# The Impact of Placement Strategies on the Success of Students in Introductory Computer Science*

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*Abstract*—Studies have shown that novice programmers face unnecessary obstacles when they are enrolled in an introductory course alongside students with previous programming experience. Thus a recommended best practice is to have separate courses or separate sections for novice and experienced students in introductory programming courses. Having two starting points for our introductory sequence with one aimed at novice programmers and a second aimed at students with some programming experience, we assumed that the curriculum was in alignment with this best practice. A survey of our incoming students indicated that students were not enrolling in the courses in alignment with our expectations. By changing the timing and means of offering an assessment to determine student placement in the introductory sequence, we were able to substantially impact the make-up of our introductory courses. The change did have the desired positive impact on students in the course for novice programmers. In this paper, we will also discuss some of the other issues we uncovered with this change.

*Keywords—retention; first-year programming course; placement strategies; student surveys; retention*

## I. INTRODUCTION

For many years both the Computer Science (CS) and Electrical and Computer Engineering (ECE) Departments at Michigan Technological University have enrolled a low number of women in our programs and have had lower retention rates than other departments on campus. In November 2014, the two departments were selected to participate in the National Center for Women & Information Technology's (NCWIT's) Extension Services for Undergraduate Programs (ES-UP) [1]. ES-UP, supported by NSF and Google, is designed to help departments develop strategies to recruit and retain women in computing and engineering majors. Michigan Tech's team members included individuals from CS, ECE and our Admissions Office.

One of the requirements for the ES-UP program was that we conduct surveys of first year students in the two departments each of the students' first two semesters on campus. An analysis of our first semester survey from Fall 2015 was previously published [2]. One of the surprises that we found when analyzing the first semester survey conducted in Fall 2015 was a substantial mismatch between the percentage of students reporting programming experience and the student enrollments in the first semester programming courses. For the past 20 years, the CS Department has offered two starting points for the introductory programming sequence required of majors. The standard introductory three credit course, CS 1121, is intended for students with little or no programming experience while an alternative course, CS 1131, covers material at an accelerated rate. This latter course is intended for students with some experience, but not sufficient experience or depth to place out of the first semester course. CS 1131 is a five credit course that covers the material from both CS 1121 and the follow-on course, CS 1122.

Multiple research studies [3-6] have shown that when both novice and experienced programmers are in the same course, the novice programmers are negatively impacted. These findings are consistent with the research that shows that students tend to develop their sense of self-efficacy and belonging through comparisons of their performance with their perceived sense of their classmates' performance [7-9]. Given that we had two alternative starting points for students entering the CS curriculum, the CS Department assumed that the curriculum was in alignment with best practices. The survey given in Fall 2015 made it clear that, although the curriculum was designed in alignment with best practice, the students were not enrolling consistent with this best practice. The follow-on second semester survey and analysis of student performance confirmed that the student enrollment choices were negatively impacting student experience and success.

To better serve both the students new to programming and those with programming experience, we set a goal for Fall 2016 to increase the percentage of students who took the assessment with the anticipated result being more students with experience would enroll in CS1131. In this paper, we will compare student performance and student perceptions across the two years to assess the impact of shifting students to the accelerated course. We will also discuss some additional issues that surfaced during Fall 2016. We speculate these issues were likely always present, but had been buried in previous years because of the challenges that surround a class consisting of students with dramatically differing levels of previous experience with the material.

## II. BACKGROUND

### A. Our Context

Michigan Technological University enrolls approximately 5,700 undergraduate students and 1,500 graduate students primarily in STEM-related degree programs. Nearly two-thirds of the undergraduate students are enrolled in programs in the College of Engineering. In terms of undergraduate enrollments ECE is the second largest department in the College of Engineering and CS is the largest department in the College of Sciences and Arts. ECE enrolls undergraduates majoring in electrical engineering (EEE) and computer engineering (ECP) and CS has undergraduates in computer science (SCS) and software engineering (SSE). First-year students at Michigan Tech are admitted directly into their intended major.

As a technological university, it is not very surprising that the campus as a whole has a low percentage of women. Indeed, the University recently celebrated a new high when the undergraduate class in Fall 2017 was 27% female. Both CS and ECE have struggled to attract a diverse student population for many years. The current percentages of women enrolled in the four majors is shown in Table 1. These numbers actually represent a recent increase in the percentage of women enrolling in these programs. In the last decade CS, for example, was averaging only 5% women in their graduating classes.

Both departments are putting considerable energy and resources into attracting more women into their programs. Simultaneously, it is important to look at retention in the programs since there is little point in attracting a more diverse population if the students are not likely to be retained. Much of what is discussed in this paper is not directly aimed at retaining female students specifically, but at the student population in total. Ideally retention efforts will broadly impact the student population. We do examine the changes by gender in order to be certain that we are not negatively impacting this smaller population. Because the numbers of women are still quite small when broken down by major, it is not possible to report much of the analysis by gender in order to protect individual privacy.

### B. Change

A relatively simple change was made for Fall 2016 students. In recent years students could choose to take an optional assessment during orientation the week before fall classes began to determine if they had sufficient programming

Table I: Percentage of Women Enrolled in CS and ECE Majors

| Major | Fall 2016 Enrollments | | |
|-------|------------------|------------------|----------------|
| | *Number of Females* | *Number of Males* | *Percent Female* |
| SCS | 42 | 296 | 12% |
| SSEN | 9 | 93 | 9% |
| ECP | 18 | 234 | 7% |
| EEE | 41 | 299 | 12% |

background to take the accelerated course. Our expectation was that students with programming experience would want to take the assessment in order to place into CS1131. We learned in Fall 2015 that many students with programming experience were choosing not to take the assessment. This was likely occurring for a number of reasons. Some likely reasons include students may have simply been overwhelmed with the number of activities going on during orientation; they may have believed that they had forgotten a lot of the material over the summer, or they may have heard from others that one could get an "easy A" by skipping the test and taking CS1121.

Having a large percentage of students with programming experience in the course for novices creates multiple issues for both the students and the instructor of the course. For the instructor, it is difficult to appropriately pace a course when many students have had much of the material previously and thus appear to catch on quickly. Student complaints tend to be bimodal with some complaining that the course is going too fast while others complain the pace is too slow. Students with little or no programming experience are likely to gauge their performance on how others in the class appear to be doing and this often results in low self-efficacy. Students with programming experience are likely establishing poor study habits in their major since they are not needing to learn significant new material and hence are not studying very hard or starting programming assignments early.

To increase the percentage of students taking the assessment, we decided to offer it over the summer, before students arrive on campus and are exposed to peer pressure. In addition, we chose to piggyback on testing the students were already required to take for enrollment. Prior to registering for a math class for the fall semester, first year students must take a placement exam to determine the appropriate math course placement. We anticipated that by offering the CS assessment during the same time period, students would assume they had to take the CS exam as well before registering.

It is more difficult to mandate a placement exam for CS since, unlike mathematics, some students may have no previous experience with the subject. Requiring these students to take a test on material they have had no exposure to could potentially discourage them and give them the impression that they are deficient. After some careful deliberation, we ending up stating that the assessment was required, but dividing it into two parts. The first part asked about their experience, if any, with programming. The second part was the actual assessment. Students with no previous experience were told they could opt out of the second part. A total of 281 students who were expected to enroll in SCS, SSEN, or ECP were emailed information describing the assessment procedure. We had 228 students respond to the assessment during the summer with 58 opting out of the programming assessment portion. Thus, over 80% of the students took part in the assessment process with over 60% attempting the programming portion. Another 39 students took the assessment near the beginning of the school year, with 8 of those opting out of the programming portion. Thus, approximately 1/4 of the students taking the assessment opted out of the programming assessment portion. This closely matched our expectations as 75% of CS majors had indicated in 2015 that they had previous programming experience.

Of the students who took the programming portion of the assessment, a bit over half had sufficient background to place into CS1131 and slightly less than half received a recommendation to take CS1121. As can be seen in Table II, this did result in a higher percentage of the students in these majors enrolling in CS1131. One might question why a shift in numbers is only apparent for CS1131. This is due to the larger incoming class in Fall 2016. Digging into the numbers by department, there was a 10 percentage point drop for CS students enrolling in CS1121. Our previous study indicated that CS students are the most likely to have had programming experience, hence this was the desired outcome.

### III. ANALYSIS OF IMPACT

Our analysis of the impact of this change is based both on the students' reported experience - primarily through the surveys conducted as part of our participation in the NCWIT ES-UP program - and an analysis of the performance outcomes for the courses.

#### A. Surveys

Surveys were given for Fall and Spring semesters during the academic year 2015-16 and again during 2016-17. The surveys were originally designed based on the NCWIT ES-UP recommendations. The fall survey was emailed to all first semester students enrolled in majors in the CS and ECE departments during the sixth week of the semester. The stated purpose of the survey was to better understand what attracts students to the University and their chosen major. Students were emailed a follow-on survey in their second semester. The purpose of this second survey was to gain insight into their first semester experiences.

Separate versions of the second semester survey were developed for students based on the CS course they were enrolled in during their first semester. Since students enrolled in CS1121 are not expected to have previous programming experience, we wanted to be able to direct specific questions at these students with no previous programming experience to gauge how a lack of experience impacted their perception of the course. Students enrolled in the more advanced CS courses are assumed to have previous programming experience so there was no need for such a section. We did however ask about their perceptions of how their programming background impacted their course performance compared to their classmates. We also created separate versions of each of these surveys for students enrolled in the CS Department versus the ECE Department. One factor in the decision to make these separate versions by department was to increase students' sense that these surveys were directed at them specifically.

Some minor changes were made to the Fall 2015 first semester survey for the Fall 2016 survey including the addition of some questions about previous programming experience. The second semester surveys were identical both years. An example of the first semester survey was previously published in [1]. A second semester survey is included in the Appendix of this paper. We had a consistent response rate of 37% for the second semester survey each of the two years. The response rates for each of the individual surveys can be seen in Table III.

Table II: Enrollment Distribution across Introductory Computing Courses

|  | Fall 2015 | | Fall 2016 | |
|---|---|---|---|---|
|  | CS/ECE students | % enrolled in course | CS/ECE students | % enrolled in course |
| CS 1121 | 162 | 66% | 161 | 58% |
| CS 1131 | 36 | 15% | 68 | 24% |
| CS 1122 | 48 | 20% | 50 | 18% |

Table III: Second Semester Survey Response Rates

| Survey | Spring 2016 Surveys | | |
|---|---|---|---|
|  | Number of Surveys Emailed | Number of Responses | Response Rate |
| CS in CS1121 | 83 | 34 | 41% |
| CS in CS1122 | 12 | 7 | 58% |
| CS in CS1131 | 26 | 11 | 42% |
| CS – not above | 2 | 0 | 0% |
| ECP in CS1121 | 66 | 22 | 33% |
| ECP in CS1122 | 3 | 2 | 67% |
| ECP in CS1131 | 9 | 4 | 44% |
| ECP – not above | 59 | 15 | 25% |
| Total | 260 | 96 | 37% |
| Survey | Spring 2017 Surveys | | |
|  | Number of Surveys Emailed | Number of Responses | Response Rate |
| CS in CS1121 | 76 | 35 | 46% |
| CS in CS1122 | 21 | 13 | 62% |
| CS in CS1131 | 49 | 21 | 43% |
| CS – not above | 5 | 0 | 0% |
| ECP in CS1121 | 65 | 19 | 29% |
| ECP in CS1122 | 7 | 5 | 71% |
| ECP in CS1131 | 11 | 3 | 27% |
| ECP – not above | 67 | 15 | 29% |
|  | 301 | 111 | 37% |

#### 1) Programming experience

The surveys conducted the second year on which we asked about programming experience did indicate a shift in the programming experience level of students enrolled in CS1121. The percentage of survey respondents enrolled in CS1121 who indicated that they had programming experience changed only slightly with 54% of the CS and ECE majors enrolled in CS1121 Fall 2015 indicating they had previous programming experience. That percentage was roughly the same for Fall 2016 at 52%. The bigger change was in the amount of experience that the students reported. As can be seen in Table IV, in 2015 40% of the students responding had more than a

Table IV: Previous Programming Experience Reported by Students Enrolled in CS1121

| | Fall 2015 | | Fall 2016 | |
|---|---|---|---|---|
| Informal only | 9 | 30% | 9 | 32% |
| < 1 year | 6 | 20% | 10 | 36% |
| 1 year | 3 | 10% | 5 | 18% |
| 1 – 2 years | 6 | 20% | 2 | 7% |
| > 2 years | 6 | 20% | 2 | 7% |

Table V: Previous Programming Experience Reported by Students Enrolled in CS1131

| | Fall 2015 | | Fall 2016 | |
|---|---|---|---|---|
| Informal only | 3 | 20% | 5 | 21% |
| < 1 year | 4 | 27% | 5 | 21% |
| 1 year | 0 | 0% | 2 | 8% |
| 1 – 2 years | 3 | 20% | 4 | 17% |
| > 2 years | 5 | 33% | 9 | 37% |

year of formal coursework in programming. In 2016 only 14% of the students had more than a year of coursework. Looking at the actual language experience in 2015, 1/3 of the students responding with programming experience indicated they had a year or more of coursework using Java. In 2016 only two students (7% of the respondents) indicated they had a year of Java experience. The distribution of student experience in CS1131 did not change dramatically, as can be seen in Table V.

*2) Student perceptions*

The survey results showed a change in how students with no previous programming experience perceived the difficulty of CS1121. As shown in Table VI, 63% of the students enrolled in CS1121 in Fall 2015 described the course as being too difficult or unreasonably difficult. That percentage was reduced to 27% for Fall 2016. In Fall 2016 students without programming experience were still aware that others in the course did have programming experience, as indicated by nearly half (46%) of these students choosing the response "CS1121 was a bit intimidating because others clearly had previous programming experience, but I did fine anyhow."

The responses from students with programming experience shown in Table VII indicated that they were more appropriately placed in Fall 2016 compared to Fall 2015, with 57% indicating that although they had previous programming experience, CS1121 was the right placement. This is an increase of 40 percentage points over Fall 2015. Similarly, whereas 21% indicated in 2015 that they were bored and should have taken CS1131, no students indicated that in 2016.

Interestingly, students in CS1131 were now more aware of others having more programming experience than they had,

with 39% choosing that response as shown in Table VIII compared to only 7% choosing that response in 2015.

*3) Student performance*

To gauge how the change impacted student performance, we examined the successful completion rate of the students in CS1121 and CS1131. We will also be examining their persistence in their major into the second semester once that data is available.

We defined successful completion of the course as passing with a grade higher than a "D". Table 9 shows the successful completion rates for Fall 2015 and Fall 2016. There is a slight improvement in the percentage of students successfully completing CS1121 as well as the overall successful completion rate if we total the completions of CS1121 and CS1122 together. Although the change isn't dramatic, a significant finding is that many more students are apparently capable of completing CS1131 than had been registering for that course in the past.

IV. DISCUSSION

One of the unanticipated consequences of having fewer experienced programmers in CS1121 is that we were able to identify issues that were likely always a factor, but were not easily seen. For instance, we are now much more aware of the amount of work students without previous programming experience need to develop their logical thinking and problem solving skills. This has become more apparent as the students in CS1121 appear to struggle more on average with applying what they have learned to new problems or problems with multiple steps. Teaching students to think computationally as our introductory course continues to encompass more non-programmers will likely be essential to their success alongside the traditional approach we have taken.

Further, this highlights that the pace of material in the course may need to be modified to accommodate the novice students. Observations by the instructor and teaching assistants of the students at the end of the course indicate that many students are still struggling to properly retain concepts from new material as they work to solidify their foundation knowledge. This sometimes result in frustration and low achievement even though students ware working hard on the material. Modification of pacing may be a step toward addressing this concern, as the more novice students may require further time on certain aspects of the material to more fully grasp it in a way that matches course objective expectations.

As CS1121 focuses more on students with little or no previous programming background, we also may need to reshape past practices regarding attitudes toward programming. In the past, the vast majority of students who took CS1121 planned to be in a computing major, but our placement initiative has unearthed a sizable body of students who are uncertain of major choice or come from very divergent majors. Some students despite a divergent major are required to take CS1121, while others have taken it for personal reasons. Other students may even be in CS1121 but uncertain if they would like to continue in a computing major, or are trying out the course to consider switching majors.

Table VI: Perceptions of the Level of Difficulty of CS1121 by Students with No Previous Programming Experience

|  | Fall 2015 | | Fall 2016 | |
|---|---|---|---|---|
|  | # of Responses | Percentage | # of Responses | Percentage |
| CS1121 was too easy. | 1 | 4% | 1 | 4% |
| CS1121 was taught at an appropriate level for a beginner programmer like me. | 3 | 12.5% | 4 | 15% |
| CS1121 was very challenging, but I enjoyed it. | 2 | 8% | 2 | 8% |
| CS1121 was a bit intimidating because others clearly had previous programming experience, but I did fine anyhow. | 3 | 12.5% | 12 | 46% |
| Because other students have had previous programming experience, CS1121 seems unreasonably difficult for new programmers like me. | 11 | 46% | 5 | 19% |
| CS1121 was too difficult for a beginning programmer like me. | 4 | 17% | 2 | 8% |

Table VII: Perceptions of the Level of Difficulty of CS1121 by Students with Previous Programming Experience

|  | Fall 2015 | | Fall 2016 | |
|---|---|---|---|---|
|  | # of Responses | Percentage | # of Responses | Percentage |
| I was bored and probably should have taken CS1131. | 6 | 21% | 0 | 0% |
| I was a little bored at the beginning but did ultimately learn new material in CS1121. | 13 | 45% | 8 | 29% |
| Although I had some previous programming experience, CS1121 was definitely the right level course for me to be in. | 5 | 17% | 16 | 57% |
| CS1121 was very challenging, but I enjoyed it. | 1 | 3% | 2 | 7% |
| CS1121 was too difficult given my background. | 1 | 3% | 0 | 0% |
| CS1121 was a bit intimidating because others clearly had more programming experience. | 3 | 10% | 2 | 7% |

Table VIII: Student Perception of the Level of Difficulty of CS1131

|  | Fall 2015 | | Fall 2016 | |
|---|---|---|---|---|
|  | # of Responses | Percentage | # of Responses | Percentage |
| CS1131 was too easy given my previous programming experience. | 0 | 0% | 3 | 13% |
| CS1131 was taught at an appropriate level for a student with my level of programming experience. | 6 | 40% | 6 | 26% |
| CS1131 was very challenging, but I enjoyed it. | 8 | 53% | 1 | 4% |
| CS1131 was a bit intimidating because others in class clearly had more programming experience, but I did fine anyhow. | 31 | 7% | 9 | 39% |
| CS1131 was too difficult for a student with my level of programming experience. | 0 | 0% | 2 | 9% |
| The level of material covered in CS1131 was appropriate for me, but the pace of the course was too intense for me. | 0 | 0% | 2 | 9% |

Table IX: Student Successful Completion Rate for Intro CS courses (Completion of course with grade higher than D.)

| Year | CS 1121 | | CS 1131 | | Total | |
|---|---|---|---|---|---|---|
|  | Initial Enrollment | % Successful | Initial Enrollment | % Successful | Initial Enrollment | % Successful |
| 2015 | 230 | 80% | 36 | 92% | 266 | 82% |
| 2016 | 188 | 82% | 74 | 91% | 262 | 84% |

Regardless, this now more visible body of students are in a likely fluctuating state regarding their feelings on computer science as a discipline. Ensuring that the CS1121 course feels inviting to non-majors, and pushes forward the "anyone can program" mentality with a positive light, may play a critical role in student persistence in computing as the course continues to enroll these non-CS or undecided students.

These changes may also cause CS1131's environment to shift and require modification as well. If the students have quite varying levels of programming experience, it is likely to exhibit some of the "both ends of the spectrum" behavior CS1121 exhibited previously. As has already been noted, students in CS1131 are more acutely aware with the recent shifts of their peers knowing more material than them. While all students in this course can be guaranteed to have some baseline knowledge of programming, certain students will still be more experienced than others. Ensuring reasonable pacing for an accelerated course as well as attentiveness to observing both ends of the spectrum may be key to identifying core issues and potential solutions before the gap "pains" become more pronounced.

## V. Conclusions and Future Work

There are a multitude of benefits to having students with more similar backgrounds and experience in an introductory programming course. As stated earlier, it can be difficult to determine an appropriate pace for presentation of material when a classroom is filled with students with substantially differing backgrounds. A typical faculty member often tries to read the classroom or give mini-activities to decide if further discussion of a topic is necessary, but when many in the classroom have seen the material previously, reading the classroom in this fashion will likely be detrimental to those with little or no background.

Simultaneously, students with little or no background notice that others understand the material more quickly and become discouraged, which can cause them to develop a belief that they are not "good at programming". This can also lead to the instructor being given impossible to satisfy feedback from the students, with some wanting the course to go faster and others wanting it to go slower. There can be logistical advantages to a department to accelerate some of the students in their major. For example, we are able to more evenly distribute the course enrollments over the fall and spring semesters by having a higher percentage of students enrolling in the accelerated course. These students are then off-sequence from the students starting in the regular introductory course, which can result in faculty and classroom resources able to be more efficiently and consistently allocated throughout the academic year.

Our change in placement policy does appear to allow us to better serve our incoming students with little or no programming experience, as their needs are now more apparent and more representative in the introductory course. Our goal for the future is to monitor the pace of the two courses to ensure that they are meeting the needs of the student populations being served. We also intend to examine long-term retention and performance of these students. On the flip side, we also hope to attract more non-majors to computing with a course more suitable to those with no previous experience, and will continue to monitor the numbers of students who do change majors.

## Appendix

### CS Dept -- Second Semester Survey For Students Enrolled in CS 1121

Dear student:

We would like to invite you to complete a short questionnaire about your experiences in your major last semester. Participation in this survey is voluntary. You can choose not to participate at all or to ignore individual questions. Your answers will not affect your academic standing in any way.

This survey is part of a national project to improve retention in majors related to computing. The results of this study will be used to improve academic programs at Michigan Tech. Your responses to the survey will be combined with information from your academic records, and all of your information will be kept strictly confidential. Any published results will be presented only in aggregate form.

Under no circumstances will your individual responses be made available in identifiable form. The questionnaire should take about 10 minutes to complete and your participation does not involve any risks beyond what you would encounter in daily life.

In appreciation of your time, your name will be entered into a drawing for one of five $20 gift cards from Amazon if you submit a completed survey.

Your email address (abcde@mtu.edu) will be recorded when you submit this form. Not abcde? Sign out

1. Are you planning on continuing with a major in computer science or software engineering?
*Mark only one.*
    Yes
    No                                 *Skip to question 3.*

**Interest in major**
2. Assuming you are still majoring in computer science or software engineering, how interested or disinterested are you now in your current major?
*Mark only one.*
    Extremely disinterested
    Disinterested
    Interested                    *Skip to question 8.*
    Extremely interested      *Skip to question 8.*

**New Major**
3. If you have changed your major or are planning on changing your major from a computing major to a non-computing major, which of the following were factors in your decision to change your major?
*Check all that apply.*
    I don't think I'd enjoy the types of careers that are available for computing graduates.
    I decided to switch to another major that I'd previously been considering.
    I had a negative experience.
    Other:

4. Please tell us a bit more about why you decided to change or are considering changing your major.

5. What major have you or do you plan to change to?

6. Are you potentially interested in a minor in computer science?
*Mark only one oval.*
   Yes
   No

7. Do you intend to stay at Michigan Tech?
*Mark only one oval.*
   Yes
   No

## CS1000
8. Assuming you took CS1000 last semester, to what extent did your experience in CS1000 impact your current feelings about your major?
*Mark only one.*

   Not much, I was already committed to a major in computer science or software engineering before enrolling in CS1000.
   *Skip to question 10.*

   To some extent, it answered questions that I had about my intended major.                          *Skip to question 10.*

   A great deal, it answered many questions that I had about my intended major.                        *Skip to question 10.*

   I am changing to a non-computing major because of what I learned in CS1000.

   I am changing to a non-computing major because of a poor experience in CS1000.

   I did not take or complete CS1000.        *Skip to question 10.*

## CS1000 experience
9. Please tell us about your experience in CS1000 that contributed to your decision to change your major.

## CS1121
10. To what extent did your experience in CS1121 impact your current feelings about your major? 9*Mark only one.*

   Not much; I was already committed to my major before enrolling in CS1121.                            *Skip to question 12.*

   To some extent; it gave me some feel for my intended major.
   *Skip to question 12.*

   A great deal; I discovered I really enjoy programming.
   *Skip to question 12.*

   I am changing to a non-computing major because of what I learned in CS1121.

   I am changing to a non-computing major because of a poor experience in CS1121.

   Other:                                              *Skip to question 12.*

## CS1121 experience
11. Please tell us about your experience in CS1121 that contributed to your decision to change your major.

## Learning Activities
12. For each of the following indicate if you participated in that learning activity and if so, how beneficial the activity was for your learning:
*Mark only one per row.*

|                                                                    | Did not Participate | Very Helpful | Somewhat Helpful | Not helpful |
|--------------------------------------------------------------------|---------------------|--------------|------------------|-------------|
| CS Learning Center                                                 |                     |              |                  |             |
| Pair programming                                                   |                     |              |                  |             |
| Questioned TA during scheduled lab                                 |                     |              |                  |             |
| Questioned other computing students during our lab                 |                     |              |                  |             |
| Worked with other students from my class outside of class or our scheduled lab. |       |              |                  |             |
| Learned from the feedback                                          |                     |              |                  |             |

|                                                      | Did not Participate | Very Helpful | Somewhat Helpful | Not helpful |
|------------------------------------------------------|---------------------|--------------|------------------|-------------|
| from the autograder                                  |                     |              |                  |             |
| Attended weekly help sessions                        |                     |              |                  |             |
| Visited my instructor or TA during office hours      |                     |              |                  |             |
| Lived in Computer Science Learning Community         |                     |              |                  |             |
| Studied the textbook                                 |                     |              |                  |             |

13. Please provide any suggestions you have for improving the outside-of-class learning opportunities available to you.

14. If you did not use the CS Learning Center, please tell us why.
*Check all that apply.*

   I didn't need any help with my computer science courses.
   I got the help I needed for my computer science courses other places.
   The hours weren't convenient for my schedule.
   I wasn't sure what kind of help I could get at the CS Learning Center.
   I didn't know what questions to ask.
   The CS Learning Center was always busy when I tried going there.
   I wasn't comfortable going to the CS Learning Center.

15. How could we change the CS Learning Center to make it more useful and inviting?

16. Did you have any programming experience prior to taking CS1121?
*Mark only one.*

   Yes                                              *Skip to question 18.*
   No

## No previous programming experience
17. Which best describes your experience in CS1121?
Mark only one.

   CS1121 was taught at an appropriate level for a beginner programmer like me.
   CS1121 was a bit intimidating because others clearly had previous programming experience, but I did fine anyhow.
   CS1121 was very challenging, but I enjoyed it.
   CS1121 was too difficult for a beginning programmer like me.
   Because other students have had previous programming experience, CS1121 seems unreasonably difficult for new programmers like me.
   CS1121 was too easy.
   Other:
   *Skip to question 21.*

## Programming experience
18. How much and what kind of programming experience did you have prior to enrolling in CS1121?
*Mark only one per row.*

|                     | One to multiple week module in another course | One semester | Two semesters | More than a year |
|---------------------|-----------------------------------------------|--------------|---------------|------------------|
| Informal learning   |                                               |              |               |                  |
| Java                |                                               |              |               |                  |
| C++                 |                                               |              |               |                  |
| Basic (any variation) |                                             |              |               |                  |
| Python              |                                               |              |               |                  |
| Scratch             |                                               |              |               |                  |
| Javascript          |                                               |              |               |                  |
| Other               |                                               |              |               |                  |

19. How did your previous programming experience affect your experience in CS1121?
*Mark only one.*

- I was bored and probably should have taken CS1131.
- I was a little bored at the beginning but did ultimately learn new material in CS1121.
- Although I had some previous programming experience, CS1121 was definitely the right level course for me to be in.
- CS1121 was very challenging, but I enjoyed it.
- CS1121 was too difficult given my background.
- CS1121 was a bit intimidating because others clearly had more programming experience, but I did ok.
- Other:

20. Did you take the CS 1131 placement test?
*Mark only one.*

- Yes, but I didn't pass it.
- Yes and I passed it, but decided not to take CS1131 because I was concerned it would be too challenging.
- Yes and I passed it, but decided not to take CS1131 because I wanted to make sure I got a good grade in my major.
- Yes and I passed it, but I wanted to make sure that I had a solid foundation in my major.
- Yes, but I didn't really try to pass it.
- No. I didn't want to take CS1131 because I was concerned it would be too challenging.
- No. I didn't want to take CS1131 because I wanted to make sure I got a good grade in my major.
- No. I didn't want to take CS1131 because I wanted to make sure that I had a solid foundation in my major.

**Final questions**

21. Where did you work on your out-of-class programming assignments?
Mark only one per row.

| | Never | Occasionally | Often | Almost Always |
|---|---|---|---|---|
| In a lab in Rekhi | | | | |
| In a lab on campus, but not in Rekhi | | | | |
| In my dorm room (or wherever you are living) | | | | |
| On my laptop in a non-lab environment | | | | |

22. Did you have any difficulties working on your programming assignments when working in your "favorite" programming environment?

23. Please tell us anything else that would help us better understand how to improve the learning environment for our first year computing students.

24. Finally, do you know of any first year students in your major who did not return this semester?
*Mark only one.*

- Yes
- No

25. If so, do you know of any reason that they choose not to return?

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