Board 76: Expansion of Peer Tutoring Program to In-Class Sessions in Multiple Disciplines

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Abstract

Peer tutoring has been used for several years at University of Portland, where peer tutors hold office hours in the Vollum Study Room to help students on homework problems and understand concepts. However, the peer tutors were not used very much by students. To expand on the existing peer tutoring program and increase use of peer tutor office hours, we added peer tutors in the classroom. In-class peer tutoring (ICPT) is defined as peer tutors attending sessions where students solve in-class assignments. Student surveys indicated students recognized the value of the peer tutors and thought ICPT improved their learning in the classroom. Student use of peer tutors outside of the classroom increased significantly; many students had to wait to get help from the tutors and the Vollum Study Room was often at capacity during tutoring hours. Peer tutors are a low-cost, community building way to provide more resources for student success. The implementation of ICPT has improved the peer tutoring program at University of Portland, and we plan to continue implementing ICPT in other classes and engineering disciplines.

Paper Type: Evidence-Based Practice

Key Words: tutoring, peer learning, conceptual understanding, multidisciplinary

Introduction

Peer tutoring has been used extensively in the past 20 years, and many studies have shown that it is beneficial to student learning [1]-[5]. Peer tutoring is particularly helpful in the first two years of engineering, when most students leave engineering for other majors [6], [7]. Peer tutoring can provide a sense of community and provide help for students beyond just the instructor. However, peer tutors may not always be fully utilized. Many peer tutors have office hours where students can informally drop by and get help, or students are asked to formally join a peer tutoring program [1]. These programs are voluntary and may be missing the students who need it the most.

ICPT may improve access to peer tutors for all students. ICPT involves peer tutors attending class sessions where students solve in-class assignments. Because it is during class, all students interact with the peer tutors. ICPT has been used in statics and mechanics of materials [8]-[10], thermodynamics [11], and introductory engineering courses [12], [13] but has been limited in other classes and engineering disciplines. ICPT is highly valued by students as an important resource for student learning and has been shown to improve student self-efficacy as well as have a positive impact on social capital [14]. In the Street et al. [14] study, students in statics and mechanics of materials were interviewed about ICPT. Results indicated the presence of peer tutors in the classroom encouraged communication, cross-grade network building, and a more supportive and friendly environment. In addition, creating a good learning community in the classroom made students more confident in their ability to solve statics and mechanics problems. This is supported by the Thompson and Garik [10] study, which showed that ICPT helped students build confidence in their ability to succeed and provided a valuable link to the university

community. Cao et al. [12] found that classes with ICPT were better staffed and students received more immediate and strategic feedback. Students felt they learned more because of the peer tutors due to the variety of ways peer tutors explain concepts [15]. These studies indicate students benefit from ICPT in many ways.

The peer tutors have reported benefits as well; in addition to finding satisfaction and enjoyment in helping others, peer tutors also thought it helped them review concepts as preparation for the Fundamentals of Engineering (FE) exam and improved their communication skills [15]. The peer tutors in a thermodynamics class thought the experience improved their problem solving skills, as well as their understanding of the connection between thermodynamics, heat transfer, and fluids [11]. Faculty have noted the benefits of ICPT as well; instructors were able to interact more with students in the class, many of whom would otherwise not talk with the instructor at all [11]. Quan et al. [13] noted that peer tutors are supporting growth rather than evaluation of the students. ICPT can help improve student outcomes and teacher preparation, and create a student-centered learning environment [16]. Although it is clear that ICPT is beneficial, the use of ICPT in other engineering courses has been limited. The general benefits of ICPT can benefit other engineering classes, regardless of the technical content. ICPT should be extended to other courses in all areas of engineering.

This study expands an existing peer tutoring program to include ICPT in computer science, civil and electrical engineering classes. The goals were to increase student use of the peer tutors during office hours and improve student learning in the classroom. A survey was given to students to evaluate whether they thought ICPT helped, and student use of peer tutors during office hours were tracked.

Peer Tutoring Program at University of Portland

The peer tutoring program at University of Portland involves Junior and Senior level students being available for help during specific evening hours Sunday-Thursday. The tutors sit in the Vollum Study Room, and students can get help on an as-needed basis. Tutors apply to the position and are selected based on how well they did in the classes they will be tutoring for. Tutoring is only available for first-year and sophomore level classes. Instructors make solutions to homework problems available to provide guidance for tutors when they are helping students.

Historically, the peer tutors only had one or two students get help from them at a time, and the Vollum Study Room was often empty. To increase use of peer tutors, we expanded the program so the tutors attend class for ICPT sessions. In-class peer tutors were used in civil engineering, electrical engineering, and computer science. In particular, we used peer tutors in CE 367, a sophomore level environmental engineering class, EE 332, a sophomore level digital systems class, CS 203, a first-year introductory computer science class, and CS 305, a sophomore level data structures class. As far as we are aware, ICPT has not been used in these classes at other universities before. The CE 367 class is an 85-minute lecture class that meets twice per week, and covers concepts used in water and wastewater treatment as well as climate change and water pollution. The EE 332 class is also an 85-minute lecture class that meets twice per week and introduces students to principles of digital system design with a focus on CMOS design families. The CS 203 and CS 305 classes are 55-minute lecture class that meet three times per week.

Students learn about computer programming through writing, running, and debugging programs in CS 203, and students learn how to compile, debug, and execute C programs as well as implement fundamental data structures and iterative and recursive algorithms in CS 305. There were 29 students in CS 203, 27 in CS 305, 20 in EE 332, and 22 in CE 367.

One peer tutor attended each class approximately once per week when in-class assignments were assigned. Typically, ICPT sessions occurred after one or two lectures on the topic. In-class assignments included problems similar to homework for students to get formative feedback on problem-solving in the classroom, and typically take 30-60 minutes of class time. Problems vary from software coding (such as in the computer science classes) and debugging bread boards (such as in the electrical engineering class) to solving chemical equilibrium problems (such as in the civil engineering class). In CE 367, CS 203, and CS 305, both the instructor and peer tutor were in the classroom during in-class assignments. The EE 332 class was structured differently, where the instructor taught online and the peer tutor was in the classroom to help students (without the instructor).

In preparation for tutoring, peer tutors went through a training session at the campus student resource center on best practices for helping students during tutoring sessions. Peer tutors also met with the instructors to discuss expectations and what peer tutors should do, such as walking around and checking on student progress, asking if students need help, etc. Prior to the ICPT session in class, the peer tutor solved the in-class assignment. The peer tutor then met with the instructor at least 2-3 days prior to the class session to go over the in-class assignment solution and make sure the peer tutor understood how to complete the assignment, as well as discuss possible "sticking points" where students make common mistakes or get stuck.

Evaluation of Addition of In-Class Peer Tutoring

To evaluate whether ICPT was beneficial to students and increased use of peer tutors, we had students fill out a survey. Students were asked to rate on a 1-5 Likert scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree) the following survey questions:

1. The peer tutor has been helpful to me in this course.
2. I have learned more in this course because of the peer tutor.
3. I wish that my other engineering courses used peer tutors.
4. The peer tutor did not add any value to this course.
5. The peer tutor was able to answer my questions.
6. My performance in this course was improved because of the peer tutor.
7. The peer tutor wants me to do well in this course.
8. The peer tutor has gone out of their way to help me.
9. Interacting with the peer tutor has increased my sense of community in the School of Engineering.

We also asked the following open ended questions:

10. In what ways did the peer tutor help you this term?

11. Comment on having a peer tutor in the classroom. What did you like and what would you change or add?

Question 4 is a reverse question included to ensure reliability of survey responses. Survey questions 7 and 8 were used to evaluate what students thought about the classroom environment with peer tutors, and are based on the Classroom Life Survey [17]. Survey questions 1-6 were used to determine if students thought the ICPT program was valuable, and question 9 was added to further understand the impacts of ICPT on community. Although these questions were not taken from a previously validated survey or based on a specific theoretical framework, the results still provide helpful information on student attitudes. Further research could evaluate why students think the tutors are helpful, and in what ways they are helpful.

Students were given the survey during the last week of class. In CS 203, CS 305, and EE 332, students were asked to fill out the survey online. This appeared to decrease participation; 60% of the students (34/56) filled out the survey in CS 203 and CS 305, and only 25% of the students (5/20) filled out the survey in EE 332. Students were asked to fill out a hard copy of the survey in CE 367, which resulted in 100% participation (22/22 students). We also monitored the Vollum Study Room, and asked the peer tutors to report back on how many students took advantage of the tutoring services.

Results and Discussion

Overall, students agreed with the survey questions (average scores of 3.6-4.5, median 4-5). Question 4 was a negative question regarding the value of the peer tutor in the class, and students disagreed (average score of 1.7, median 1). Students recognized the value of the peer tutors and thought ICPT improved their learning in the classroom. Table 1 shows the overall results and the results for each class. Unfortunately, the same survey link was given to CS 203 and CS 305 students and the data could not be disaggregated. Thus, the results for CS 203 and CS 305 are combined in Table 1.

Table 1. Average student responses to survey questions. Median values are in parentheses.

	Question								
Class	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
CS 203 and CS 305	3.7 (4)	3.2 (3)	4.2 (4)	1.9 (2)	3.7 (4)	3.3 (3)	4.5 (5)	3.6 (4)	3.5 (3)
EE 332	4.8 (5)	4.6 (5)	4.6 (5)	1.4 (1)	4.6 (5)	4.2 (4)	4.4 (4)	3.2 (3)	3.8 (4)
CE 367	4.5 (5)	4.0 (4)	4.4 (5)	1.4 (1)	4.5 (5)	4 (4)	4.6 (5)	4.3 (5)	4.2 (4)
Overall	4.1 (4)	3.6 (4)	4.3 (4)	1.7 (1)	4.0 (4)	3.6 (4)	4.5 (5)	3.8 (4)	3.8 (4)

Student responses from the open-ended questions 10 and 11 were generally positive. General themes from student comments included that peer tutors were “easier to connect with” than instructors, the tutors “can explain confusing stuff in many different ways,” and the “peer tutors provided career, study skills, and other advice” for student success. Students appreciated that the peer tutors could explain concepts in a different way from the instructor, which is helpful when the original explanation was confusing to them. They also liked that the peer tutors had recently

taken the class. Students likely felt comfortable asking the peer tutors for help since they are not much different from them.

Student responses were not as positive in computer science classes compared to electrical and civil engineering. Average scores were lower for all questions except question 7 (peer tutor wants me to do well in this course). This may be due to the nature of the computer science classes; students completed coding labs in these classes and had to be "checked off" by the peer tutor confirming they had successfully completed the lab. Many students commented that they didn't need to use the peer tutor or that they just checked off their labs. The structure of these labs may need to change to more successfully implement ICPT.

Student responses in EE 332 and CE 367 were similar for most questions except 8 (peer tutor has gone out of their way to help me) and 9 (interacting with the peer tutor has increased my sense of community in the School of Engineering). This may be due to the different class structure of EE 332. The lecture portion of the class was fully online and the instructor was not present in the classroom with the students and peer tutors. Although students responded that the peer tutors helped them, not having the instructor in the classroom may have affected the classroom climate. In CE 367, the instructor was present with the peer tutor, which may have created more of a sense of community. Differences may also be due to the function of the peer tutors in each class; the peer tutors in EE 332 were often checking breadboards and helping with the debugging process whereas the peer tutors in CE 367 were helping students on computational problems such as calculating pH using chemical equilibrium.

Student use of peer tutors outside of the classroom increased significantly; many students had to wait to get help from the tutors and the Vollum Study Room was often at capacity (32) during tutoring hours. Peer tutors reported being busy with students during the entire tutor time. Table 2 shows the total number of visits for computer science, civil and electrical engineering tutors, which has increased from one or two students per day or ~20 per semester to over 200 in the fall and over 100 in the spring. The percentage of visits by discipline is the proportion of visits by computer science, civil engineering, and electrical engineering students, or the number of visits for each discipline compared to the total. These may be repeated visits by the same student, but nevertheless is much higher than the number of visits observed in past years and indicates students are using this resource more than previously. It is interesting to note that computer science students, who consistently evaluated the ICPT lower than civil and electrical engineering students, visited the peer tutors outside of the classroom more often. This further supports that the structure of labs may need to change to better take advantage of the peer tutors in the classroom. Regardless, there was a significant increase of visits to the peer tutors outside of the classroom, particularly for computer science students. Survey scores may have been low for ICPT, but just getting to know the peer tutor in the classroom may have encouraged computer science students to visit outside of the classroom.

Table 2. Number of visits to peer tutors outside of the classroom.

	Computer Science	Civil Engineering	Electrical Engineering	Total
Fall	150	35	20	205
Spring	56	34	34	124
Total	206	69	54	329
%Visits by Discipline	63%	21%	16%	100%

Having peer tutors in the classroom likely helped students get to know the peer tutors and made them more comfortable getting help during tutoring hours in the Vollum Study Room. This is evident from the following student quote:

> "The tutor has been very helpful this term as she addressed any problems, concerns, and advice I had. She helped me with homework problems as well as ICAs [In-class Assignments]. She also helped me with general CE advice and which courses to take."

Another student said:

> "The tutor would come into class and remind us there are tutors and where to find them. She gave us tips on what she wanted to know when she was us. She was very social and helpful in the classroom."

Similar statements were made by 15 students including students from all 4 classes. Students were comfortable going to tutoring hours because they thought the tutors were more available than professors, easier to connect with, and provided a different way of explaining things compared to the professor. Students may not have thought this if they hadn't interacted with the peer tutors in class. Increased student traffic in the Vollum Study Room and positive student comments indicate that ICPT successfully increased student use of the peer tutors during office hours.

Conclusions

The peer tutoring program at University of Portland was expanded by including ICPT and showed that ICPT can be used to benefit students in computer science, electrical and civil engineering classes. Based on student surveys and the increased use of peer tutor office hours in the Vollum Study Room, ICPT was successful achieving the goals of increased student use of the peer tutors during office hours and improved student learning in the classroom. Peer tutors are a low-cost, community building way to provide more resources for student success. They are more approachable than instructors, and can explain concepts in different ways that may be more relatable to students. ICPT should be used in all disciplines in engineering, and not just

mechanics and introductory courses. We plan to expand ICPT to mechanical engineering and other computer science, electrical, and civil engineering classes.

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