Peer and Cooperative Learning at the Freshman Level
Digital Forensics Course Enhancement Through a Mentor-Mentee Program

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Abstract
The impact of peer- and cooperative learning is two-fold: Not only do the mentees benefit, but the mentor also has a lot to gain. This forms the basis for our research. We seek to imbue active-learning and community-engagement pedagogical techniques into the introductory digital forensics course series, DF1 and DF2, at our institution (Sam Houston State University). These courses are required by the Digital Forensics major and seek to transform the freshman student into a digital forensic analyst by their junior year. Many students find this course series challenging. This leads to several issues: failure in subsequent courses, change of major, and a general degradation of student morale. An oft-repeated request from students is the availability of tutors/mentors for guidance. Lack of funding has been a primary impediment to alleviating this concern. Our research entails enlisting the DF2 students as mentors and pairing them up with specific mentees in the DF1 course, effectively creating a peer-learning community. The mechanics of our peer-learning implementation lends itself to making the classroom more responsive to diversity. It is well-known that instructors tend to orient themselves, in terms of both effort and positive affect, towards students whom they consider 'teachable' and steer away from students who they perceive to be difficult-to-teach. By pairing mentors and mentees with diverse backgrounds, and ethnicities, we are attempting to mitigate this issue and promote a robust and vibrant, diverse learning community.

Keywords: Digital Forensics, Mentorship Program, STEM Course Enhancement

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Introduction

Global economic changes have increased the demand for science, technology, engineering, and mathematics (STEM) professionals in the United States (Washington et al., 2006). However, in the US, less than half of the students who enter STEM undergraduate curricula as freshmen will actually graduate with a STEM degree (Wilson et al., 2012). To address this concern, it is imperative to take steps that will propel students towards success. Mentorship is an excellent tool for fostering college students' success (Crisp & Cruz, 2009).

Benefits of mentorship include improved academic performance, social integration, and retention rates (Campbell & Campbell, 1997), (Allen et al., 1999), (Mangold et al., 2002). Additionally, peer mentoring can play a big role in students' social identities, helping them develop a sense of belonging (Inzlicht & Good, 2006) by connecting with students in similar groups. It also helps in developing friendships with their peers which increases performance of underrepresented students who face uncertainty about belonging in a group (Walton & Cohen, 2007). As such, near-peer mentorship provides a critical support for students.

In this study, we incorporate a student mentorship program within the revamped Introductory Digital Forensics and Information Assurance course series. The study was effectively executed and completed by introducing a mentorship initiative which involved the pairing of experienced upper-level digital forensics students from DFSC 2316.01 (DF 2): Introduction to Digital Forensics and Information Assurance – II (an ACE certified course) with students from DFSC 1316.01 (DF 1): Introduction to Digital Forensics and Information Assurance – I. By integrating student mentorship as a cornerstone of the revamped course series, we aim to create an inclusive and empowering learning environment where students can thrive academically and personally.

This approach will contribute to the overall success and development of our students, further solidifying the position of the Introductory Digital Forensics and Information Assurance courses as pivotal components of the Digital Forensics major. These sequential courses, known as DF-1 and DF-2, form the core and foundational classes of the Digital Forensics major thus, they play a vital role in fostering student retention and success within our department.

To effectively execute the program, two DF2 students were appointed as the ACE (Academic community engagement) facilitators. These students were carefully chosen based on their knowledge, dedication, and grades in the DF1 class. As part of their duties, they were responsible for maintaining the Discord server created for the Mentor Mentee program communication, led the mentor mentee introductions and pairings, and acted as a direct point of contact and contribute their concerns and feedback on behalf of the students. All the communication regarding the mentor mentee program was facilitated by a Discord server created for the program with dedicated channels for each lab assignment, general communication, and resources.

As part of the mentorship program, the students of the DF1 and DF2 classes were given an opportunity to meet each other through a Discord call organized by the ACE facilitators. Through that, mentors and mentees were paired up with whom they could engage in regular one-on-one meetings and collaborate study sessions. To foster this supportive learning environment outside the classroom, mentors and mentees were assigned specific labs and projects to complete together. These hands-on activities would serve as opportunities for

mentees to gain practical experience under the guidance and supervision of their mentors. We aimed that this collaborative work would not only enhance the technical skills but also foster teamwork and strengthen the mentor-mentee relationship.

Throughout the semester, two labs/projects and one collaborative exercise were given with a time span of two weeks to complete each lab. Upon completion of the labs, the points would then be accounted for as extra credit on the class grade which kept students motivated. After every lab, we conducted a survey to gauge the glows (strengths) and grows (areas of improvement) of the program. The feedback from the first lab was then used to improve the next lab assignment. Overall, both the feedback surveys helped us gauge the effectiveness of the program.

Methodology

As part of the grant sponsorship, we developed and implemented materials for student learning. We developed two comprehensive digital forensics labs on key topics. These labs served as comprehensive guidelines that outlined a tutorial of the software, objectives, tasks and learning activities for student instruction. These instructions provide clear and concise directions, ensuring that students understand the purpose of the activity and can effectively engage with the provided resources.

To gauge student progress and understanding, we developed end of lab surveys. This allowed for the evaluation of students' performance and feedback on the mentorship program. Following the surveys, the results were compiled and analyzed. These assessment results provided valuable insights into the areas for improvement, and overall effectiveness of the program. The assessment outcomes helped inform future strategies and allowed for tailored feedback and support to enhance students' learning experiences.

By providing well-structured student instructions, implementing effective assessment tools, and analyzing assessment results, the grant-sponsored learning activities aimed to promote active student engagement, facilitate learning outcomes, and foster continuous improvement in the educational process through community engagement and mentorship.

The following were the questions used for the survey:
1. On a scale of 1-5, rate how likely you would take this class if it were not required. (1 is being not likely and 5 being very likely)
2. On a scale of 1-5, rate how much you are interested in the cybersecurity field. (1 is being not likely and 5 being very likely)
3. How many times have you met with your mentor/mentee?
4. Are you satisfied with your mentor/mentee relationship? (Strongly disagree, Disagree, Too early to tell, Agree, Strongly agree)
5. Is there a positive change with your mentor/mentee relationship compared to the first weeks? (Strongly disagree, Disagree, Too early to tell, Agree, Strongly agree)
6. List anything you feel would make this mentorship program effective.
7. What have you gained from this program?

Results and Discussion

By integrating this comprehensive mentorship program, we aim to create a nurturing environment that promotes peer-to-peer learning, encourages knowledge sharing, and fosters personal and academic growth. The mentorship program not only facilitated the acquisition of essential digital forensics skills but also fostered a sense of community and camaraderie among students within the department.

Additionally, the mentorship program extended beyond the classroom, providing mentees with access to a support system and a network of individuals who share similar academic and career goals. This aspect of mentorship was instrumental in fostering personal and professional growth, boosting student morale, and increasing retention rates within the Digital Forensics major.

By leveraging the expertise and insights of more advanced students, mentees benefited from personalized attention, gaining valuable insights into the intricacies of digital forensics and information assurance. Mentors, on the other hand, developed their leadership and communication skills while solidifying their own understanding of the subject matter through teaching and guiding their peers.

Figures 1 and 2 show the number of students from different majors in the DF1 and DF2 classes respectively. Additionally, the graphs also depict that prior to this course, majority of the students did not engage in any sort of mentorship activity. This observation sheds light on the prevailing lack of mentorship experiences among the students, suggesting a potential gap in their academic journeys before encountering the course material. Figures 3 and 4 show the level of interest for cybersecurity after lab 1 and lab 2 for DF1 and DF2 students respectively on a scale of 1 to 5 (1 being not interested and 5 being very interested). These graphs depict a growing interest in cybersecurity among students as the mentorship activities progress. This is a key indicator of progress that we gauged. Additionally, Figure 5 depicts the positive change felt among the students by participating in the mentorship program between 1 to 5 (1 being no positive change and 5 being considerable positive change). This feedback was gathered after lab 2 so that students could analyze and understand the personal progress they have throughout the program. It can be seen that among DF1 and DF2 students most of the responses were between 4 -5 which indicates considerable progress observed by the students.

Another aspect the survey aimed to understand from the students was their personal goals from the program and whether they achieved those goals at the end of the program. Figure 6 shows a word cloud of the key skills/goals students wanted to acquire from the mentorship program. Key concepts circled around gaining knowledge, helping others, gaining extra credit for class, developing working knowledge of the software and developing teamwork skills. After the successful completion of the program, students were asked about the skills/goals they accomplished from the program as depicted by Figure 7. Majority of the ideas in the word cloud revolved around learning digital forensics concepts, gaining experience, building teamwork skills and many more majority of which students wished to accomplish on the onset of the program.
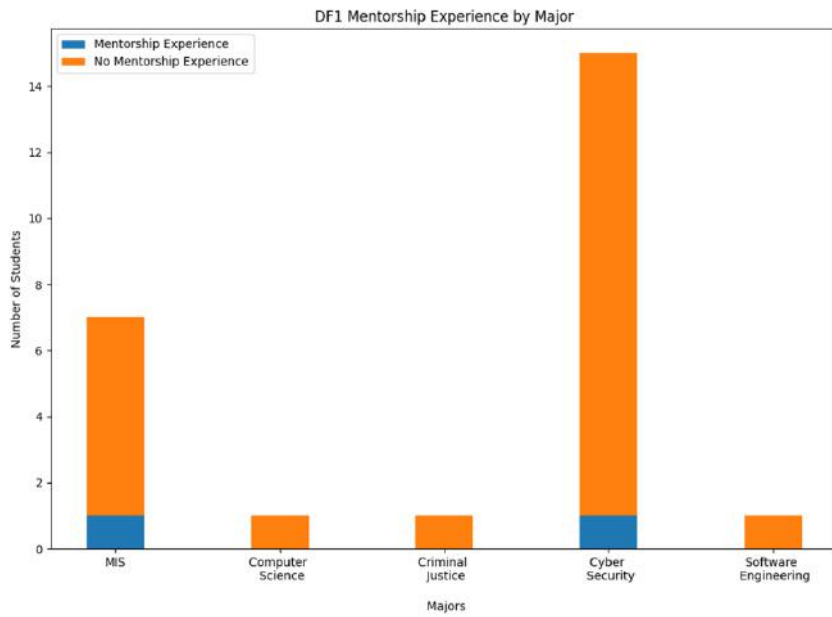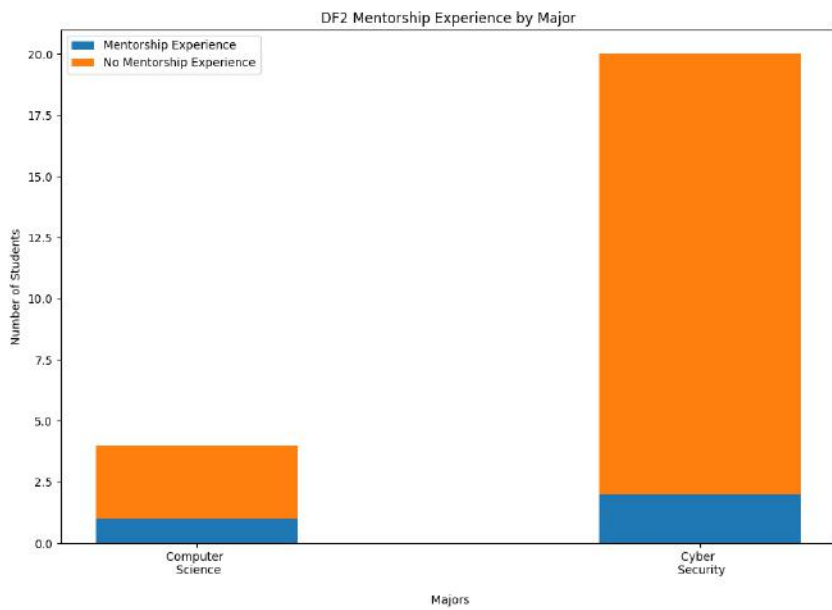
Figure 1: DF1 students mentorship experience by major

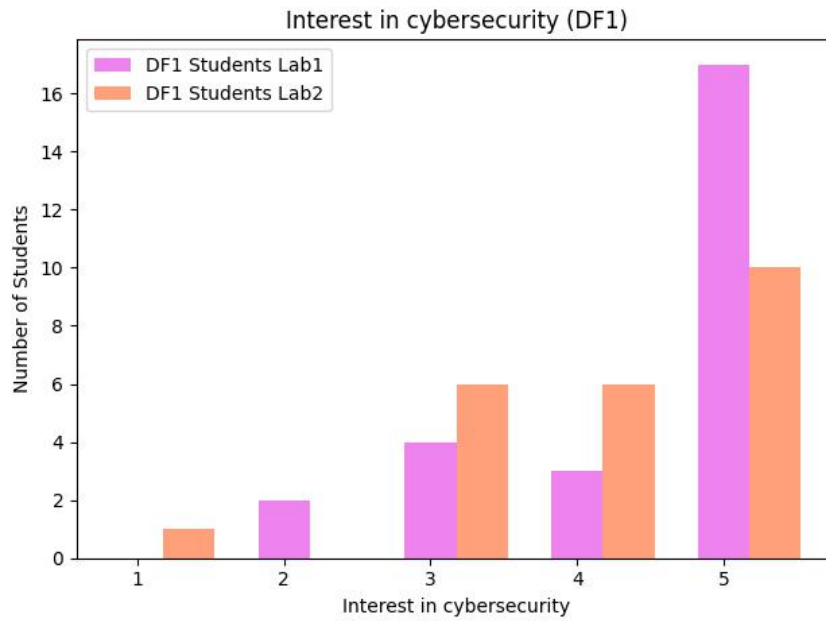
Figure 2: DF2 students mentorship experience by major

Figure 3: Level of interest in cybersecurity in DF1 students
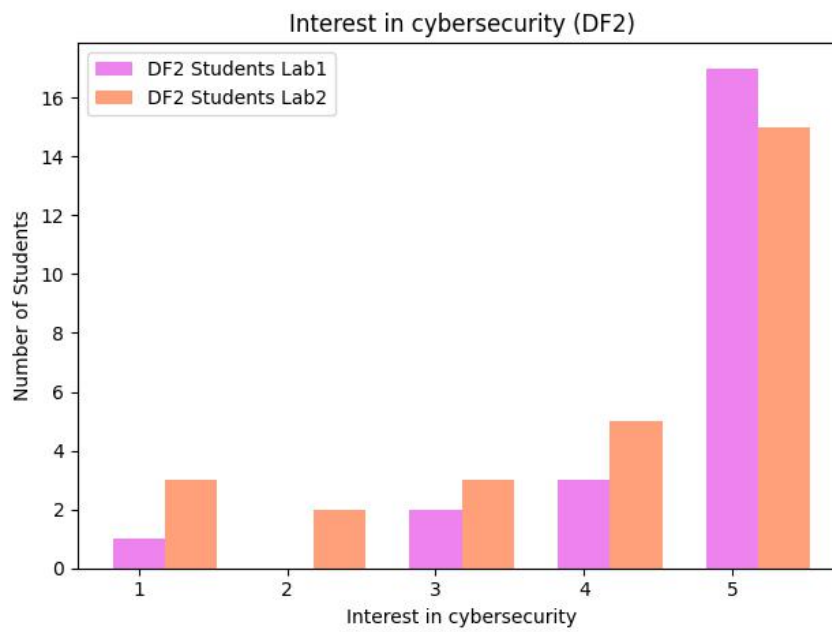

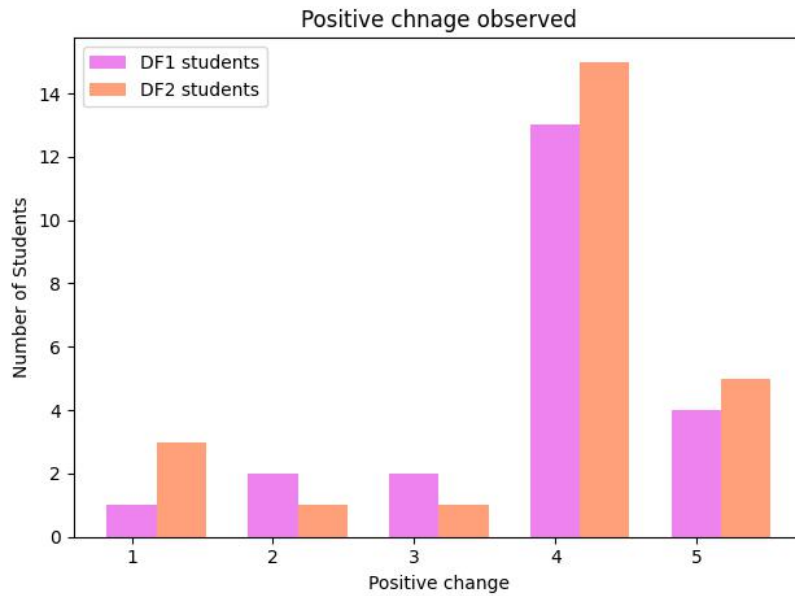*Figure 4: Level of interest in cybersecurity in DF2 students*

Figure 5: Positive change observed in DF1 and DF2 students

Figure 6: Skills students aimed to get from the program   *Figure 7: Skills students gained from the program*

Conclusion - Lessons Learned

The assessments conducted after every lab helped us gauge areas of improvement to help us effectively plan and execute the next mentorship activities as shown in Figure 8 and 9 respectively.

Some of the feedback received included pointers on:
1. The mentorship activity should include dedicated time for mentorship meetings/exercises.
2. The mentorship should constitute of bi-weekly meetings with reports.
3. There should be video tutorials on downloading and using the software.

Some of the lessons learned during this preliminary mentorship exercise included:
1. Students should be able to choose whether they would like to participate in the program or not so that they can immerse themselves in the experience and reap the benefits of the program.
2. Students should be given more time to choose their mentor based on their interests and working styles.

3. There can be a better way of tracking personal progress throughout the mentorship program which can be executed with meeting reports.

Figure 8: Areas of improvement after iteration 1

Figure 9: Areas of improvement after iteration 2

Acknowledgements

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