ESP	520	4.19	0.04	0.80	4.0	4.2	0.04	0.88	4.0	-0.04	0.718
Ability to explain math	Female ESP	60	3.5	0.13	1.00	4.0	3.48	0.14	1.11	4.0	-0.01	0.945
	Female Non-ESP	134	3.6	0.09	1.03	4.0	3.66	0.09	1.07	4.0	-0.08	0.446
	Male ESP	132	3.42	0.09	1.04	3.5	3.62	0.09	1.02	4.0	-2.07	0.038
	Male Non-ESP	517	3.62	0.04	0.97	4.0	3.75	0.05	1.04	4.0	-3.30	0.001

Source: Baseline and Exit Survey (2005-2007)

The final item in this group of ratings is "Ability to succeed in a university computer science course" Wilcoxon signed ranks tests did not reveal any significant shifts for either ESP or Non-ESP groups at the aggregate level. However, disaggregate gender data shows an increase in perceived abilities among ESP males but not when the Bonferroni correction is applied (*Male ESP Baseline: M = 3.58, SD = 1.26 , Exit: M = 3.86, SD = 1.02, p = 0.032, Table 45).* Female ESP respondents came in with the least confidence, and left showing very little increase to that confidence (*Baseline: M = 2.95, Exit: M = 2.97, p = 0.968*). However, both non-intervention groups leave with a noticeable (but insignificant) drop in mean scores (*Female Non-ESP Baseline: M = 3.09, Exit: M = 2.93, p = 0.280; Male Non-ESP Baseline: M = 3.62, Exit: M = 3.59, p = 0.562, Table 46*). A look into data by institution (and across years) shows some trends within specific institutions, but no overall significant trends.

Table 45: Perceived Ability to Succeed in a Computer Science Course by Enrollment

Perceived Ability to Succeed in a CS Course, by Enrollment; All Institutions (2005-2007)

			Baseline				Exit				Wilcoxon signed rank test	
	Group	n	*M*	*SE*	*SD*	*Mdn*	*M*	*SE*	*SD*	*Mdn*	*Z*	*Sig.*
Ability to succeed in CS course	ESP	192	3.39	.09	1.30	4.0	3.58	0.09	1.20	4.0	-1.700	0.084
	Non-ESP	650	3.51	.05	1.23	4.0	3.45	0.05	1.29	4.0	-1.085	0.283

Source: Baseline and Exit Survey (2005-2007)

Table 46: Perceived Ability to Succeed in a Computer Science Course by Gender and Enrollment

Perceived Ability to Succeed in a CS Course, by Gender and Enrollment; All Institutions (2005-2007)

			Baseline				Exit				Wilcoxon signed rank test	
		n	*M*	*SE*	*SD*	*Mdn*	*M*	*SE*	*SD*	*Mdn*	*Z*	*Sig.*
Ability to succeed in CS course	Female ESP	60	2.95	0.17	1.29	3.0	2.97	0.17	1.33	3.0	-0.041	0.968
	Female Non-ESP	133	3.09	0.11	1.30	3.0	2.93	0.12	1.41	3.0	-1.086	0.280
	Male ESP	132	3.58	0.11	1.26	4.0	3.86	0.09	1.02	4.0	-2.136	0.032
	Male Non-ESP	517	3.62	0.05	1.19	4.0	3.59	0.05	1.23	4.0	-0.581	0.562

Source: Baseline and Exit Survey (2005-2007)

Interest in Computer Science

One goal of the intervention was to increase and/or maintain interest in computer science. Five items were developed to evaluate respondents' incoming/outgoing levels of interest in computer science (scale: '0' low interest -'5' high interest):

1. Taking another computer science course following the current course
2. Majoring in computer science (or electrical computer engineering)
3. Pursuing a career that requires programming skills
4. Pursuing a career that would benefit from an understanding of computer science
5. Working in small teams to complete programming assignments

Over the last three years, these items have shown great variability within and between institutions. However, the overall trend often shows a decreased interest in computer science. As we separate ESP groups' data from the non-intervention respondents, however, we find these decreases somewhat lessened by ESP participation (although insignificantly). Data are shown in Table 47.

Table 47: Interest in Computer Science by Enrollment

Interest in Computer Science, by Enrollment; All Institutions (2005-2007)

			Baseline				Exit				Wilcoxon	
	Group	n	*M*	*SE*	*SD*	*Mdn*	*M*	*SE*	*SD*	*Mdn*	*Z*	*Sig.*
Interest in taking another CS course	ESP	190	3.68	0.10	1.35	4.0	3.59	0.13	1.75	4.0	-0.687	0.495
	Non-ESP	649	3.13	0.07	1.66	3.0	2.88	0.08	1.97	3.0	-3.905	0.000
Interest in Major in CS or ECE	ESP	188	3.06	0.13	1.80	3.0	3.18	0.14	1.87	4.0	-1.151	0.254
	Non-ESP	643	2.40	0.08	1.95	2.0	2.40	0.08	2.02	2.0	-0.125	0.903
Interest in Minor in CS Interest	ESP	12	3.58	0.54	1.88	4.0	3.00	0.56	1.95	2.0	-1.345	0.221
	Non-ESP	22	2.50	0.33	1.57	2.0	3.50	0.27	1.26	3.0	-1.896	0.057
Interest in pursuing a career that requires programming	ESP	187	3.22	0.12	1.58	3.0	3.07	0.13	1.81	3.0	-1.481	0.137
	Non-ESP	647	2.87	0.06	1.62	3.0	2.77	0.07	1.76	3.0	-1.962	0.049
Interest in pursuing a career that would benefit from CS	ESP	189	3.89	0.09	1.28	4.0	3.59	0.12	1.63	4.0	-3.001	0.003
	Non-ESP	643	3.59	0.05	1.38	4.0	3.39	0.06	1.61	4.0	-3.652	0.000

Interest in Computer Science, by Enrollment; All Institutions (2005-2007)

			Baseline				Exit				Wilcoxon	
	Group	n	*M*	*SE*	*SD*	*Mdn*	*M*	*SE*	*SD*	*Mdn*	*Z*	*Sig.*
Interest in working in small teams to complete programming assignments	ESP	98	3.29	0.13	1.32	4.0	3.24	0.16	1.61	4.0	-0.062	0.958
	Non-ESP	303	2.97	0.09	1.54	3.0	2.82	0.10	1.73	3.0	-1.488	0.138

Source: Baseline and Exit Survey (2005-2007)

Four of the five items show significant decreases in non-intervention female interests:

- Interest in taking another computer science course (*Baseline: M = 2.41; Exit: M = 1.80, p = 0.000*),
- pursuing a career that requires programming (*Baseline: M = 2.16; Exit: M = 1.78, p = 0.003*),
- pursuing a career that benefits from knowledge of computer science (*Baseline: M = 3.05; Exit: M = 2.69, p = 0.009*), and
- working in small teams to complete programming tasks (*Baseline: M = 2.72; Exit: M = 2.07, p = 0.005*).

ESP females show only one significant decrease in interest: Pursuing a job that would benefit from computer science (*Baseline: M = 3.47; Exit: M = 2.76, p = 0.009*). ESP females also show higher median ratings than their non-intervention counterpart for interest in taking another class (*ESP: Mdn = 3; Non-ESP Mdn = 1*) and interest in working in small teams to complete programming assignments (*ESP: Mdn = 3; Non-ESP Mdn = 2*)

Non-ESP males also saw significant decreases in interest for taking another class (*Baseline: M = 3.31, Exit: M = 3.16, p = 0.044*) and pursuing a career that would benefit from knowledge of computer science (*Baseline: M = 3.73, Exit: M = 3.57, p = 0.006*). No statistically significant shifts in interest were observed among ESP males. They tended to enter the course with higher interest mean scores than other groups and leave with the same high levels of interest in taking another computer science course (baseline M = 4.04; exit M = 4.05), majoring in computer science (*Baseline M = 3.48; Exit M = 3.68*) and pursuing a career that would benefit from computer science (*4.08; Exit M = 3.95*). Data are shown in Table 48.

Demographic data, however, reminds us that respondents enrolling in this course are often fulfilling requirements and/or had already come to the course with other major interests. Also, given the number of respondents arriving to the course with little prior experience and/or are testing to see whether they enjoy computer programming or not, students may not have had a firm understanding of the rigors computer programming entails. The fact that interest has a general tendency to decrease may also have roots in the essence of the course – "Introduction to Computer Science." With the large variability seen with this item the validity of this question is unclear. In other words, we are not certain if we are measuring naivety regarding rigor, end-of-semester burn out or other attitudinal issues.

Table 48: Interest in Computer Science by Gender and Enrollment

Interest in Computer Science by Gender and Enrollment; Institutions Combined (2005-2007)

			Baseline				Exit					
		n	*M*	*SE*	*SD*	*Mdn*	*M*	*SE*	*SD*	*Mdn*	*Z*	*Sig.*
Interest in taking another CS course	Female ESP	58	2.88	0.18	1.40	3.0	2.55	0.26	2.00	3.0	-1.423	0.156
	Female Non-ESP	134	2.41	0.14	1.64	2.0	1.80	0.16	1.88	1.0	-4.356	0.000
	Male ESP	132	4.04	0.10	1.17	5.0	4.05	0.12	1.42	5.0	-0.503	0.617
	Male Non-ESP	515	3.31	0.07	1.62	4.0	3.16	0.08	1.89	4.0	-2.016	0.044
Interest in Major in CS or ECE	Female ESP	56	2.05	0.23	1.69	1.5	1.98	0.26	1.93	1.5	-0.441	0.672
	Female Non-ESP	133	1.32	0.14	1.65	1.0	1.25	0.16	1.82	0.0	-0.768	0.450
	Male ESP	132	3.48	0.15	1.68	4.0	3.68	0.14	1.61	4.0	-1.636	0.103
	Male Non-ESP	510	2.68	0.09	1.93	3.0	2.70	0.09	1.96	3.0	-0.26	0.795
Interest in Minor in CS Interest	Male ESP	11	3.55	0.59	1.97	4.0	3.00	0.62	2.05	3.0	-1.149	0.305
	Male Non-ESP	22	2.50	0.33	1.57	3.0	3.50	0.27	1.26	3.0	-1.896	0.060
Interest in pursuing career that requires programming skills	Female ESP	58	2.40	0.20	1.53	2.0	2.09	0.25	1.89	2.0	-1.504	0.136
	Female Non-ESP	134	2.16	0.13	1.54	2.0	1.78	0.14	1.66	2.0	-2.928	0.003
	Male ESP	129	3.60	0.13	1.47	4.0	3.51	0.14	1.60	4.0	-0.641	0.526
	Male Non-ESP	513	3.05	0.07	1.60	3.0	3.02	0.08	1.69	3.0	-0.602	0.548
Interest in pursuing career that would benefit from CS	Female ESP	58	3.47	0.17	1.29	3.5	2.76	0.23	1.77	3.0	-3.16	0.001
	Female Non-ESP	131	3.05	0.14	1.56	4.0	2.69	0.15	1.75	3.0	-2.592	0.009
	Male ESP	131	4.08	0.11	1.24	4.5	3.95	0.12	1.42	4.0	-0.986	0.330
	Male Non-ESP	512	3.73	0.06	1.30	4.0	3.57	0.07	1.52	4.0	-2.727	0.006
Interest in working in small teams	Female ESP	36	2.89	0.24	1.41	3.0	2.53	0.27	1.59	3.0	-1.291	0.205
	Female Non-ESP	72	2.72	0.18	1.56	3.0	2.07	0.21	1.75	2.0	-2.784	0.005
	Male ESP	62	3.52	0.16	1.23	4.0	3.66	0.19	1.47	4.0	-1.328	0.198
	Male Non-ESP	231	3.04	0.10	1.52	3.0	3.05	0.11	1.65	3.0	-0.061	0.951

Source: Baseline and Exit Survey (2005 – 2007)

Attitudes towards working in teams/pairs

One of the premises of the ESP is that students are better able to learn difficult content when working in small group with other supportive students. The ESP group sessions provided extra opportunity to engage in this type of small group work.

To measure attitudinal changes regarding team work over the course of the semester, this third area of comparison data examined respondents' rating of agreement (scale: '0' strongly disagree -'5' strongly agree) with five items regarding working in small groups/teams. Institutions had the option of removing these questions to assist in brevity of the surveys, therefore questions were asked only in 2005 and 2007 and only at some institutions.

A few significant increases in attitudes towards teamwork were revealed among ESP respondents. By the end of the semester, aggregate female ESP group mean scores indicated a statistically significant increase in their perception of working in teams to be beneficial over working individually (*Baseline: M = 3.59, Exit: M = 3.95, p = 0.031*). Although not significant, Non-ESP females' aggregate scores showed a

slight decrease on this item and median scores did not differ between any of the gender groups (*Mdn = 4*). ESP Males indicated a significant increase in belief that they learned more by working and studying with others than working and studying alone (*Baseline: M = 3.06; Exit: 3.37, p = 0.035*). Data are shown in Table 49.

Finally, both ESP males and ESP females show statistically significant increases in comfort discussing assignments with other students whereas, no significant changes were observed in scores of non-intervention participants.

Table 49: Interest in Team Work by Gender and Enrollment

Interest in Team Work by Gender and Enrollment; Institutions Combined (2005-2007)

			Baseline				Exit					
		n	*M*	*SE*	*SD*	*Mdn*	*M*	*SE*	*SD*	*Mdn*	*Z*	*Sig.*
Working in teams has benefits over working individually	Female ESP	37	3.59	0.18	1.07	4.0	3.95	0.17	1.03	4.0	-2.162	0.031
	Female Non-ESP	72	3.61	0.11	0.94	4.0	3.40	0.16	1.35	4.0	-1.337	0.188
	Male ESP	94	3.80	0.10	0.99	4.0	3.86	0.13	1.23	4.0	-0.593	0.564
	Male Non-ESP	323	3.64	0.06	1.10	4.0	3.70	0.07	1.26	4.0	-1.012	0.313
I learn more by working and studying with others than by working and studying alone	Female ESP	37	2.97	0.18	1.07	3.0	3.38	0.24	1.44	3.0	-1.784	0.078
	Female Non-ESP	72	3.14	0.12	1.05	3.0	2.99	0.17	1.48	3.0	-0.603	0.553
	Male ESP	94	3.06	0.14	1.34	3.0	3.37	0.14	1.31	4.0	-2.107	0.035
	Male Non-ESP	322	3.05	0.07	1.28	3.0	3.07	0.09	1.52	3.0	-0.195	0.846
Some people in a team always end up doing all the work, while others hardly do anything	Female ESP	36	3.11	0.22	1.30	3.0	2.92	0.21	1.23	3.0	-1.081	0.302
	Female Non-ESP	72	2.68	0.14	1.16	3.0	2.46	0.14	1.16	2.5	-1.380	0.172
	Male ESP	92	2.88	0.12	1.17	3.0	2.86	0.14	1.31	3.0	-0.052	0.961
	Male Non-ESP	323	2.97	0.06	1.08	3.0	3.01	0.07	1.26	3.0	-0.887	0.376
I feel comfortable going to instructors for help with assignments I don't understand	Female ESP	36	3.72	0.18	1.09	4.0	4.03	0.18	1.08	4.0	-2.057	0.051
	Female Non-ESP	72	3.76	0.12	0.99	4.0	3.68	0.13	1.14	3.0	-0.379	0.713
	Male ESP	94	3.86	0.11	1.02	4.0	3.98	0.11	1.05	4.0	-1.440	0.153
	Male Non-ESP	322	3.75	0.06	1.06	3.0	3.69	0.07	1.16	4.0	-0.693	0.490
I feel comfortable asking other students for help with assignments that I don't understand	Female ESP	37	3.30	0.22	1.35	4.0	3.97	0.16	0.96	4.0	-3.078	0.002
	Female Non-ESP	72	3.43	0.13	1.14	4.0	3.18	0.16	1.37	4.0	-1.290	0.202
	Male ESP	93	3.54	0.12	1.13	4.0	3.77	0.12	1.19	4.0	-2.253	0.024
	Male Non-ESP	324	3.40	0.06	1.15	4.0	3.44	0.07	1.30	4.0	-0.624	0.534

Source: Baseline and Exit Survey (2005-2007)

REASONS FOR NOT PURSUING A DEGREE OR CAREER IN COMPUTER SCIENCE

What are groups' reasons for pursuing/not pursuing a degree or career in Computer Science

Respondents who indicated they were not going to pursue a major or career in computer science, or were unsure, were then asked their reasons for this decision. Data are shown in Table 50. Of the 606 respondents, nearly half (*45.0%*) indicated that the most influential reason for not pursuing computer science was that they already had chosen another major. When we look at the percentage grouped by gender and enrollment, some differences in the response patterns emerge. Approximately half of Non-ESP males (*44.9%*) and Non-ESP females (*53.6%*) indicate this as the most influential reason, whereas about one third of ESP males (34.2%) and only a quarter of ESP females (*27.3%*) indicate this as the most influential reason for not pursuing computer science. To better understand why ESP respondents determined not to pursue computer science some of the categories were collapsed into broader categories including: work-related reasons, difficulty reasons and lack of interest or enjoyment. Respondents remained fairly spread in their reasons for not pursuing computer science:

Difficulty: One- quarter of females and 20% of males indicated that it was too difficult (*ESP males 4.9%; ESP females 9.1%*), they did not feel good at computer science (*ESP males 12.2%; ESP females 13.6%*) or there was too much math involved (*ESP Males 2.4%; ESP females 2.3%*)

Lack of Enjoyment: 18% of females and 10% of males indicated they did not enjoy it (*ESP males 9.8%; ESP females 13.6%*) or it was not the thrill they thought it would be (*ESP males 0.0%, ESP females 4.6%*).

Work-related Reasons: Very few ESP females selected work-related reasons for not pursuing, with only 4.6% selecting they did not want a job sitting in front of a computer alone all day (*n=2*) and one person indicating wanting a job working with other people. Interestingly, just under 15% of ESP males indicated they did not want a job sitting in front of a computer alone all day.

Table 50: Most Influential Reasons for Not Pursuing a Major or Career in Computer Science

Most Influential Reasons for not Pursuing a Major or Career in Computer Science by Gender and Enrollment; All Institutions Combined (2005-2007)

	Female ESP		Female Non-ESP		Male ESP		Male Non-ESP		Total	
	#	%	#	%	#	%	#	%	#	%
The course was too hard	4	9.1%	5	3.3%	2	4.9%	24	6.5%	35	5.8%
I don't want a job sitting in front of a computer alone all day	2	4.6%	4	2.7%	6	14.6%	32	8.7%	44	7.3%
Getting a program to run wasn't the thrill I thought it would be	2	4.6%	1	0.7%	0	0.0%	7	1.9%	10	1.7%
Even before enrolling in this course, I had already decided on a different (non-computer science) major	12	27.3%	81	53.6%	14	34.2%	166	44.9%	273	45.1%
I want a job working with other people	1	2.3%	3	2.0%	0	0.0%	15	4.1%	19	3.1%
I just didn't enjoy it	6	13.6%	17	11.3%	4	9.8%	25	6.8%	52	8.6%
I felt I wasn't very good at it	6	13.6%	13	8.6%	5	12.2%	27	7.3%	51	8.4%
Computer science requires too much math	1	2.3%	4	2.7%	1	2.4%	12	3.2%	18	3.0%
Other	4	9.1%	7	4.6%	4	9.8%	26	7.0%	41	6.8%
Several reasons equally influential	6	13.6%	16	10.6%	5	12.2%	36	9.7%	63	10.4%
Total	44	100%	151	100%	41	100%	370	100%	606	100%

Source: Exit Surveys (2005-2007)

CONCERNS

Students were asked to indicate any concerns they might have about computer science on both the baseline and exit surveys. Data for all institutions from 2005 through 2007 were combined to determine what, if any, trends or differences between groups would emerge. To detect changes in the same set of respondents, these data are reported first as only those who responded to both surveys (*Tables 51-53*), then as all responses, matched or not .

Who has concerns at the end of the semester, how do concerns change over time, how do they vary?

The most notable trend regarding concerns is seen in higher percentages of females indicating a lack of interest in computer science on the baseline and exit surveys as compared to men (*Non-ESP Females Baseline = 41.4%, Exit = 55.0%; ESP Females, Baseline = 38.5%,Exit = 51.9% ; Non-ESP Males, Baseline = 23.5% Exit = 34.8%; ESP Males, Baseline = 14.0%, Exit = 23.6%*). It may also be interesting to note that the percentage of respondent indicating a lack of interest increased on the exit survey. The higher percentage of Non-ESP females may not be surprising, given the large number of females entering to fulfill a requirement of their intended degree and for few other reasons. However, it also suggests that students coming into the ESP to see whether they enjoy it, are determining that they do not. A cursory review of the data on students entering to see whether they enjoy computer science shows about 41%

of them indicated that they would not pursue a major or minor in computer science. It should be kept in mind that this figure is drawn from a very small sample of students across institutions (*n=43*).

Also noted in overall ESP concerns, nearly one quarter of the respondents, male and female continue to select that the field does not allow them to do something that would help other people/society (*Male exit: 21.3%, Female exit: 28.9%*). Another concern showed around a third of the respondents also feel they do not want to sit alone at a computer all day (*Male exit: 30.7%. Female exit: 38.5%*).

Across institutions, on both baseline and exit surveys, higher percentages of males, particularly ESP males, select computer science workforce issues as concerns (again caution is suggested as numbers are relatively low). Workforce issues include:

- Too competitive (*Baseline: Non-ESP Males, 11.3%; Non-ESP Females, 9.1; ESP Males, 14.7%; ESP Females, 9.3%)* (*Exit: Non-ESP Males, 1415%; Non-ESP females, 8.1%; ESP Males, 15.8%; ESP Females, 7.7%).*
- CS would not pay enough (*Baseline: Non-ESP Males, 7.2; Non-ESP females, 2.8%; ESP Males, 13.4%; ESP Females, 1.5%*) (*Exit: Non-ESP Males, 6.3%; Non-ESP Females, 4.4%; ESP Males, 11.8%; ESP Females, 3.9%*)
- Outsourcing of jobs (*Baseline: Non-ESP Males, 22.7%; Non-ESP Females, 9.5%; ESP Males, 28.0%; ESP Females, 7.7%)* (*Exit: Non-ESP Males, 20.9%; Non-ESP Females, 9.4%; ESP Males, 22.8%; ESP Females, 7.7%)*
- Uncertain future of computer science (*Baseline: Non-ESP Males, 16.7%; Non-ESP Females, 7.9%; ESP Males, 23.5%; ESP Females, 4.6%)(Exit: Non-ESP Males; 13.3%; Non-ESP Females, 4.8%; ESP Males, 20.5; ESP females, 3.6%*)

As shown, the number of students reporting concerns about the computer science workforce is fairly small but the pattern is relatively consistent across institutions. This suggests a gender gap in concerns that is not associated with the main course or intervention; but it is not addressed either.

Table 51: ESP Student Concerns at Baseline and Exit

ESP Student Concerns at Baseline and Exit; All Institutions Combined (2005-2007)

	Female Baseline		Female Exit		Male Baseline		Male Exit	
ESP	#	%	#	%	#	%	#	%
	n = 65		n = 52		n = 157		n = 127	
I'm not interested in it enough to pursue CS	25	38.5%	27	51.9%	22	14.0%	30	23.6%
I don't want to sit at a computer all day	26	40.0%	20	38.5%	43	27.4%	39	30.7%
CS is not exciting	10	15.4%	10	19.2%	10	6.4%	17	13.4%
CS is too competitive	6	9.3%	4	7.7%	23	14.7%	20	15.8%
CS wouldn't pay enough	1	1.5%	2	3.9%	21	13.4%	15	11.8%
CS work tends to be outsourced to other countries	6	9.2%	4	7.7%	44	28.0%	29	22.8%

ESP Student Concerns at Baseline and Exit; All Institutions Combined (2005-2007)

ESP	Female Baseline		Female Exit		Male Baseline		Male Exit	
	#	%	#	%	#	%	#	%
	n=44		n=52		n=116		n=127	
I want to do something that helps people and society	10	22.7	15/52	28.9	23/116	19.8	27/127	21.3
	n=22		n=28		n=85		n=83	
The job market for CS graduates is uncertain	1	4.6	1	3.6	20	23.5	17	20.5
	n=50		n=52		n=119		n=127	
I have no concerns	18	36.0	11	21.2	33	27.7	40	31.5
	n=65		n=52		n=159		n=127	
Other Concerns	10	15.4	3	5.8	13	8.2	13	10.2

Source: Baseline and Exit Surveys (2005-2007)

Table 52: Non-ESP Concerns at Baseline and Exit

Non-ESP Concerns at Baseline and Exit; All Institutions Combined (2005-2007)

Non-ESP	Female Baseline		Female Exit		Male Baseline		Male Exit	
	#	%	#	%	#	%	#	%
	n = 254		n = 160		n = 896		n = 555	
I'm not interested in it enough to pursue CS	105	41.3%	88	55.0%	210	23.5%	193	34.8%
I don't want to sit at a computer all day	80	31.5%	46	28.8%	272	30.4%	174	31.4%
CS is not exciting	31	12.2%	30	18.8%	87	9.7%	80	14.4%
CS is too competitive	23	9.1%	13	8.1%	101	11.3%	78	14.1%
CS wouldn't pay enough	7	2.8%	7	4.4%	64	7.2%	35	6.3%
CS work tends to be outsourced to other countries	24	9.5%	15	9.4%	203	22.7%	116	20.9%
	n=189		n=160		n=706		n=555	
I want to do something that helps people and society	33	17.5%	30	18.8%	111	15.7%	96	17.3%
	n=76		n=83		n=454		n=316	
The job market for CS graduates is uncertain	6	7.9%	4	4.8%	76	16.7%	42	13.3%
	n=254		n=160		n=900		n=555	
Other Concerns	22	8.7%	8	5.0%	86	9.6%	45	8.1%
	n=219		n=160		n=724		n=555	
I have no concerns	71	32.4%	40	25.0%	261	36.1%	155	27.9%

Source: Baseline and Exit Surveys (2005-2007)

Table 53: Concerns about Computer Science; All Groups

Concerns about Computer Science; All Institutions Combined (2005-2007)

All	Baseline		Exit	
	#	%	#	%
	n=1372		N=894	
I'm not interested in it enough to pursue CS	362	26.4%	338	37.8%
I don't want to sit at a computer all day	421	30.7%	279	31.2%
CS is not exciting	138	10.1%	137	15.3%
CS is too competitive	153	11.2%	115	12.9%
CS wouldn't pay enough	93	6.8%	59	6.6%
CS work tends to be outsourced to other countries	276	20.1%	164	18.3%

Concerns about Computer Science; All Institutions Combined (2005-2007)

All	Baseline		Exit	
	#	%	#	%
I have no concerns	n=1112		n=894	
	383	34.4%	246	27.5%
I want to do something that helps people and society	n=1055		n=894	
	177	16.8%	168	18.8%
The job market for CS graduates is uncertain	n=637		n=510	
	103	16.2%	64	12.6%
Other Concerns	n=1378		n=894	
	131	9.5%	69	7.7%

Source: Baseline and Exit Surveys (2005-2007)

SUCCESS IN THE COURSE:

Did ESP help males or females, or under-represented ethnic groups to do better in the main course?

Retention Rates

There was a significant association between ESP and retention rates in the main course (X^2 *(1) = 9.652, p = 0.002*). Based on the odds ratio, it appears that ESP students are 1.87 times more likely to complete the main course than are Non-ESP students.[12] Data are shown in Table 54.

Table 54: Retention Rates

Retention Rates Contingency Table; All Institutions Combined (2005-2007)

	ESP Enrolled*		Non-ESP		Total	
	#	%	#	%	#	%
Completed	383	93.2%	2363	88.0%	2746	88.7%
Dropped	28	6.8%	323	12.0%	351	11.3%
Total	411	100%	2686	100%	3097	100%
Pearson Chi-Square = 9.652 (1), p = 0.002						

Source: PI Demographic Report

**Beloit 2007 not included because students did not voluntarily enroll*

Effect Size as Odds Ratio

ESP	383/28	13.67
Non-ESP	2363/323	7.32
Odds Ratio	13.67/7.32	1.87

[12] *Some institutions reported very few or no drops, which is surprising. The analysis here is based upon the data provided, however it should be kept in mind that different institutions have different policies regarding when a drop is officially recorded.*

To determine if this held true specifically for females and under-represented ethnic groups, intervention and non-intervention retention rates were compared. No statistically significant associations were revealed between the ESP and completion of the main course for these groups (Female comparison: X^2 *(1) = 0.450, p= 0.53, Table 55; Under-represented Ethnic group comparison:* X^2 *(1) = 0.098, p= 0., Table 55*). Non-ESP females were just as likely to complete the main course, as were ESP females, as was also the case for members of under-represented ethnic groups.

Table 55: Retention Rates Among Females

Female Retention Rates by intervention; All Institutions Combined (2005-2007)

	ESP Females		Non-ESP Females		Total	
	#	%	#	%	#	%
Completed	142	88.2%	625	86.2%	767	86.6%
Dropped	19	11.8%	100	13.8%	119	13.4%
Total	161	100%	725	100%	886	100%
Pearson Chi-Square =0.450 (1), p = 0.503						

Source: PI Demographic Report

Table 56: Retention Rates Among Under-Represented Ethnic Groups

Under-Represented Ethnic Groups Retention Rates by intervention; All Institutions Combined (2005-2007)

	ESP Under-Represented Ethnic Group		Non-ESP Under-represented Ethnic Group		Total	
	#	%	#	%	#	%
Completed	51	87.9%	222	86.4%	273	86.7%
Dropped	7	12.1%	35	13.6%	42	13.3%
Total	58	100%	257	100%	315	100%
Pearson Chi-Square = 0.098(1), p=0.754						

Source: PI Demographic Report

Incoming and Course Achievement comparisons

UW Madison

In an analysis of UW Madison's data alone, Mann Whitney U tests reveal statistically significant differences in grades between WESCS and Non-WESCS student, where WESCs average grades (*M = 3.06, Table 57*) were higher than Non-WESCS average (*M = 2.75*) final CS302 grades.

Some concern has been expressed that higher grades achieved by WESCS students may be a direct reflection of invitation criteria based on higher SAT scores. Mann Whitney U tests confirmed that there were no significant differences in SAT scores between WESCS and Non WESCS students. While statistically insignificant, the overall results indicate WESCS participants actually arrived with a slightly lower mean rank score than their non intervention counterparts (*M = 687.08; Non WESCS = 695.34; p = 0.238*). However, the opposite was the case (again statistically insignificant) when comparing high

school grade point averages (g.p.a.) WESCS members collectively showed a g.p.a. of 3.70 and Non WESCS students mean score of 3.62 (*t = -1.86, p = 0.63).*

Analysis of final CS302 grades to incoming SAT scores showed weak positive correlations in both groups (the higher the SAT score, the better outcome in CS302). This was also the case for HS GPA. Data are shown in Table 57.

Table 57: Comparisons of Final CS302 Grades, SAT, GPA, WESCS Participation

	Group	n	*Scores*	Statistic score	Sig.
Final CS 302 Grade by Participation			Final Grade		
	WESCS	324	3.06, SE = 0.06, SD = 0.87	Mann Whitney	
	Non WESCS	1169	2.75, SE = 0.03, SD = 1.04	U = 114455.00	**0.000**
Incoming SAT Score by Participation			SAT Mean		
	WESCS	96	687.08, Mean Rank 245.74	Mann Whitney	
	Non WESCS	427	695.34, Mean Rank 265.66	U = 18935.00	**0.238**
Incoming HS GPA by Participation			HS GPA Mean		
	WESCS	226	3.70, SE = 0.04, SD = 0.62	T-test for independent samples	
	Non WESCS	1040	3.62, SE = 0.02, SD = 0.60	t (df=1264) = -1.86	**0.063**
Correlation of Final CS 302 Grade to Incoming SAT Score				Spearman's Rho	
	WESCS	96		0.326	
	Non WESCS	345		0.370	
Correlation of Final CS 302 Grade to HS GPA				Spearman's Rho	
	WESCS	206		0.217	
	Non WESCS	863		0.278	

Source: Institutional Enrollment Data (2004-2007)

All Institutions

A significant association between enrollment in ESP and grade was revealed where $X^2(1) = 15.604$, $p = 0.000$. According to the odds ratio, ESP students are 1.87 times as likely to get a grade of B or better in the main course as Non-ESP students. The same significant association occurs when comparing only females from each group. Based on the odds ratio, it seems that ESP females are 2.14 times as likely to obtain a grade of B or better than Non-ESP females ($X^2 = 6.15$ (1), $p = 0.013$). Data are shown in Tables 58 & 59.

Table 58: Grades by Enrollment

Final grades by intervention; All Institutions Combined (2005-2007)

	ESP Enrolled		Non-ESP		Total	
	#	%	#	%	#	%
B or Better	219	80.2%	1130	68.4%	1349	70.1%
Less than B	54	19.8%	522	31.6%	576	29.9%
Total	273	100%	1652	100%	1925	100%
Pearson Chi-Square = 15.604 (1); p = 0.000; Fisher's exact test p = 0.000						

Source: PI Demographic Report

Effect Size as Odds Ratio

ESP	219/54	4.056
Non-ESP	1130/522	2.165
Odds Ratio	4.06/2.16	1.870

Table 59: Grades Compared by Female Enrollment

Female Grades by intervention; All Institutions Combined (2005-2007)

	ESP Females		Non-ESP Females		Total	
	#	%	#	%	#	%
B or Better	70	83.3%	295	70.1%	365	72.3%
Less than B	14	16.7%	126	29.9%	140	27.7%
Total	84	100%	421	100%	505	100%
Pearson Chi-Square = 6.15 (1), p = 0.013						

Source: PI Demographic Report

Effect Size as Odds Ratio

ESP	70/14	5.00
Non-ESP	295/126	2.34
Odds Ratio	5.00/2.34	2.14

While percentages appear slightly higher for the ESP under-represented ethnic groups to achieve a B or higher compared to the non-intervention group, no significant association was revealed ($X^2 = 1.36$ (1) $p = 0.243$). Non-ESP under-represented ethnic groups are equally likely to achieve a grade of B or better as ESP groups. Data are shown in Table 60.

Table 60: Grades Compared by Under-Represented Ethnic Groups

Under-Represented Ethnic Groups Grades by intervention; All Institutions Combined (2005-2007)

	ESP Under-Represented Minority		Non-ESP Under-represented minority		Total	
	#	%	#	%	#	%
B or Better	20	64.5%	85	53.1%	105	55.0%
Less than B	11	35.5%	75	46.9%	86	45.0%
Total	31	100%	160	100%	191	100%
Pearson Chi-Square = 1.361 (1), p = 0.243; Fisher's exact test: p = 0.324						

Source: PI Demographic Report

LONG-TERM OUTCOMES

Who declares computer science as a major?

No significant association between ESP and declaration of a computer science (or related) degree were revealed ($X^2 = 2.098$ (1), $p = 0.147$). As the percentages within groups suggest, Non-ESP students (*27.9%*) are just as likely to declare a major in computer science as are ESP students (3*2.2%*). Data are shown in Table 61.

Table 61: Number of Students Declaring a Major in Computer Science by Enrollment

Number of Students Declaring Major in Computer Science

	ESP Students		Non-ESP Students		Total	
	#	%	#	%	#	%
Major in CS	85	32.2%	473	27.9%	558	28.5%
No Major in CS	179	67.8%	1224	72.1%	1403	71.5%
Total	264	100%	1697	100%	1961	100%
Pearson Chi-Square = 2.098 (1), p = 0.147						

Source: PI Outcomes Data Report (2005-2007)

SUMMARY AND DISCUSSION

Each institution achieved some level of diversity in their ESP groups. Interestingly, smaller schools tended to show the most diversity, maintaining around 50% females whereas larger institutions maintained around 20-25% representation by females. Most schools attracted a few students from under-represented ethnic groups ranging from around 4% to 18%. Although it might be stating the

obvious, institutions with more diverse geographic populations were also the most successful in achieving and maintaining ethnic diversity in their ESP sections.

From the evaluation, we have developed a fairly good idea of the student who typically enrolled in the ESP during the past three years. The majority of males and females who enrolled in the ESP section did so because they wanted a more comprehensive understanding of computer programming (*ESP Males: 78.5%; ESP Females: 77.8%*), an opportunity to learn programming in a smaller group (*ESP Males: 65.1%; ESP Females: 59.0%*) and a better grade (*ESP Males: 62.0%; ESP Females: 65.0%*).

A far greater percentage of males indicated having some prior experience with computer science and/or programming (*67.7%*) than did females (*37.5%*). A much higher percentage of males also indicated they would be majoring in computer science (*ESP Males: 46.2%; ESP Females: 15.4%*). ESP females indicated they enrolled in the main course to see whether they would enjoy computer science and/or programming (*ESP Males: 40.1%; ESP females 48.1%*) whereas ESP males enrolled knowing they had an interest in computer science (*ESP Males: 69.8%, ESP Females: 32.7%*). The difference between experience levels and gender did not appear to disrupt the collaborative balance of the sessions. Males and females enrolled in the ESP were equally favorable in their review of the sessions and when asked, both gender groups disagreed that the sessions they attended were "dominated by one or two people" (*ESP Males: M = 2.28; ESP Females: M = 2.03, Mdn 2; U = 6384.0, p = .224*).

We also know that ESP respondents viewed their experience in ESP favorably. Across institutions, ESP respondents generally evaluated their peer leaders quite favorably, with combined institutional data mean scores over 4.0 in all areas. Respondents tended to respond neutrally regarding the sessions being a lot of work (*ESP Males: M = 2.38, Mdn = 3.; ESP Females: M = 2.50, Mdn = 2*) and moderately agreed that the sessions they attended were a lot of fun (*ESP Males: M = 3.84, Mdn 4.0; ESP Females: M = 3.93, Mdn 4.0*).

ESP respondents also generally indicated that the sessions were useful preparation for completing assignments (*Males: M = 3.76, Mdn 4; ESP Females: M = 3.59, Mdn 4.0*) and helped them to do better on exams (*ESP Males: M = 3.97, Mdn 4.0; ESP Females: M = 3.82, Mdn 4.0*). Even respondents who indicated they would not re-enroll in either the ESP section or the main course still found the ESP experience to be important to their learning.

In general, all respondents were favorable in their assessment of the main course, regardless of enrollment in ESP or not. However, Kruskal-Wallis tests and post-hoc Mann-Whitney tests revealed some interesting statistically significant differences between gender groups. ESP males tended to agree significantly more than Non-ESP males that the instructor adapted his/her instruction for people without prior programming experience (*ESP Males: M = 3.73, Mdn = 4.0; Non-ESP Males: M = 3.56, Mdn = 4.0; U = 47379.5, p = 0.018*) and disagreed that instructor covered material too quickly (*ESP Males: M = 1.77, Mdn 1.0; Non-ESP Males: M = 2.05, Mdn 2.0; U=46127.5, p=0.002*). Comparatively, Mann-Whitney tests revealed statistically significant differences in rank scores between ESP females and Non-ESP females regarding the Teaching Assistants (TAs). ESP females agreed more strongly than Non-ESP females that:

- The TA was knowledgeable (*ESP females: M = 4.45, Mdn 5.0; Non-ESP females: M = 4.03; Mdn 4.0; U=4513.0, p = 0.003*)
- The TA answered questions adequately (*ESP females: M = 4.30, Mdn 5.0; Non-ESP females: M = 3.88, Mdn 4.0; U = 4915.0, p=0.000*)
- They felt comfortable asking the TA questions (*ESP females: M = 4.38, Mdn 5.0; Non-ESP females: M = 3.95, Mdn 4.0; U = 5221.0, p = 0.001*).

We find these statistically significant differences to be most interesting for two reasons. First, the significant differences were isolated to items dealing with perceptions of instruction. Second, although it might be interesting that the differences are between same-sex gender groups they are also located between groups with similar prior computer science experience levels (males report more experience and females report less or no prior experience). This gives us some indication that the ESP is having an influence on students' ability to navigate through the main course with a bit more ease than non-ESP students.

We see this increased confidence in particular for ESP females on baseline-exit questions regarding teamwork. ESP females showed statistically significant positive increases in their comfort levels to seek out the instructor for help with assignments they did not understand (*Baseline M = 3.72; Exit M = 4.03, Z = -2.057, p = 0.051*) and asking for help with assignments from other students (*Baseline M = 3.30; Exit M = 3.97; Z = -3.078, p= 0.002*). Additionally, ESP females showed a significant increase in their agreement that "working in teams has benefits over working individually (*Baseline M = 3.59; Exit M = 3.95; Z = -2.162, p = 0.031*).

Not only do we have evidence that ESP increases confidence among its students but chi-square statistical tests revealed a significant association between enrollment in ESP and grades. Students (male or female) who enrolled in the ESP were approximately two times more likely to receive a grade of B or better than were Non-ESP students ($X^2(1) = 15.604, p = 0.000$). There was also a significant association between enrollment in ESP and grades for ESP females compared to Non-ESP females (*Pearson* $X^2 (1) = 6.15, p = 0.013$). However, a Fishers exact test did not reveal a significant association between ESP and grades for under-represented ethnic groups. Please note that the group of students from which we reached this conclusion was quite small. Additional data could be collected and may be worthwhile revisiting.

Despite the fact that ESP appears to have some favorable short-term benefits for ESP students there was no significant association between enrollment in ESP and persistence in computer science (X^2 results). A lack of interest in pursuing computer science was also demonstrated in the baseline/exit questions, where a statistically significant decrease was revealed among ESP females to pursue a career that would benefit from a knowledge of computer science (*Baseline M = 3.47; Exit M = 2.76; Z = -3.160, p = 0.001*). Although persistence in pursuing computer science as a major or career was a goal of the program, it was admittedly a lofty one. It may not be realistic to assume that a one-semester intervention can significantly change attitudes and/or career decisions. This is especially true when the

main course to which the intervention was attached is an entry-level course that serves a variety of purposes.

No single reason why ESP students decide not to pursue computer science as a major or career emerged from the data. When asked why they do not want to pursue computer science, ESP respondents were fairly spread in their reasons, with about

- One-quarter of females and one-third of males indicating they had already selected another degree program before enrolling (*ESP males: 34.3%; ESP females: 27.3%*).
- One- quarter of females and 20% of males indicating that it was too difficult (*ESP males: 4.9%; ESP females: 9.1%*), they did not feel good at computer science (*ESP males: 12.2%; ESP females: 13.6%*) or there was too much math involved (*ESP males 2.4%; ESP females 2.3%)*
- 18% of females and 10% of males indicating they did not enjoy it (*ESP males: 9.8%; ESP females: 13.6%*) or it was not the thrill they thought it would be (*ESP males: 0.0%, 4.6%*).

What does seem clear from the data is that many of the reasons indicated are ones that ESP most likely cannot address. It seems reasonable that a certain percentage of students who are exploring an area where they have little or no experience, to determine whether they enjoy it, might end up deciding that they do not. The percentages presented here (*approximately 20%*) seem reasonable when we consider that this data is based on only respondents who decided not to pursue computer science. Institutions interested in implementing a similar intervention might want to focus on recruiting students who have had at least some exposure to computer science or programming, as they have more likely already determined if they like computer science or not. It also appears equally unlikely that a one-semester intervention program is sufficient in changing attitudes enough that students would be willing to change their degree program.

Unfortunately, while we thought to ask students why they would not pursue computer science, we did not ask those who indicated they would pursue why they would do so. What we do know is that when we asked students how much ESP influenced their decision to major in computer science they indicated it had only a moderate influence on males decisions (*M = 2.63*) and even less for females (*M = 1.65; U 524.5, p=0.17*).

At this time, it seems that males reaped the most rewards from the ESP intervention; however, they also enter with more certainty about their interest in computer science. Females do benefit from the ESP experience as well, especially when compared to their Non-ESP female counterpart. Regardless of gender, ESP students decidedly get some short-term gains over Non-ESP students in terms of enjoyment and grades. In terms of long-term impact on computer science departments and the field of computer science, ESP might play a role in helping to foster positive computer science experiences but it will most likely take a multi-faceted departmental (if not institutional) approach to recruit and retain under-represented populations.