

THE PEER-LED TEAM LEARNING INTERNATIONAL SOCIETY
PROCEEDINGS OF THE 2015 CONFERENCE
MAY 28-30, 2015
UNIVERSITY OF TEXAS AT DALLAS
RICHARDSON, TEXAS

**DEVELOPING HYBRID PLTL WORKSHOPS
FOR AN INTERMEDIATE PROGRAMMING COURSE**

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PLTL online workshops are utilized as supplemental material for CS 1: Intro to C++, the introductory programming course at the University of Houston-Downtown. These workshops have been shown to positively affect student performance in the course. Students who are pursuing a degree or minor in Computer Science subsequently enroll in CS 2: Data Structures and Algorithms. Face-to-face workshops have been offered for this course since Spring 2014, but have garnered only inconsistent attendance from students. We propose a change in the way CS 2 workshops are delivered, with the dual aim of increasing attendance and impact by incorporating proven techniques from CS 1 workshops. The new approach will include both face-to-face and online workshops. We hope to widen the scope of ideas introduced to CS 2 students and to provide more thorough training in the applications of course concepts.

Introduction

In the Spring 2014 semester, a PLTL workshop model was developed to support the course CS 2410: Data Structures and Algorithms at the University of Houston-Downtown. The professor for the course was Dr. Ali Berrached, and the workshops were developed and revised by Melissa Greenlee, a computer science student, as part of her senior thesis in computer science. (Greenlee, 2014) The course was held face-to-face and students met for an hour and 45 minutes of lecture twice a week.

The model consisted of twelve workshops, one for approximately each week of the semester. The workshops were designed to be held face-to-face for one hour. Peer leaders who had previously done well in the course led the workshops, which were offered at two to three different times during the week to accommodate students' schedules. At the end of the Spring 2014 semester, students were given a survey to assess their experience with the workshops. The survey questions were open-ended and concerned with whether the students felt the workshops had been beneficial to them. Feedback was also gathered from the peer leaders on the workshop material and the reactions of students to each workshop. This feedback was used by Ms. Greenlee to revise the workshops with the input of Dr. Berrached and the UHD PLTL coordinator, Ms. Mitsue Nakamura, to complete Ms. Greenlee's senior thesis.

The revised workshops were used in the Fall 2014 and Spring 2015 semesters to support the same course, taught by Mr. Cyril Harris. One workshop was added to reflect an additional topic covered in the course by Mr. Harris. Throughout these past two semesters, workshop attendance has been consistently low, with some workshops going completely unattended.

In response to this issue, workshop leaders for CS 2410 and CS 1410: Introduction to C++, as well as peer leaders with experience attending workshops for both courses, met to discuss how the workshop materials and delivery could be revised to increase attendance and engage students. The resulting proposal also incorporates results from online workshop support for CS 1410, which suggest that that mode of support is beneficial for students.

Motivations

As of Spring 2015, extremely low and inconsistent attendance, in itself a major issue, has prevented us from collecting sufficient data to evaluate the efficacy of CS 2410 workshops. PLTL support for CS 2410 has only been offered through face-to-face workshops. At the University of Houston-Downtown, a commuter school, this has resulted in many students being unable to attend due to scheduling conflicts. To counter this, several workshop sessions are offered per week; however, attendance remains low. This may be due to lack of academic motivation, that is, non-strict requirements within the course to attend more than one workshop session; infrequent interaction of workshop leaders with students in the course outside of workshop sessions; and students' perception of the workshop sessions and material, which may be inaccurate.

Figures 1 and 2 illustrate the attendance of CS 2410 workshops by students in the 2014-15 academic year. In the Fall 2014 semester, workshops were offered twice a week. In the Spring 2015 semester, workshops were offered three times a week. The figures show the number of students, in green, who attended any of the workshops offered during each week of each semester. The rest of each bar, in red, represents the remainder of the students in the class, who did not attend any workshop offered during the given week.

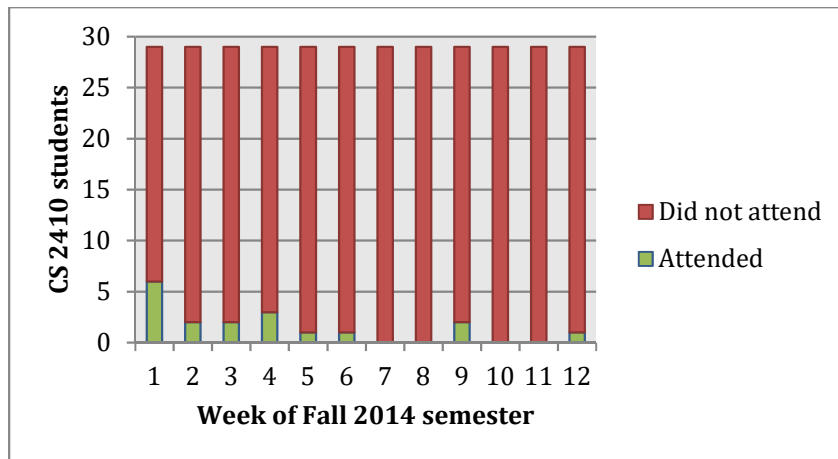


Figure 1: Workshop attendance for Fall 2014

In Fall 2014, we supported one section of CS 2410 with a total of twenty-nine (29) enrolled students. In Spring 2015, we supported two sections of the course, both taught by Mr. Harris, with a total of forty-six (46) enrolled students. Students from both sections were eligible to attend the workshops, with no restrictions on workshop sessions based on the section a student was enrolled in.

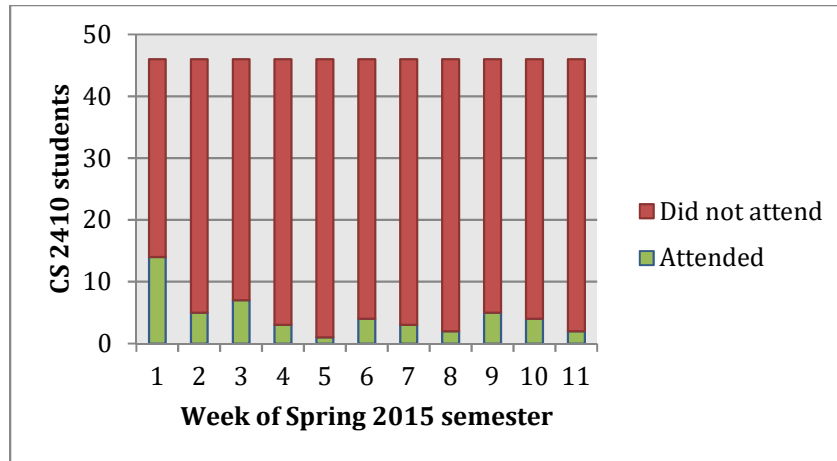


Figure 2: Workshop attendance for Spring 2015

On average, the percent of students who attended a workshop session during any given week was 5.17% of enrolled students in Fall 2014, and 9.88% in Spring 2015.

In our discussions on how to address the issue of attendance and improve support for CS 2410 overall, we’ve also realized that current workshop material is not optimally conducive to student learning, preventing us from accurately assessing students’ ability to grasp core concepts. The majority of the material takes the form of large paragraphs that dissuade students from taking effective notes. Core concepts are important topics that should be further discussed outside the classroom, but these take up the majority of the workshop sessions and content, overlooking exercises that focus on programming aspects of CS 2410 and preventing the discussion of other topics in the workshop sessions which may be of interest to students and improve their workshop experience.

Although professors like the idea of PLTL, there is a lack of communication between PLTL leaders and professors. Our PLTL program is small and lacks the formal structure of other programs that are deeply embedded within the courses they support. In the absence of this kind of structure, our current workshop model does not respond ideally to changes in curriculum, which may occur since it is not guaranteed that CS 2410 will be taught by the same professor from semester to semester. As another consequence of the informal structure of our program, there can be periods of little communication between leaders and professors. This can lead to students becoming our only source for understanding what ground the course is covering. This lack of communication also prevents us from identifying concepts students are having trouble with in the course with the professor, as well as contributing to the issue of students lacking an understanding of the nature and purpose of the workshop sessions. After the first few weeks of the course, without constant reinforcement from leaders in the class, students begin to perceive the workshop sessions as unnecessary or insignificant to the course. This is not how the sessions should be viewed. The workshop sessions should be regarded as a small community, where students can effectively collaborate with each other to solidify new C++ concepts.

Finally, we are encouraged by the measurable success of online workshop support for CS 1410. Figure 3 illustrates the relation of workshop participation grades to overall course grades for CS 1410 students who attended online workshops for that course during the Spring 2015 semester.

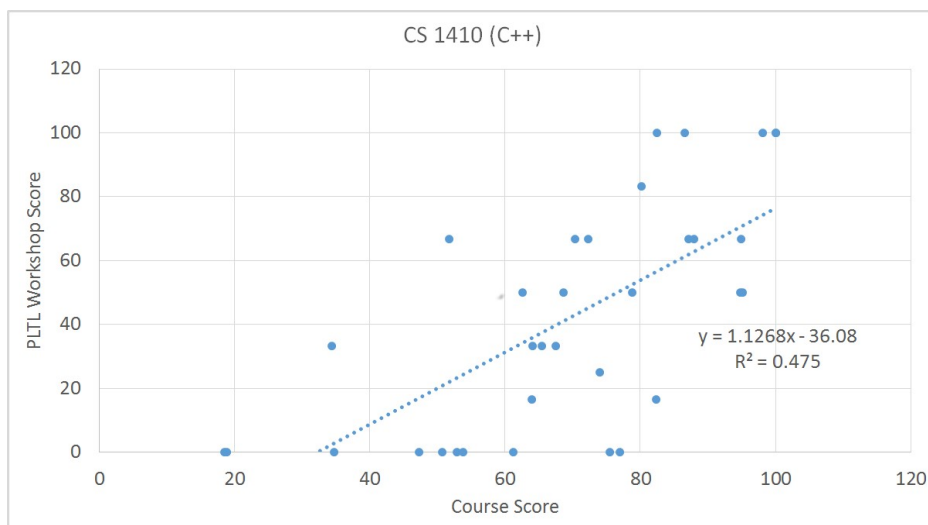


Figure 3: Relation of CS 1410 workshop attendance to overall course grade

In Spring 2015, PLTL support was provided through online workshop sessions for CS 1410, taught by Dr. Dvijesh Shastri. Students in the course received a grade for workshop participation based on the number of workshops they attended, with a grade of 33% for one workshop, 66% for 2 workshops, and 100% for 3 or more workshops attended throughout the semester. Figure 3 indicates that students who attended more workshop sessions tended to perform better overall in the course.

To summarize, low and inconsistent workshop attendance prevents us from pinning down problems students have in the course, creating surveys to better the workshop model for CS2, and furthering the PLTL model throughout other subjects. Several issues, such as the quality of workshop materials and sparse communication between professors and workshop leaders, which span from and contribute to this major problem also serve as motivation for us to overhaul our current workshop model. Our proposal aims to alleviate these issues and to build on the proven success of the online workshop model.

Proposal

Beginning Fall 2015, we will support CS 2410 in a much-revised manner. Firstly, the course itself will be offered in a hybrid style, meaning the class will meet once a week for an hour and 45 minutes and students will study a portion of the material online. We will try to use this style to our advantage by also hybridizing the workshop model. Face-to-face workshops will be held in class each week following an hour of lecture, thereby alleviating scheduling issues and ensuring attendance from a majority of students. Online workshops, conducted through Blackboard Collaborate, will be offered at 2 to 3 different dates and times between each class meeting day and the next. The in-class workshops will focus on reinforcing the concepts just discussed in lecture and tying theory to practice, while the online workshops will offer further opportunities for students to develop and hone their programming skills.

Workshop Development

As noted in our Introduction and Motivations, we received feedback from workshop leaders who previously participated in CS 2410 workshops as students, which gave us an idea of the limitations of our

current workshop material. The major issues brought to our attention were a lack of note-taking space for students, impeding student engagement during sessions, and an absence of programming practice to bridge the gap between theory and practice. Our development of the new workshop model is progressing with these issues in mind.

The current CS 2410 workshop material will be modified for use in the face-to-face portion of the hybrid model. In addition to the specific problems with the material mentioned above, we are also working under general concerns such as modifying the material for 45-minute, rather than hour-long, sessions, and designing the new material to be supplemented by intensive programming practice in the online workshop sessions. The new material will have limited exposition of core concepts and focus on discussion elements on how to approach problems in topics found in CS 2410. This will not only strengthen comprehension but also build the design and algorithmic skills required for computer programmers.

To illustrate how we plan to incorporate these changes, shown in Figure 4 below is *Workshop 6: Introduction to Classes*, used in face-to-face support for CS 2410 in the 2014-15 academic year. Shown in Figure 5 is our proposed revision of Workshop 6, according to the reasons outlined above.

Workshop 6: Introduction to Classes

In the real world, not everything can be represented using the predefined data types available in a programming language, specifically C++. To deal with this, we can create structs, or records, to represent things encountered in the real world. However, even though new data types can be created, there are still limitations. In the workshop for structs, one of the exercises looked at the operations that can and cannot be performed on a struct. What is the point of being able to define a new custom data type if it can possibly limit what we can do with it? This is where classes come into the picture. Classes are a way to create a new data type and to define the operations and/or functions that can be performed with it. A class consists of data members and member functions that can be public or private.

Exercise 1: Classes are an abstract data type. Abstraction is the act of separating the essential qualities of an idea or object from the details of how it works or is composed. Based on what you have learned about classes, what makes them abstract? What are some class objects that you use in your programs but do not know the inner workings of (If you're stuck, think about the #include statements you might include in a program)? What are some everyday activities or things that you encounter that could be considered an abstraction?

Exercise 2: Class data members and member functions can be public or private. One might think that since a class is designed to add a layer of abstraction that every member should be private. So why does a class need public and private members? What are some criteria that will help to determine if a class member should be public or private?

Exercise 3: Class member functions typically consist of getters, setters, and other functions. Which one of the three categories do class constructors belong to? What distinguishes a class constructor from other member functions? Are there different types of constructors, and if so, how many? Why is it important to use constructors? What category does a class destructor fit into to? How many destructors can a class have?

Exercise 4: A secretary has asked your help in designing a scheduling program to use. Design an appointment class to be used within the program. What data members and member functions are necessary to create an appointment object? Should this class have constructors and destructors? Why or why not?

Figure 4: Original Workshop 6

Material for the online portion of the model will be created by peer leaders with previous experience leading online workshops. An average online workshop will consist of a central problem that must be analyzed and solved using concepts covered in that week's lecture, and implementation techniques introduced in the corresponding in-class workshop session. These online sessions will allow students to develop the skill of breaking a problem down into the structures and algorithms needed to solve it, as well as providing a chance to practice the coding aspect itself.

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- Public member functions:
- Private member functions:
- Constructors:
- Destructors:

Exercise: A secretary has asked your help in designing a scheduling program to use. Design an appointment class to be used within the program. What data members and member functions are necessary to create an appointment object? Should this class have constructors and destructors? Why or why not?

Figure 5: Revised Workshop 6

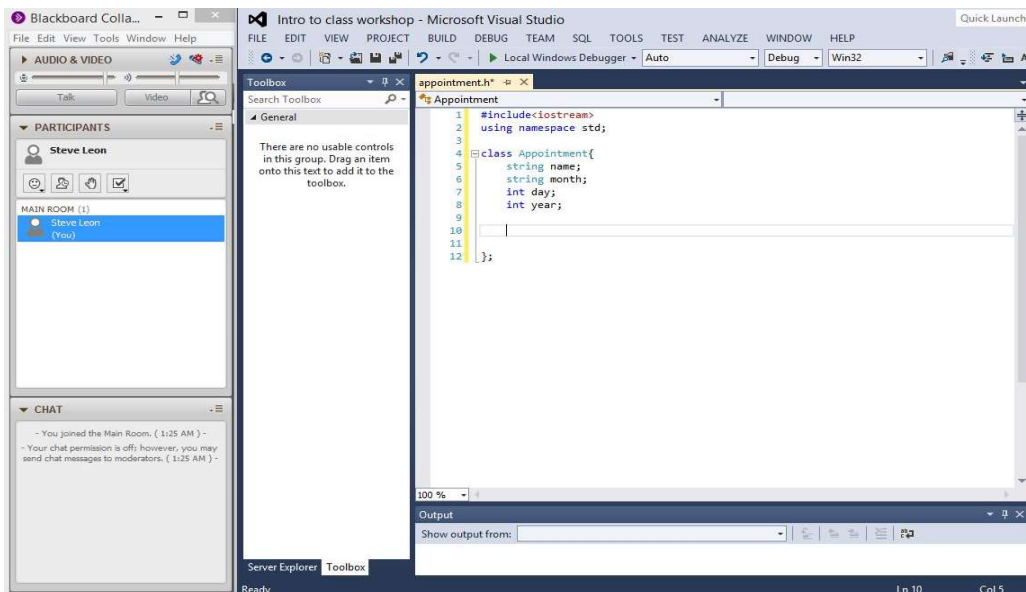


Figure 5: Blackboard Collaborate session

The online workshop sessions will be conducted using Blackboard Collaborate. Blackboard Collaborate is an application that allows peer leaders to facilitate workshop sessions online, using features like text, video, voice chat, and desktop sharing capabilities to interact with students. An example session is shown in Figure 6, in which the workshop leader is using Microsoft Visual Studio to write code and sharing their screen through Collaborate. Students log in to Collaborate using their university-registered Blackboard accounts, and Figure 6 shows that Collaborate also displays a record of students who are logged in to a session on the left of the screen under 'Participants'. Programming during these sessions, as seen above, will be done within a C++ integrated development environment (IDE) such as Microsoft Visual Studio.

Challenges

We must be careful to consider that in designing, developing, and implementing the hybrid workshop model, we will encounter various challenges. Some of these are problems we have previously encountered in face-to-face and online models, such as technical difficulties during online sessions, while some are unique to our proposed hybrid model.

One of our primary challenges is finding a sufficient number of trained and knowledgeable leaders to carry out the workshop model. That is, there need to be enough leaders for the in-class portion of the model to partition the class into workshop groups of the recommended size (8 to 10 students), avoiding overcrowded workshop groups; as noted, this was not an issue in our previous support for CS 2410, for which attendance was voluntary and outside of class time. A similar issue arises in the online portion of the model, where we would like to offer as many sessions as possible to accommodate student schedules.

We also need to make sure the in-class and online workshop material is highly complementary, so as to take full advantage of our hybrid mode of delivery. The in-class sessions must reinforce the knowledge students gain from the lecture and build a bridge to the implementation of those concepts. The online sessions must fully develop students' ability to solve problems and put ideas into practice. We plan to do our utmost to eliminate the gaps in student understanding that prevent their benefiting from the workshops.

Finally, a challenge we hope to solve is encouraging students to attend all the sessions that are offered. Fostering interest so that students participate in both portions of the model is unique to the hybrid model and crucial to its success. The students lose the unique benefit of the hybrid model by attending only the in-class or online workshop sessions, since the element of reinforcement of knowledge through practice and vice versa disappears. Although we cannot entirely control whether students are dedicated to maximizing their benefit from the workshop support, we, along with the course professors, will do our utmost to foster this interest in the students.

Goals

Our goal is for the hybrid workshop model to address the problems of the previous, fully in-person model. By embedding the face-to-face workshop sessions within class time, we hope to resolve the attendance issue. In addition, the in-person portion of the hybrid model will lead to a better relationship with the professor because of increased communication in the classroom as well as workshops better synchronized to the pace of the course and the needs of the students. Our goal in revising the face-to-face workshop material to focus on core concepts and provide note-taking space is to guide students to more effective learning, in response to feedback from previous CS 2410 workshop participants. Similarly, the online workshops also address a need voiced by previous workshop participants for more programming practice to bridge the gap between theory and practice. Finally, one of our major goals is to gather data to determine the efficacy of the workshops, making use of the high and stable attendance we hope to see from students in the course as a result of this highly structured workshop model.

Acknowledgments

We gratefully acknowledge Mr. Cyril Harris, Department of Computer Science & Engineering Technology, UHD; Dr. Dvijesh Shastri, Department of Computer Science & Engineering Technology, UHD; Mitsue

Nakamura, Department of Mathematics & Statistics, UHD; Melissa Greenlee; and Dr. Ongard Sirisaengtaksin, Department of Computer Science & Engineering Technology, UHD.

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Cite this paper as: Leon, S., Turchaninova, A., Perez, E., Cervantes, I., Rodarte, F. (2016). Developing Hybrid PLTL Workshops for an Intermediate Programming Course. *2015 Conference Proceedings of the Peer-Led Team Learning International Society*, May 28-30, 2015, University of Texas at Dallas, Richardson, Texas. www.pltlis.org; ISSN 2329-2113.