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LEADING TO SUCCESS VIA MENTORSHIP

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ABSTRACT

Numerous studies in the past decade have proven that mentoring benefits college students' lives on campus. A survey was conducted at the beginning of the spring semester in 2009 and 2010 to investigate the degree of assistance the students expected from their mentors. The population was selected from the computer science foundation course: CS146 - Introduction to Algorithms & Programming. 120 out of 145 (82.8%) students completed the Computer Science Pre Mentoring Program survey. The results showed that the students agree the mentoring program should be able to assist them in the following areas, ordered from greatest to least: (a) assisting their success in the CS146 course, (b) building a solid foundation in computer science, (c) embracing them as a family member of the Computer Science Department, (d) assisting their success in college life, (e) joining the mentoring program, and (f) selecting their future career path. After reviewing the results of the survey, we suggested that the stakeholders of vulnerable departments ought to maintain a long term mentoring program to lead their students to success.

Keywords: Computer Science Student Retention, Mentorship, Social Network

INTRODUCTION

Mentoring programs have been shown to be a benefit to the learning environment. Mullen [13] stated that mentoring reaches beyond individuals to nurture the potential of groups and communities. Crenshaw, Chambers and Metcalf [5] reported that their CS students felt isolated from fellow students and professors; majors need to feel part of a community, and mentors are part of a vital network of contacts that help achieve that goal. Miller and Kay [12] assert that a collection of classes is not enough for a CS major; the students need a community focused on learning. Some feel that mentoring plays such a vital role in attracting and retaining students that CS departments must be committed to supporting, encouraging, and rewarding both faculty and peer mentors [14].

New, expanded ideas of mentorship were created in undergraduate and graduate programs, for recruitment and retention. One of the many examples, Carver and Henderson [3], studied the use of pair programming for laboratory exercises in the introductory programming course. Keathly and Akl [11] reported an undergraduate mentoring program that used the Ambassador cohort, young women enrolled in the computer science and computer engineering programs that served in a form of outreach to area high schools and junior colleges. Keathly and Akl stated that the programs were intended to recruit and retain women in the fields by providing opportunities to develop student-to-student relationships. Doerschuk [6] stated that both industrial mentors and peer mentors were recruited to advise and guide students how to successfully complete their degree and become a computer science professional. To overcome the geographical limitations for the mentors and mentees, Clabargh, Barron, and Martin [4] conducted a telementoring program.

Henry, and Holz [9] stated that most research on recruitment and retention has focused on underrepresented groups. They emphasized the importance of addressing the problems and needs of the general Computer Science student population. A number of mentoring programs, including ours, assume that mentoring can help all of the students in a CS1 course [12]. Rather than open mentoring to some group perceived to be "at risk," everyone in CS1 is invited to participate. Miller and Kay [12] indicate that this had a positive impact on retention, especially among female students.

To maintain a successful mentoring program, it is important to build a supporting relationship between mentors and mentees. Bowley [2] stated that mentorship is complex, idiosyncratic, a function of the personal biographies, needs, interests, and dispositions of both the mentor and the mentee. Asmar et al. [1] report that freshmen tend to view their peers as their single most important support system. Miller and Kay [12] suggest that peer mentors close in age and/or academic classification are better able to relate to the issues facing the mentees. Although active involvement of faculty can be invaluable, a good mentoring program should

include peer mentors. Many researchers agree that developing a critical and progressive mentorship is critical for converting the scholarly curriculum into one that fosters vital skills [13].

Problem

There are three computer science program tracks offered to the students at Sam Houston State University (SHSU): (a) Computer Science, (b) Information Assurance, and (c) Information Systems. Two of the Computer Science core prerequisite courses are the foundation of programming which includes CS 146, Introduction to Algorithms and Programming, and CS 147 Programming Algorithms and Data Structures. To maintain a stable enrollment status, we resolved to create some strategies to increase the retention rate in the Computer Science department. Thereafter, our Mentoring Program to assist the CS146 students in and out of lab time was proposed to the Texas Workforce Commission for the Texas Youth in Technology Program. This grant was approved and the projects started from Spring 2009 to Summer 2010.

RESEARCH METHODOLOGY

In the past, we had experienced a significant difference in the student enrollment between the fall and spring semester. Therefore, we chose spring 2009 and spring 2010 to conduct a pre-survey to study, assess, and compare the students' expectation from this mentoring program.

Population

The population was selected from the computer science foundation course: CS146 - Introduction to Algorithms & Programming. There were 145 total students enrolled in spring 2009 (59) and in 2010 (86). We received 120 (82.8%) samples of which 43 were in spring 2009, and 77 were in spring 2010. Gall, Gall, and Borg [8] stated that the minimal total sample size was 64 for different hypotheses tests with Alpha at the 0.05 levels and with statistical power at the medium effect size. Our sample size was sufficient for preceding the data analysis.

Instrument

The survey was constructed with a total of 13 questions divided into two parts (see Appendix A). Six multiple-choice of demographic information questions comprised part one. The demographic questions included the age, ethnicity, gender, classification, transfer student status, and state financial aid support. The second part included six Likert-scale questions and one open question regarding the students' expectation of the mentoring program (based on a 5 scale system: 1 being the least and 5 being the largest value). By collecting the second group of questions, we studied the degree of how the students expected that the mentor would assist their success in the CS146 course, and in their college life, selecting their future career path, building a solid foundation in computer science, and embracing them as a family member of the Computer Science Department. Moreover, we analyzed the degree of how the students would like to join the mentoring program in the Computer Science Department and studied the students' thoughts in any other ways a mentor could assist them.

Analysis

The research hypotheses to be tested were as follows:

H1. Among the demographic information, there is no difference regarding the students' expectations for the mentoring program in the Computer Science Department.

H2. Between the two selected semesters, there is no difference regarding the students' expectation for the mentoring program in the Computer Science Department.

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. The collected data was analyzed with descriptive statistics, independent *t* test, and analysis of variance (ANOVA). To avoid research bias, ANOVA with post hoc and Tucky were also used to determine whether the statistically significant differences found were reliable between the independent and dependent variables [7].

Findings

The pre-mentoring program survey showed that the means of the expectation for the mentoring program from the highest to the lowest scores were (see Table 1): (a) assisting their success in CS146 course (b) building a solid foundation in computer science, (c) embracing them as a family member of the Computer Science Department, (d) assisting their success in college life, (e) joining the mentoring program, and (f) selecting their future career path.

Table 1. Descriptive Results for Mentoring Expectation

Items	*N*	Mean	Std. Deviation
Success in CS146	119	3.9	0.938
Build a solid foundation in Computer Science	119	3.7	1.194
Embrace them as a family member	119	3.3	1.219
Assist their success in college life	118	3.1	0.986
Join the mentoring program	120	3.0	1.334
Select their future career path	119	2.9	1.194

We analyzed the normality test to review the stableness at all levels of the variables (Field, 2000). Field [7] stated that the values of skewness and kurtosis should be zero in a normal distribution. Positive values of skewness indicate a pile-up of scores on the left of the distribution and negative values indicate a pile-up on the right. Positive values of kurtosis indicate a pointy distribution whereas negative values indicate a flat distribution.

The results showed that the distribution had a pile-up on the right which indicated that more students expected more from the mentoring program in the following areas: success in CS146, build a solid foundation in Computer Science, embrace them as a family member, and assist their success in college life (see Table 2).

Table 2. Normality Test Results

Items	*N*	Std. Deviation	Skewness	Kurtosis
Success in CS146	119	0.938	-0.688	0.266
Build a solid foundation in Computer Science	119	1.194	-0.615	-0.033
Embrace them as a family member	119	1.219	-0.275	-0.796
Assist their success in college life	118	0.986	-0.168	-0.175
Join the mentoring program	120	1.334	0.019	-1.016
Select their future career path	119	1.194	0.109	-0.878

We also found that five out of six items showed a flat distribution from the amount of responses for each scale. The only pointy distribution occurred was the item "Assist in CS146 Course" which indicated that a significantly high percentage (69.7%) of students responded with a score of 4 (40.3%) and a score of 5 (29.4%) (see Figure 1). Mystified, we knew that something was missing among the concepts we received from the students that they expected the mentoring program will assist their success in CS146 course (*N*=119, *Mean*=3.91), but the willingness to join the mentoring program was not as high as we expected (*N*=120, *Mean*=2.97). After investigating the normality test, we found that the most significantly negative Kurtosis value showed in the item was "the willingness to join the mentoring program" (Kurtosis = -1.016). The flat distribution showed 65.8% of students responded with a score of 3 and above. 33.3%, 15%, and 17.5% of students, respectively, responded to the score of 3, 4, and 5 (See Figure 2). From this investigation, we are not able to report that there was a correlation between the expectation and willingness to join the mentoring program. However, we can firmly report that a high percentage of students did respond with a high score to join our mentoring social network.

Figure1. Histogram of the item "Assisting in CS146 Course"

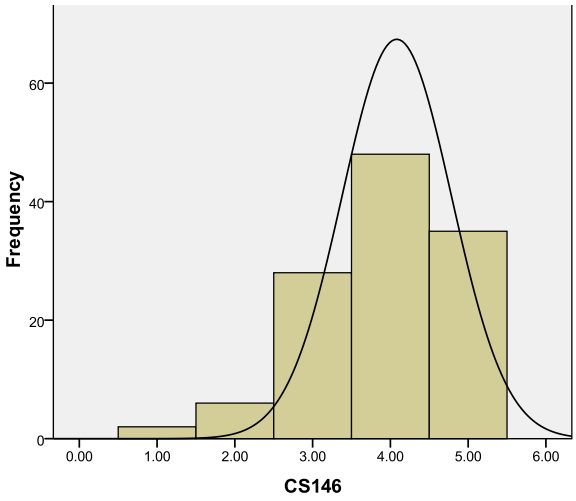
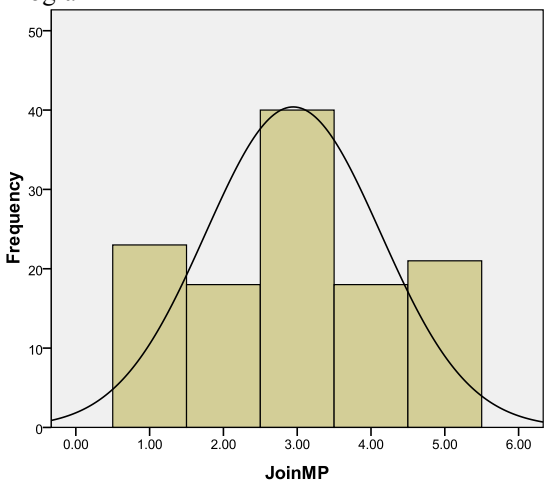


Figure 2. Histogram of the item "Joining Mentoring Program"



We also found that there were various significant differences between the demographic information and the responses of the studied items. We will list the details in the following sections for each demographic category.

Age

The samples showed that 15.9% were at the age of 18 and younger, 25.0% were 19 and 20, and 49.2% were 21 and older when they took this pre-program survey. The results showed that there was not a significant difference for the students' expectation for the mentoring program, except one item, "their success in CS146 course" (N=118, F=3.126, P=0.018) (see Table 3). The statistical analysis showed that the older the students were, the less they expected that the mentor would be able to assist their success in CS146 course. The older students might have more experiences in programming and more mature than the mentors; therefore, the older student groups did not value the mentoring program as high as the younger student groups did.

Table 3. ANOVA Results for Age

Items	*df*	*F*	*P*
Success in CS146	4	3.126	0.018
Build a solid foundation in Computer Science	4	1.787	0.136
Embrace them as a family member	4	1.809	0.132
Assist their success in college life	4	1.460	0.219
Join the mentoring program	4	0.240	0.915
Select their future career path	4	1.248	0.295

Note. *P<0.05, ** P<0.01

Ethnicity

The ethnicity in this study included Africa American (14.7%), Asian (5.2%), Hispanic (11.2%), Caucasian (66.4%), and Other (2.6%). The results showed that there was not a significant difference for each one of the six questions in part two. However, we did find a pattern that showed that the Hispanic student group had the lowest score for most of questions, and the Other student group had a second lowest score. The Asian student group had the highest score for most questions, and the African American group had the second highest score. We suspect that the cultural social network and digital divide might be a few of the reasons to form the pattern we observed. Further research will be worthwhile to study the ways for bridging the gap between ethnicity.

Gender

29.2% of the sample was female and 65.8% was male in this study. Surprisingly, the only item showing a significant difference was "to expect the mentoring program would embrace them as a family member of the Computer Science Department" (P=0.027). The female group significantly scored this item (mean = 2.9) lower than the male group did (mean = 3.5). From a general perception, Computer Science is a male dominated field. Female students (N=35) might not feel comfortable enough to consider that they can be embraced as a family member into the Computer Science Department (see Table 4). Again, we observed a pattern that the male group had a higher score than the females did from five out of the six studied items. Even though the statistical number was not significant, it is worthwhile to mention that the only item the female group expected more than the male group was that they expect the mentor will be able to assist their success in the CS146 course. We assume that the female students in Computer Science appreciate the social network power to uplift their success in the course study.

Table 4. Independent Samples Test for Gender

Items	Mean		Sig. (2-tailed)
	Female N=35	Male N=79	
Success in CS146	4.09	3.82	0.169
Build a solid foundation in Computer Science	3.63	3.77	0.507
Embrace them as a family member	2.94	3.49	0.027 *
Assist their success in	2.94	3.22	0.158

college life			
Join the mentoring program	2.89	3.04	0.574
Select their future career path	2.63	3.03	0.105

Note. **P*<0.05, ** *P*<0.01

Classification

The student classification in this study was freshman (20.8%), sophomore (40%), junior (29.2%), and senior (10.0%). We found that there was not a significant difference in part two for the students' classification. However, the pattern showed the same as the age groups' responses. The higher classification the students were, the less the students would expect from the mentoring program. We believed that the juniors and seniors had more computing experiences than the freshmen and sophomores did. Also, greater experience with college classes would lead to greater confidence in their ability to succeed independently of a mentor. Therefore, the students of higher classification did not value the mentoring program as high as the students of lower classification did.

Transfer Student

40.3% of samples were transferred students in this study. We observed a pattern that non-transferred students expected more than the transferred students from all of the part II questions. The only one was significantly different was that the non-transferred students expected the mentor will be able to assist their success in a CS146 course (see Table 5). Transferred students often take CS 146 later in their academic career than non-transferred students, giving them more confidence in their abilities to handle the college class without extra assistance. In some cases, transfer students have taken introductory programming classes prior to realizing that they may not be able to get transfer credit for the courses, resulting in greater confidence, as well. Therefore, the transferred students would not expect as much as the non-transferred students did.

Table 5. Independent Samples Test for Transfer Student

Items	**Mean**		**Sig. (2-tailed)**
	Transfer Student *N*=47	**Non-Transfer *N*=71**	
Success in CS146	3.62	4.10	0.006 **
Build a solid foundation in Computer Science	3.49	3.86	0.058
Embrace them as a family member	3.00	3.44	0.057
Assist their success in college life	2.98	3.24	0.165
Join the mentoring program	2.94	3.01	0.757
Select their future career path	2.79	2.94	0.490

Note. **P*<0.05, ** *P*<0.01

S*tate Financial Aid Support*

44.5% of samples were under state financial aid support to pursue their bachelor's degree. We found that there was not a significant difference in part II for this demographic comparison. However, a pattern emerged that the students receiving state financial aid support expected more from the mentoring program than the non-financial aid support students. We expected to see that the financial pressure could be the main driver for the students to value any resource available for them to improve their academic performance.

Semester Comparison

The results showed that there was a significant difference regarding the degree of expecting the mentoring program to embrace them as a family member of the Computer Science Department. Comparing the student groups from the Spring 2009 (*N*=43) and Spring 2010 (*N*=77) (see Table 6). The group from Spring 2010 showed a higher score than the group from 2009 (see Table 6). Other than this item, there was not a significant difference for part two questions.

Table 6. Independent Samples Test for Spring 2009 and 2010

Items	**Mean**		**Sig. (2-tailed)**
	Spring 2009 *N*=43	**Spring 2010 *N*=77**	
Success in CS146	3.81	3.96	0.402
Build a solid foundation in Computer Science	3.55	3.81	0.196
Embrace them as a family member	2.88	3.48	0.010**
Assist their success in college life	3.17	3.12	0.800
Join the mentoring program	3.21	2.83	0.137
Select their future career path	2.74	2.96	0.333

Note. **P*<0.05, ** *P*<0.01

Overall, we could find the pattern showed that the 2010 group had a higher score than the 2009 group. However, the item of "To what degree would you like to join the mentoring program in the Computer Science Department?" did not follow this pattern. We further studied the demographic information in both groups and found that there were more transferred students in 2010 group (63.6%) than the group in 2009 (55.8%). This situation might support the assumption of analysis results in the Transfer Student section that the transferred students might have completed some programming courses. Moreover, we believe that the transferred students might not be ready to join the mentoring program because of their uncertainty toward the social network within the department.

RESULTS

H1. Among the demographic information, there is no difference regarding the students' expectations for the mentoring program in the Computer Science Department.

Hypothesis one was accepted among the demographic categories of ethnicity, classification, and financial aide support. We found that there was not a significant difference regarding the categories mentioned above to the students' expectation for the mentoring program in the Computer Science Department. However, among the demographic categories of age, gender, and transfer status, hypothesis one was rejected because there was a difference regarding the degree of how the students expect the mentor would be able to assist their success in the CS146 course, and embrace them as a family member of the Computer Science Department.

H2. Between the two selected semesters, there is no difference regarding the students' expectation for the mentoring program in the Computer Science Department.

Hypothesis two was rejected regarding the students' expectation to be embraced as a family member of the Computer Science Department between the two selected semesters. For the rest of studied items, hypothesis two was accepted in that there is no difference regarding the students' expectation of joining the mentoring program, and how the students expect the mentor would be able to assist their success in CS146 course, their college life, selecting their future career path, and building a solid foundation in computer science.

The common comments the students shared about how the mentors would assist them in the mentoring program are as follows:

"Helping to get a good grade"
"Assisting for programming codes"
"Helping to understand the concepts of Computer Science"
"Providing information about CS fields, careers, & internships"
"Managing my time and priority list"
"To aid my thought process transition into that of a programmer"
"Helping me as I need assistance in computer sc/ other studies"

This study guided us to prepare for a best practice for offering the mentoring program in our department.

CONCLUSIONS

We are hoping that the Mentoring Program will become a main support system to guide Computer Science and Non-Computer Science students completing their basic programming course. Bridging to retention is the main goal of this Mentoring Program. We would like to see the retention rate increasing through this program, in order to obtain graduates who can become the future workforce employees as computer scientists, software engineers, etc. Mullen stated, "Without a cultural approach to mentoring that is supported by colleges and departments and reinforced by leaders who are compensated for time and expertise, mentoring is left to chance" [12].

It was evidenced that a proper training for the mentors will be critical for a successful Mentoring Program. It would be of benefit for the students and mentors for such a training program to include the disciplines of social skills as well as programming skills. Horwitz and Rodger ([10] suggest that mentors should also be trained in proper management skills. Their program utilizes peer-led team learning where participation of each team member must be encouraged, but even a one-on-one tutoring model requires that the mentor know when to send the mentee to think over something on their own while simultaneously making time to work with other mentees. Miller and Kay [12] indicate that mentors can easily become focused on the struggling student to the exclusion of students with less dramatic but very real needs. The mentors also need to become familiar with the different computer science program tracks and possible career paths suited for those tracks so that they can help advise students and

promote an excitement in career possibilities. The training program could prepare the mentors to be more confident around the students and to be competent in the assigned subject content.

Building a social network between the mentors and students can be a valuable tool to keep the mentors working collaboratively. The mentors should be able to share their experiences and understand the students' needs. They could also support each other if some unexpected situations occurred. Bowley [2] stated that the very best mentors understand that the mentees are developmentally different and consequently required different forms of communication.

As Bowley stated, the high-performance mentors persist in their efforts to help others and recognize that building a mutually satisfying relationship does take two and that the mentees and the mentors should work together.

The further research might benefit from an investigation on how a "One-on-One" tutoring session from a help desk would become a valuable tool to assist the students who are not available after the lab sessions. The students could walk in and ask for help outside of their class and lab times when they need some assistance from the mentors. Fundamentally, a solid social network is built by the relationship between individuals. We would like to reinforce the mentoring program from the basis of a one-on-one foundation and evaluate the outcome after the student complete CS146 courses.

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APPENDIX A

Mentee Survey: Pre-Program Survey

Name: _____ Date: _____

Demographic information: Please circle the proper status.

Age	Younger than 18	18	19	20	21 and older
Ethnicity	Africa American	Asian	Hispanic	Caucasian	Other
Gender	Female	Male			
Classification	Freshman	Sophomore	Junior	Senior	
Transfer Student	Yes	No			
State Financial Aid Support	Yes	No			

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 would you like to join the mentoring program in the Computer Science Department?

1 2 3 4 5

To what degree do you expect the mentor will be able to assist your success in ***CS146 course***?

1 2 3 4 5

To what degree do you expect the mentor will be able to assist your success in ***your college life***?

1 2 3 4 5

To what degree do you expect the mentor will be able to assist your success ***in selecting your future career path***?

1 2 3 4 5

To what degree do you expect the mentor will be able to assist you with ***building a solid foundation in computer science***?

1 2 3 4 5

To what degree do you expect the mentoring program to ***embrace you as a family member of the Computer Science Department***?

1 2 3 4 5

Please share your thoughts of any other ways a mentor could assist you.

_____

_____

_____

_____