Peer Mentors and Their Impact for Beginning Programmers

Ken Hartness
hartness@shsu.edu

Li-Jen Shannon
Lys001@shsu.edu

Sam Houston State University
Huntsville TX

Abstract

The Computer Science department at SHSU is currently employing student mentors to assist with recruitment and retention. The primary purpose of these students is to help frustrated new majors in the beginning programming course realize that they are not alone in their struggles and to assist the students over hurdles in their learning and skill development. We examine the impact of peer mentors on students, including a breakdown of that impact across underrepresented groups.

Keywords: mentoring, retention, tutoring, social networks

1. INTRODUCTION

The Bureau of Labor Statistics in the U.S. Department of Labor predicts 34% growth in software engineering and 17% growth in IT management positions between 2008 and 2018 (Bureau of Labor Statistics, 2010a, 2010b). Enrollment in computer science, computer engineering, and information systems is increasing, although evidence suggests that work still needs to be done on recruiting and retaining capable students who will complete these degrees (Zweben, 2009). However, the reported number of majors does not begin to match the predicted growth of the field, even without considering the retirement and promotion of current IT workers.

Efforts need to be made across the education spectrum to attract and retain individuals to help fill this need. At the college level, we can take steps to ensure that capable majors do not become unnecessarily frustrated and discouraged without lowering our expectations; some of these same steps can create an environment that will attract students who did not, at first, consider a computer science or information systems major.

In 2009, the Texas Workforce Commission awarded SHSU the Texas Youth in Technology grant as part of an effort to recruit and retain students in technology-related majors. In addition to scholarships and travel money to bring us to high schools and bring high school teachers and counselors to us for workshops, the grant included a payroll budget for up to ten students who would act as peer mentors and support our recruitment efforts.

Students who are programming for the first time may view coding errors as a personal failure on their part, getting frustrated as hours pass without success. Some students, upon seeing a correction increase the number of reported syntax errors, will immediately re-introduce the
original error to make the numbers go back
down (D’Souza et al., 2008). They need to be
reassured that errors are normal and that they
have someone to which they can turn if they are
unable to make progress. Students are more
likely to seek assistance from a fellow student
closer to their own age than they are a graduate
student or, especially, a professor (Miller & Kay,
2002). The authors disliked “bothering”
professors with questions, often thinking that
they expected us to be able to design a solution
without their assistance. However, we welcomed
and occasionally sought advice from our fellow
students. Asmar et al. (2000) stated that
Freshmen view their peers as their most
important support system; also, new majors will
often change to a different major if no peer
interaction is easily available (Barker, McDowell
& Kalahar, 2009).

The department is very excited about the
mentoring program, and the students appear to
view it as a very positive addition to our
program. A number of majors, including the
mentors, themselves, have expressed regret
that peer mentors were not available when they
were starting the major.

We have conducted surveys of students before
and after they have participated in the
mentoring program and present our findings
regarding the perceived impact of the mentoring
program across gender and ethnicity. In
addition, we share some lessons learned and
ideas for the future.

2. CURRENT DUTIES OF MENTORS

The CS major at SHSU begins with a course in
beginning programming using the Java
programming language and includes a lab for
hands-on work. A second course introduces
basic data structures and deepens their
understanding of algorithms and Java. Ten
undergraduate students, many of whom are
within a year of taking these courses, work with
the students currently enrolled in these courses
to help them understand course material, assist
them over a mental block that is preventing
them from completing assignments, and simply
assure them that problem solving is sometimes
difficult for everyone.

The ten more experienced undergraduate
students are employed primarily as mentors.
One to three mentors are assigned to a lab so
that students get to know them and can ask for
assistance without having to wait for the
instructor or lab assistant to become available.

Mentors are encouraged to be pro-active,
ensuring that students have their e-mail or
phone number, offering struggling students
extra tutoring outside of class, and organizing
study groups to help clarify issues and review for
exams. In order to meet the needs of students
who don’t want to wait for the next lab or even
e-mail reply, mentors are required to maintain
known office hours so that students can seek
assistance outside of class. Originally, students
were required to come to an actual office to
meet with mentors face-to-face, but the
department has recently organized an
independent computer room that can be used as
a work area for the students; the mentor can
then maintain a visible presence in an area
where the students may choose to work, in any
case.

In addition to their duty to support the
beginning students, the mentors also assist us
with recruitment efforts. Depending on their
skills, they may assist us with the development
or updating of recruitment videos, presentations,
and tutorials. The presentations inform high
school students, teachers, and counselors of the
ways in which our major can help people achieve
technology-related goals and inform them of
related job opportunities. The tutorials are
offered as part of a teacher workshop and
provide teachers with tools that can encourage
students to learn computational thinking and
develop an interest in how technology can be
used to accomplish goals. Mentors are also sent
to high schools to make presentations for
classes and at career fairs to let students know
about the major and its opportunities.

By participating in these presentations and
workshops, we hope that the mentors,
themselves, will develop a better understanding
of the major and the job opportunities to which
it may lead. Ideally, mentors should be able to
offer guidance and advice from their slightly
greater experience that can impact students’
college experience and awareness of career
choices while helping them build a solid
foundation for the major.

3. IMPACT OF MENTORS

Instructors of the beginning programming
course often express their appreciation of the
mentoring program. In order to evaluate the
impact of the mentors on the students,
themselves, we surveyed the students at the
beginning and at the end of the semester. Then,
we broke down the results into different groups
to see if the mentors had a greater impact on
Methodology
In spring 2010, the enrollment was 115 from Introduction to Programming (87) and Introduction to Data Structures (28). The collected post-program survey sample was 56 which made a 48.7% of participation rate. The survey was constructed with a total of 14 questions divided into two parts (see Appendix A). The first part is constructed from seven demographic information questions with multiple-choice selection. The demographic questions included the age, ethnicity, gender, classification, transfer students, state financial aid support, and the methods of seeking help from a mentor. The second part included six Liker-scale questions and one open question regarding the students’ expectation of the mentoring program (based on 5 scale system: 1 as being the least and 5 as being the most value). The Liker-scale questions allowed us to discover students’ perception of the degree to which the mentor assisted their success in the course, impacted their college life, helped them select their future career path, participated in building a solid foundation in the major, and made them feel more a member of the department “family.” The demographic questions allowed us to compare groups based on gender, ethnicity, and the degree to which they made use of a mentor either in the lab or outside class.

Analysis
The research hypotheses to be tested were as follows:

H1: The mentoring program has a profound impact on those who take full advantage of it.

H2: Students of underrepresented groups will find the mentoring program to be of higher value than others.

To test these hypotheses, the Statistical Package for the Social Sciences (SPSS) version 17.0 was utilized to determine if significant differences existed among the students’ demographic information and their responses for each research question. Data was analyzed with independent t-test, cross tabulations, and analysis of variance (ANOVA).

Findings
Overall, students agreed that the mentoring program was valuable. Our impression that underrepresented groups might not be as confident and, thus, perceive a greater value in the program was not reflected by the results, largely because all groups valued the program, highly, at least with regard to its support of the course, itself.

Seventeen female (30.4%) and thirty-nine male (69.6%) samples were collected from this study. We found that there was not a statistically significant difference between genders in all of the post program survey items (see Table 1 in appendix 2). However, the females’ mean scores were lower than the males’ mean scores, except, specifically, for the question about the mentors’ assistance in the course; female participants valued the mentors’ assistance in the course more highly than male participants (see Table 2 in appendix 2).

Regarding the utilization of mentors by students, this study found that all of the female students used the mentoring program. 53% only used mentors during the lab time, and 47% took advantage of mentor support outside of lab, as well. For male students, 2 male students reported that they did not use mentors at all and 1 male student only approached mentors outside of lab. 41% of males stated that they only used mentors during the lab time; 51% used mentors both in and out of lab time (see Table 3). Since there were only one or two students who responded to the items of “Did not use mentors” and “only use mentors outside of lab”, we will ignore these two items for the rest of the analysis.

We found that there are no statistically significant differences among ethnic groups in all of the post program survey items (see Table 4). However, certain trends were observed in the mean scores; due to the small sample size, particularly among underrepresented groups, further data should be collected to confirm these trends. This study found that the mean score from the Hispanic group is higher than the rest of the ethnic groups’ mean scores on almost every item (see Table 5). Moreover, we found that the African American group joined the Hispanic group as the top two groups who value the mentor program and stated that the mentors did indeed assist with their success in the course.

To verify the validity of the feedback, we also added the one-sample t-test to compare with a value of 2.75 (above average from 5 point scale) to determine to what degree the students evaluate each survey item. We found that each survey item showed statistically significant
difference (see Table 6), except the items that asked if mentors were of assistance to the students in their college life, in general, and their future career path. We were not surprised to see those two items show a minor lower score than the rest of the survey items, because the beginning programming course is used to introduce programming to other majors who often question why they must take it. One of the students provided the following statement: “I am an MIS minor so the mentor didn’t really need to help with my success in college life or my future career path, but he was very helpful with my [course] work.”

Based on the feedback and the statistical analysis, we confirmed Hypothesis 1, the mentoring program has a profound impact on those who take full advantage of it. The breakdown by student participation with mentors proved unnecessary as even those who did not utilize the mentors recognized their value. Hypothesis 2, students of underrepresented groups will find the mentoring program to be of higher value than others, was not significantly confirmed because all groups found the mentoring program helpful and the number of members in underrepresented groups was too small for firm conclusions in this case. However, the numbers do suggest that underrepresented groups do value the program slightly more in helping them get through the first major courses.

**Students’ Thoughts about the Mentoring Program**

At the end of the survey, we asked the participants to provide some feedback about the mentoring program they experienced. There were 20 responses provided, all of which constituted positive feedback. To reach the goals of our mentoring program, we are glad to hear that there were significant and positive impacts in the mentees’ learning and future plans. The following are some common statements we found:

*For Mentors:*

“They were all very great and helpful.”

*For Mentoring Program:*

“I think the mentor program is excellent.”

*Impacts in their Learning:*

“I felt that the mentors in my lab greatly helped me in developing in Java programming.”

“I would like to help people when they need it.”

“They helped me understand the basic concepts behind the subjects in the class and helped me be successful in the lab and class.”

Contrary to expectations that students who refused to take advantage of the program might not appreciate it, one of the students who did not use the mentor stated that “I never really used the CS mentors. They rocked though!”

**4. FUTURE POSSIBILITIES**

We were awarded a grant that allows us to pay our mentors. We have been forced to handle a small number of situations where students were just looking for any job and were not mature enough to handle flexible hours and remain sufficiently pro-active about helping students. Many of our mentors, however, have truly risen to the challenge and exceeded our expectations. It may be that a system of rewards for volunteer mentors might address that issue. If students are only paid in experience and opportunities, then only motivated students would apply. At some point, we may want to try motivating participation with something other than money.

Our students, some of whom have little support from parents, tend to feel pressure to take a job while in college, so we were concerned that volunteer mentors would not spend enough time working with students between the requirements of their job and their own classes. However, some of our better mentors actually push themselves to maintain a second part-time job while continuing to maintain high involvement with their students, so this reasoning may be flawed. Consistently well-motivated students would have an even stronger impact on new majors.

Mentors report learning valuable leadership and communication skills while also improving their own understanding of the field as they try to determine how to explain aspects of it to their students (Miller & Kay, 2002). If these advantages are, by themselves, insufficient to motivate participation in the mentoring program, other rewards that would appeal to better
students might be used, such as the opportunity to take classes for honors credit or the opportunity to work on professors’ research with the option to gain credit in an independent study course.

Studies have shown that students gain a greater understanding of the possibilities of their area of study and its appropriateness for them through greater professor-student interactions (Crenshaw et al., 2008) and are more likely to stay in a major with healthy peer networks (Barker et al., 2009). Rather than consider these concerns in an isolated fashion, departments should make an effort to integrate professor and peer mentoring throughout their program. The computer science department at Appalachian State University seeks to make mentoring a priority by establishing it as the natural behavior for interactions between professors and students (Tashakkori, Wilkes & Pekarek, 2005). Professors write prescriptions for students in need of help and occasionally participate in peer mentor sessions to offer guidance to the mentors at least as much as the mentees, helping both to learn from the experience. In addition, more advanced students are selected to work directly with professor and graduate student mentors on more advanced material related to research.

Many mentoring programs referenced here rely on volunteer participation. Rather than paid tutors, the goal is to create “communities of scholars” (D’Souza et al., 2008). Although paying for basic assistance during labs might still make sense, utilizing every student with a willingness to serve could conceivably meet students’ needs more effectively. Advanced mentors could help new mentors as well as students in sophomore or junior level courses. Mentors enrolled in sophomore and junior level courses would help new majors in the freshman level courses. The instructors would meet with mentors helping their students, and the advanced mentors would work directly with professors who would share their research and teaching experience. Mentoring would become an accepted part of the learning experience instead of a part-time job.

4. CONCLUSIONS

Healthy IT salaries in the United States make it easy for countries with growing technological expertise to compete. Failure to inspire students to prepare for technology-related careers will logically require that industry look elsewhere for their technological needs. When technology-related jobs and technological innovation are primarily overseas, how will this affect the U.S. economy and our own ability to keep IT and CS departments active?

No doubt a media campaign and K-12 education reform are necessary components of any long-term plan to improve the strength of U.S. technology, but the truth remains that many students are getting frustrated and considering a change of major before they truly see what is possible in the major. Making the mentoring of students a priority is one step we can take toward meeting the needs of industry and our economy. Recruiting mentors from underrepresented groups will also provide role models to other members of those groups; however, mentoring benefits everyone.

5. REFERENCES


Appendix 1
Mentee Survey: Post-Program Survey

Name: ___________________________________________ Date: ______________

**Demographic information: Please circle the proper status.**

<table>
<thead>
<tr>
<th>Age</th>
<th>Younger than 18</th>
<th>18</th>
<th>19</th>
<th>20</th>
<th>21 and older</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity</td>
<td>African American</td>
<td>Asian American</td>
<td>Hispanic American</td>
<td>Caucasian American</td>
<td>Other</td>
</tr>
<tr>
<td>Gender</td>
<td>Female</td>
<td>Male</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Classification</td>
<td>Freshman</td>
<td>Sophomore</td>
<td>Junior</td>
<td>Senior</td>
<td></td>
</tr>
<tr>
<td>Transfer Student</td>
<td>Yes</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State Financial Aid Support</td>
<td>Yes</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sought help from mentor</td>
<td>Never</td>
<td>In Lab</td>
<td>Outside class</td>
<td>Both</td>
<td></td>
</tr>
</tbody>
</table>

Please answer the following questions based on a 5 scale-system: 1 as being the least and 5 as being the most value.

To what degree have you benefited from your participation in the mentoring program in the Computer Science Department?

1  2  3  4  5

To what degree do you believe the mentor assisted your success in your course?

1  2  3  4  5

To what degree do you believe the mentor assisted your success in your college life?

1  2  3  4  5

To what degree do you believe the mentor assisted your success in selecting your future career path?

1  2  3  4  5

To what degree do you believe the mentor assisted you with building a solid foundation in the major?

1  2  3  4  5

To what degree do you feel the mentoring program helped you feel more a member of this community?

1  2  3  4  5

Please share your thoughts on other ways that the mentoring program has assisted you:
Appendix 2
Analysis

Table 1. Gender Independent Samples Test

<table>
<thead>
<tr>
<th>Survey Item</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefitted from Mentor Program</td>
<td>-1.570</td>
<td>52</td>
<td>.122</td>
</tr>
<tr>
<td>Assisted with success in this course</td>
<td>.624</td>
<td>54</td>
<td>.535</td>
</tr>
<tr>
<td>Assisted with success in college life</td>
<td>-.051</td>
<td>54</td>
<td>.960</td>
</tr>
<tr>
<td>Assisted in selecting future career path</td>
<td>-1.622</td>
<td>54</td>
<td>.111</td>
</tr>
<tr>
<td>Assisted in building a solid foundation in the major</td>
<td>-.519</td>
<td>54</td>
<td>.606</td>
</tr>
<tr>
<td>Helped you feel more a part of this community</td>
<td>-1.687</td>
<td>54</td>
<td>.097</td>
</tr>
</tbody>
</table>

Table 2. Gender Group Statistics

<table>
<thead>
<tr>
<th>Survey Item</th>
<th>Mean Female (N=17)</th>
<th>Std. Deviation Female (N=17)</th>
<th>Mean Male (N=37)</th>
<th>Std. Deviation Male (N=37)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefitted from Mentor Program</td>
<td>3.823</td>
<td>.951</td>
<td>4.243</td>
<td>.895</td>
</tr>
<tr>
<td>Assisted with success in this course</td>
<td>4.471</td>
<td>.717</td>
<td>4.333</td>
<td>.772</td>
</tr>
<tr>
<td>Assisted with success in college life</td>
<td>3.059</td>
<td>1.197</td>
<td>3.077</td>
<td>1.244</td>
</tr>
<tr>
<td>Assisted in selecting future career path</td>
<td>2.647</td>
<td>1.367</td>
<td>3.231</td>
<td>1.180</td>
</tr>
<tr>
<td>Assisted in building a solid foundation in the major</td>
<td>3.882</td>
<td>.857</td>
<td>4.026</td>
<td>.986</td>
</tr>
<tr>
<td>Helped you feel more a part of this community</td>
<td>3.412</td>
<td>1.372</td>
<td>3.974</td>
<td>1.038</td>
</tr>
</tbody>
</table>

Table 3. Gender related seeking help from the mentors

<table>
<thead>
<tr>
<th>Participation</th>
<th>Female (N=17)</th>
<th>Male (N=37)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did not use mentors at all</td>
<td>0 (0%)</td>
<td>2 (5%)</td>
</tr>
<tr>
<td>Only use mentors during lab</td>
<td>9 (53%)</td>
<td>16 (41%)</td>
</tr>
<tr>
<td>Only use mentors outside lab</td>
<td>0 (0%)</td>
<td>1 (3%)</td>
</tr>
<tr>
<td>Use mentors both during and outside of lab</td>
<td>8 (47%)</td>
<td>20 (51%)</td>
</tr>
</tbody>
</table>
### Table 4. Ethnicity ANOVA Test

<table>
<thead>
<tr>
<th>Survey Item</th>
<th>Mean Square</th>
<th>$F$ (df=4)</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefitted from Mentor Program</td>
<td>1.027</td>
<td>1.220</td>
<td>.314</td>
</tr>
<tr>
<td>Assisted with success in this course</td>
<td>.597</td>
<td>1.059</td>
<td>.386</td>
</tr>
<tr>
<td>Assisted with success in college life</td>
<td>.759</td>
<td>.492</td>
<td>.741</td>
</tr>
<tr>
<td>Assisted in selecting future career path</td>
<td>.429</td>
<td>.257</td>
<td>.904</td>
</tr>
<tr>
<td>Assisted in building a solid foundation in the major</td>
<td>.951</td>
<td>1.073</td>
<td>.380</td>
</tr>
<tr>
<td>Helped you feel more a part of this community</td>
<td>1.073</td>
<td>.910</td>
<td>.465</td>
</tr>
</tbody>
</table>

### Table 5. Ethnicity Descriptive

<table>
<thead>
<tr>
<th>Survey Item</th>
<th>Mean of Ethnicity Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Africa American</td>
</tr>
<tr>
<td></td>
<td>N= 8</td>
</tr>
<tr>
<td>Benefitted from Mentor Program</td>
<td>4.250</td>
</tr>
<tr>
<td>Assisted with success in this course</td>
<td>4.500</td>
</tr>
<tr>
<td>Assisted with success in college life</td>
<td>2.625</td>
</tr>
<tr>
<td>Assisted in selecting future career path</td>
<td>2.875</td>
</tr>
<tr>
<td>Assisted in building a solid foundation in the major</td>
<td>3.875</td>
</tr>
<tr>
<td>Helped you feel more a part of this community</td>
<td>3.875</td>
</tr>
</tbody>
</table>

### Table 6. One-Sample Test

<table>
<thead>
<tr>
<th>Survey Item</th>
<th>Mean</th>
<th>$t$</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefitted from Mentor Program</td>
<td>4.111</td>
<td>10.815</td>
<td>53</td>
<td>.001 **</td>
</tr>
<tr>
<td>Assisted with success in this course</td>
<td>4.378</td>
<td>16.165</td>
<td>55</td>
<td>.001 **</td>
</tr>
<tr>
<td>Assisted with success in college life</td>
<td>3.071</td>
<td>1.973</td>
<td>55</td>
<td>.053</td>
</tr>
<tr>
<td>Assisted in selecting future career path</td>
<td>3.054</td>
<td>1.808</td>
<td>55</td>
<td>.076</td>
</tr>
<tr>
<td>Assisted in building a solid foundation in the major</td>
<td>3.982</td>
<td>9.771</td>
<td>55</td>
<td>.001 **</td>
</tr>
<tr>
<td>Helped you feel more a part of this community</td>
<td>3.804</td>
<td>6.759</td>
<td>55</td>
<td>.001 **</td>
</tr>
</tbody>
</table>

Note. *P value < .05; ** P value <.001