

Starting with the A in PEAR regarding the user story focusing on Accessibility. “As a Student, I want to be able to access my Instructors lecture via video chat, so that I can learn class material.” So following our Mockups we wanted to keep the idea of simplicity consistent within our login screen and the joining or hosting a session screen. One can see that we focused on a student having accessibility to their Instructors lecture. Once a user logs in with their credentials and joins a session based on their Instructors Session ID, they are welcomed with a default student screen encompassing the students text editor, the instructors text editor and the video chat of the Instructor and all students.

Moving onto the E in PEAR regarding the user story focusing on Elementary ideals. “As a Student, I want to navigate an elementary interface, so that I do not get confused by the amount of options. Since our proposed solution focuses on those new to the coding environment and a remote work learning environment our team really focused on those labels and signifiers most significant and clear to the user. We ensured that the labels were listed in an order that had meaning to the process of one developing code and that all thematic color changes or visual representation of specific parts of the interface were resized or changed in a clean and well formatted way. Again the biggest idea we really liked was the chat window at the top to allow more real estate for coding rather having it vertically put.

Next when we look at the R in PEAR focusing on one’s ability to Request Help. “As a Student, I want to be able to notify my Instructor that I need help so that I can give and receive assistance and feedback.” When looking at the Student View the student is able to receive confirmation that they requested help along with seeing how far in the queue they are. If a student realizes that help is no longer needed, they are able to cancel the help they requested. Our

team really wanted the aspect of confirmation and the ability to undo an action for the design of this user story.

When looking at the Instructors View of what Help requests look like there is that same clickable Raising Hand icon. We felt that having a clickable button would allow the instructor to always access the Help Requests Queue. There are different colored signifiers allowing the Instructor to easily understand the interface. In particular indicating when a student is currently waiting or is currently being helped.

Lastly looking at the P in PEAR the user story regarding Public or Private. “As an Instructor, I want to be able to divide my Students into their own IDE sessions, so that I am able to help Students on a one-on-one basis.” When looking at the Instructors View again the Instructor has a clickable button signified by an icon that looks like people having a meeting. Instead of our interface resizing windows we felt a popup window would be a better option because the instructor would not need this popup window again. We added the aspect of the number of students currently online to make the interface more user friendly. The instructor has many clickable options of what type of breakout groups to choose from. When the Instructor makes breakout groups there is a clear label displaying how many students will be in each group. Again we are focusing on an elementary interface and the ability to divide students into groups, and we felt this would make the process easier. For the specified breakout groups we made it where the instructor could drag a students name to a specific group rather than clicking what students should be in a group for efficiency. The students' view for breakout groups looks similar to their default screen, however instead of the instructor's text editor there are the instructions or prompt for the breakout group.

*Research Question: Does providing better tools for collaboration and feedback improve student outcomes in online introductory programming classes?*

First and foremost our testing protocol would be an iterative process. We plan to examine this problem using a mixture of Observation of course sessions and Focus Groups, as well as Surveys and Data Analysis. The focus groups would ideally be comprised of both students in Computer Science programs (at a variety of levels of skill) and instructors of online intro level programming courses. We would observe instructors using our product in the field as silent participants in the class sessions, and ask participants to fill out a survey after each class. We mentioned earlier that this process would be iterative, and the reason is that we can and would make changes to our product to improve workflow and/or functionality based on the first few rounds of feedback before beginning to collect data on outcomes. To use a cliché, we need to make sure our product walks before it can run.

As we move through the testing process, we will begin to collect data on outcomes. Likely this will come in the form of student grades, or student surveys. We will need at least one semester and one course section, but ideally we would get more than that to maximize our data sample, and ensure statistical significance of any difference in outcomes between the control group (meeting face-to-face and/or Zoom) and our testing group (using Pear Programming). Assuming the pandemic is ongoing during our testing phase, we would of course have to use either a synchronous or asynchronous (or both) class model for our control group. Obviously we would need to obtain the consent of the students to collect their grades, so FERPA waivers would be necessary. We would like to obtain test and project grades, but simply a final grade would suffice. We would organize the data by student (anonymized in some way) and course section (also anonymized in some way). We would also need to allow them the ability to opt out

of the experimental class section(s), or offer some way to mitigate potential detrimental effects of their grade. We leave the specifics of this to the professors of each class in which our product would be used.

We also need to provide each student and instructor with the information they need for them to give informed consent. As mentioned earlier, we would need to have either the instructor or a study leader discuss the experimental nature of the course section with students on day one, to provide them ample opportunity to opt out by transferring to a different section, not providing consent for us to collect their grades, or by dropping the class entirely. During this discussion it is vital that we emphasize the voluntary nature of the research. Each would be provided with a summary of our research plan, including the purpose of the research, how long the research would continue, and what procedures we will have in place for data collection, usage, and protection. We would need to ensure the language we use is plain and appropriate for an undergraduate level college student, as well as to provide a disclosure of any foreseeable risks (lower grade, technical issues, etc) to the students. We would also explain to them the benefits of our research, and possible upsides to participation in our study, and reiterate their alternatives should they not desire to be involved.

We plan to conduct a statistical analysis to determine with a reasonable degree of certainty if our students were helped or hindered by using our product. Mean scores, distribution, and statistical significance are all elements we would need to look at for both the experimental and control groups, and conduct an in depth comparison of the two. Statistical analysis of the data from experimental (using our product) and control groups (using some other product or meeting face-to-face) would allow us to draw conclusions about the effectiveness of

our product. It would also help us to answer our research question by helping us to quantify the results of classes using our product.

This would be a simple experiment to run safely during a pandemic situation, as our product is meant to facilitate better learning in exactly that sort of situation. We would simply need to have access to the various class sections, and a way to compile the data we want to collect remotely (e-mail, uploading to a database through some interface we provide to the professor, etc).