

STUDY BUDDIES

Study Smarter

Aaron McGhie: *Manager*

Egan Anderson: *Market Research*

Jake Osterloh: *Designer*

Jordan Davis: *Product Testing*

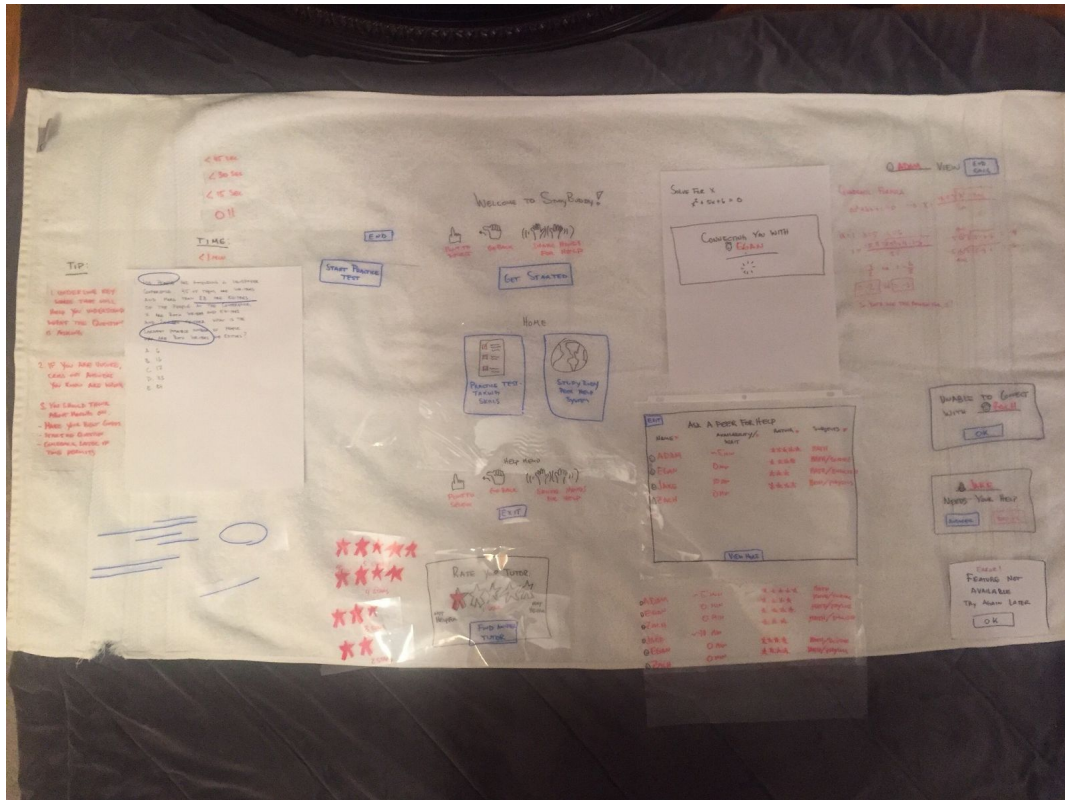
Problem and Solution Overview

Standardized tests such as the GMAT, LSAT, MCAT, ACT, and SAT are an important part of a student's application to both graduate and undergraduate programs across the country. The way a student performs on one of these tests can greatly affect whether or not they are accepted and how much money they will make in their future career. There are several problems that exist for students who are preparing for these tests. It is difficult for students to track their progress to appropriately pace their studies. Students often overlook the importance of practicing test-taking skills. Many students study alone for standardized tests and don't reap the benefits of group learning. Our solution is an application for AR glasses that would act as a study assistant. The application would use the camera on the glasses to monitor the student's study session and would display useful information to help make the session more effective. The application would provide coaching to improve test-taking skills, monitor progress towards the student's goals, and even connect students for peer study sessions.

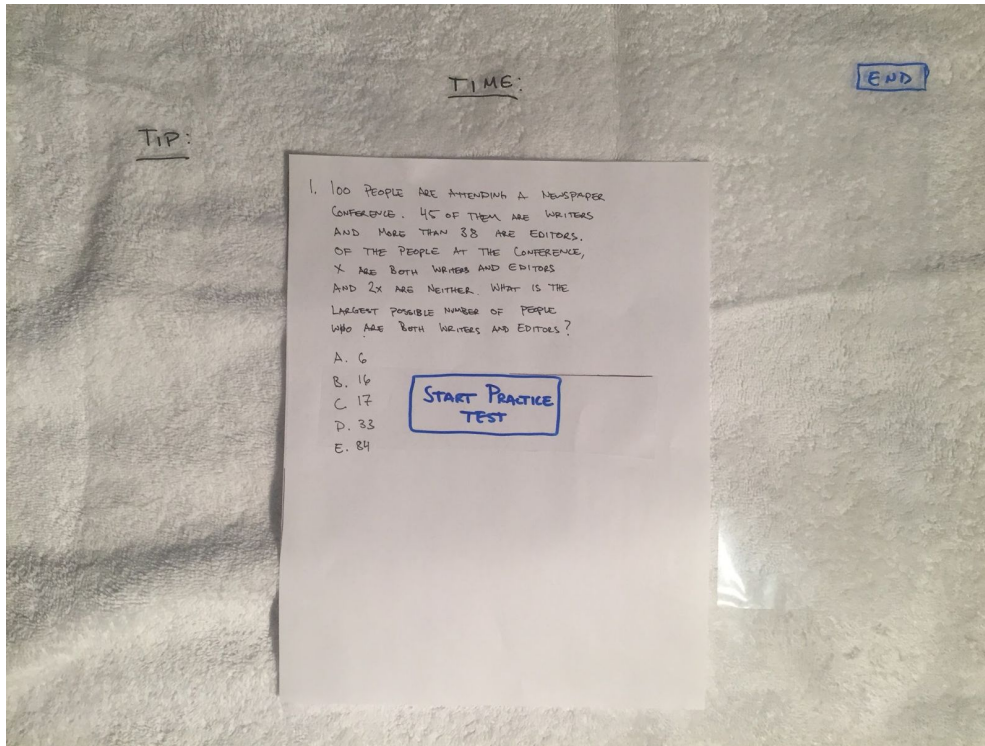
Initial Paper Prototype

Present your original paper prototype, as a baseline against which this report will present your iteration. Convey the critical aspects of your design, including your two primary tasks.

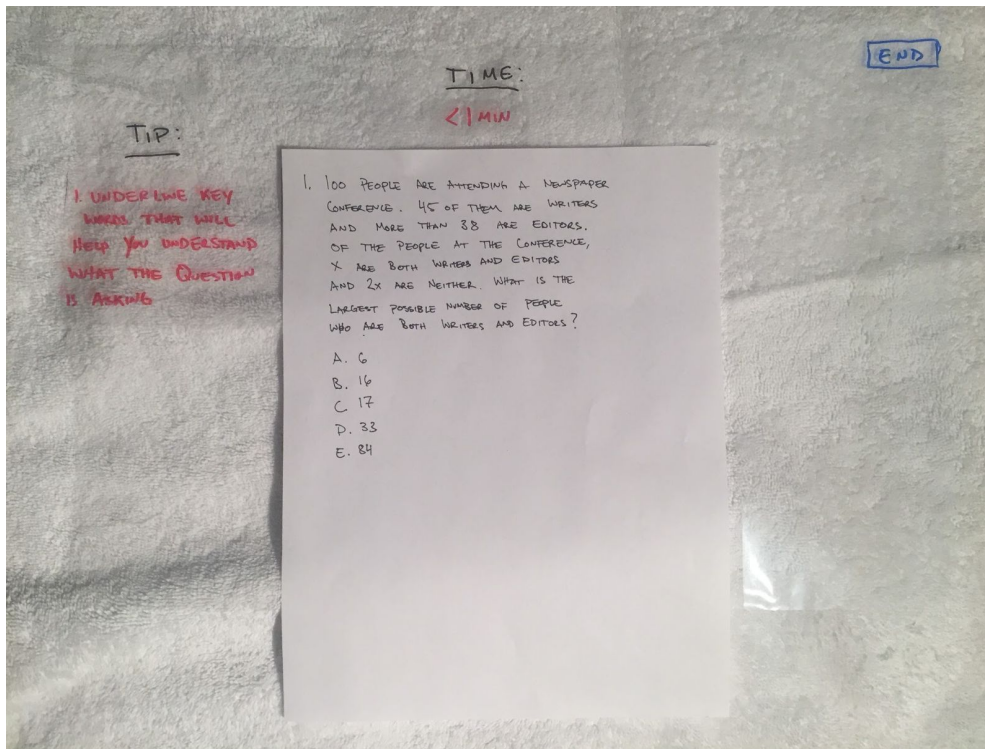
Master overview



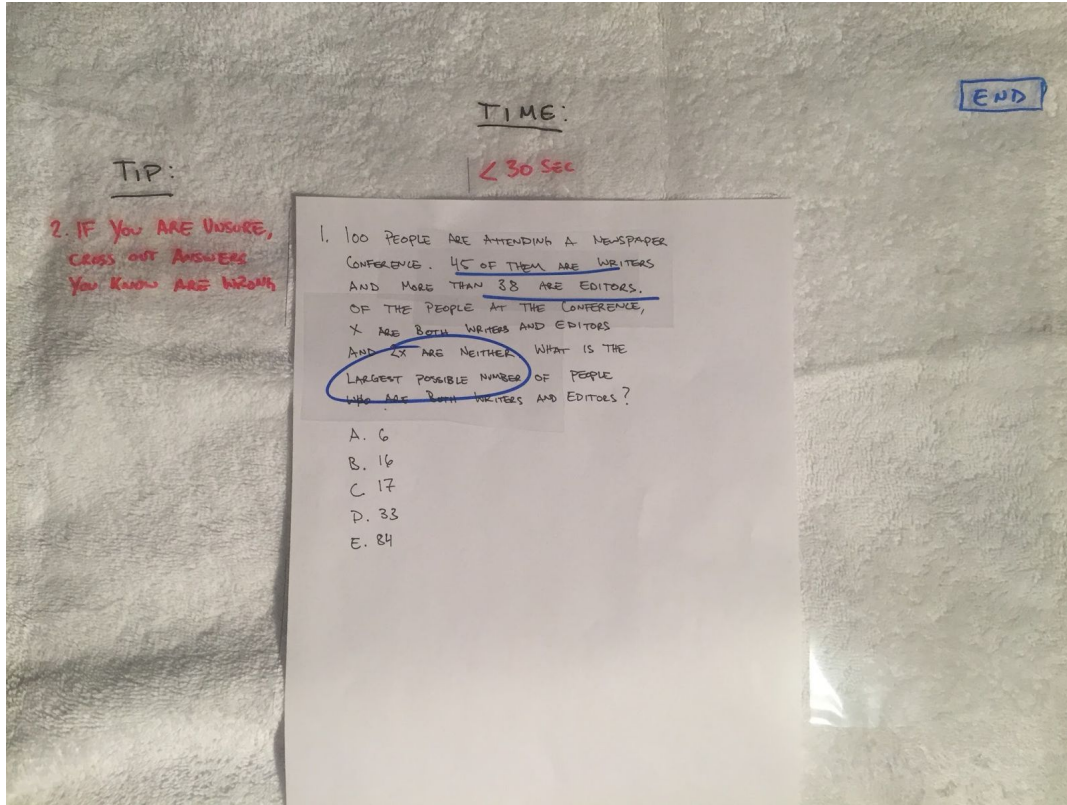
Task 1: Test-Taking Tips



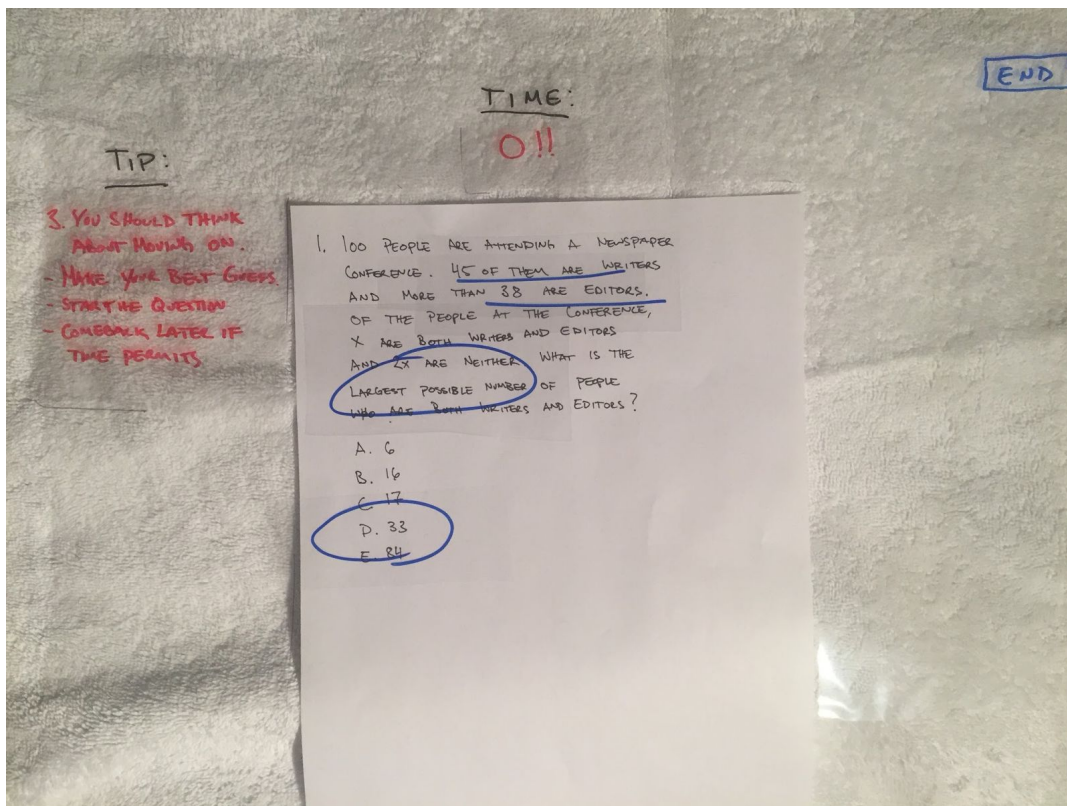
1a: The user starts the practice test by pointing to "Start Practice Test"



1b: The timer starts and the first tip is offered to the user

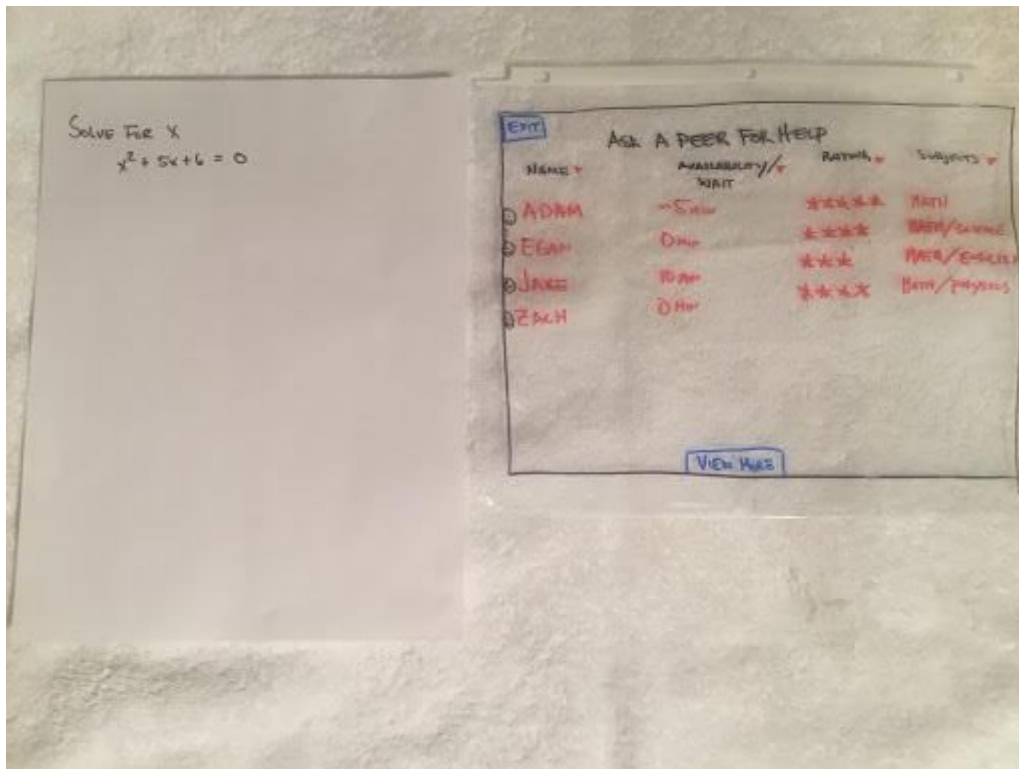


1c: The time is half expired and the user still hasn't moved on. A second tip is offered.

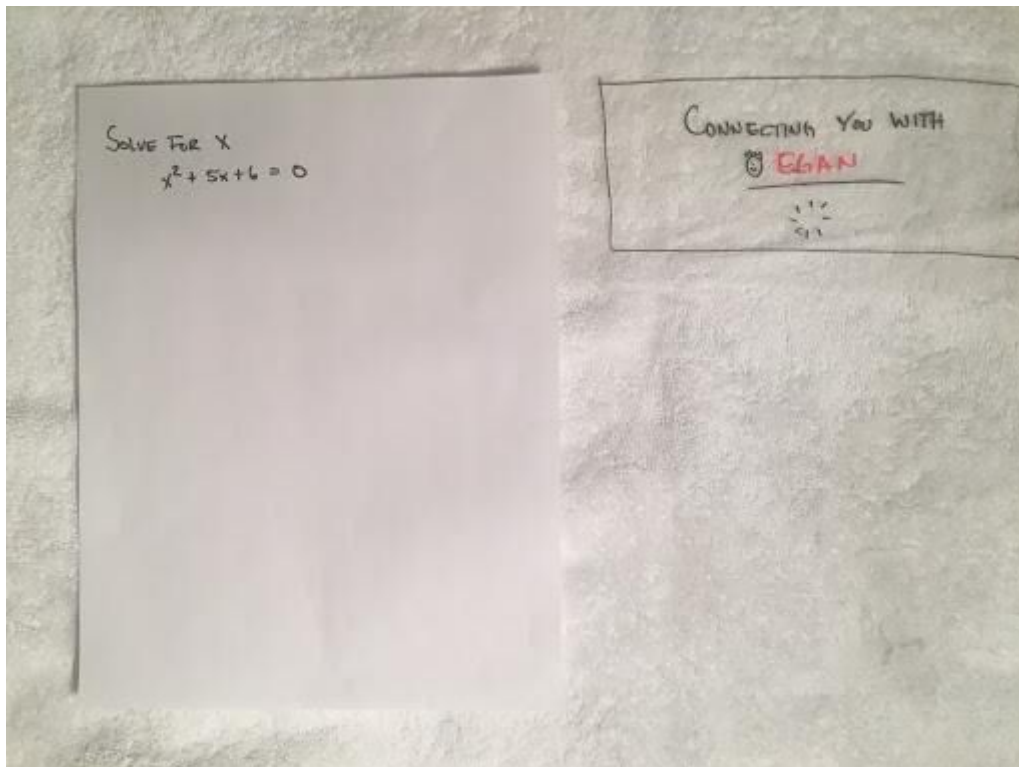


1d: Time is up. The user is encouraged to guess and move on.

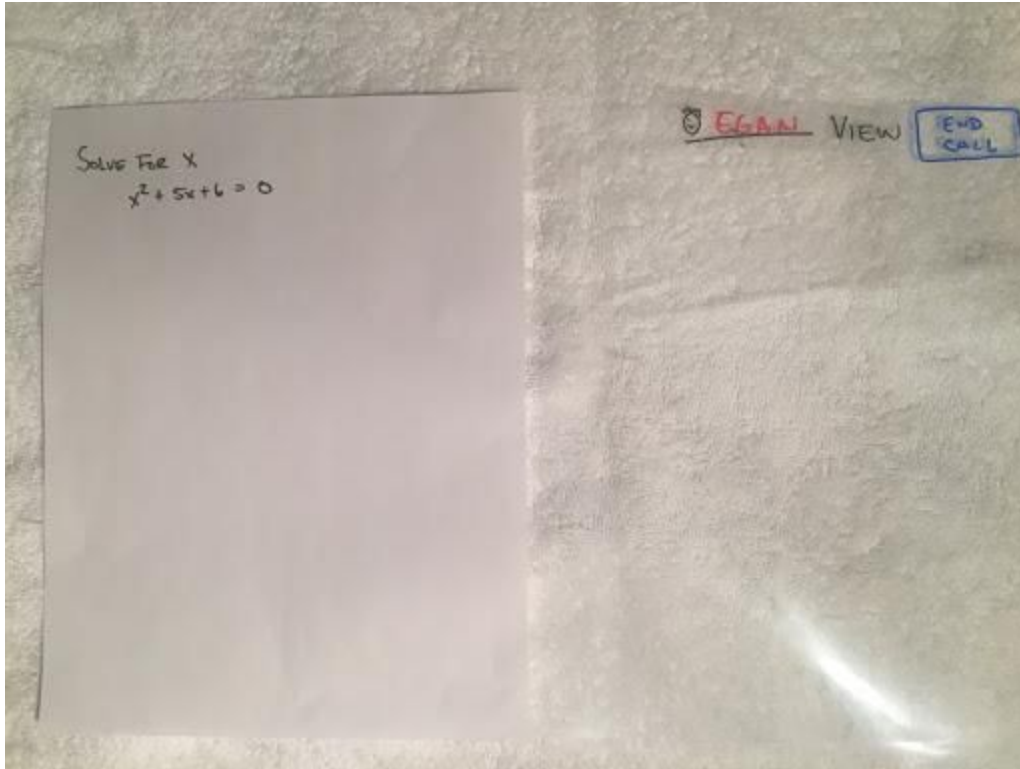
Task 2: Peer Help System



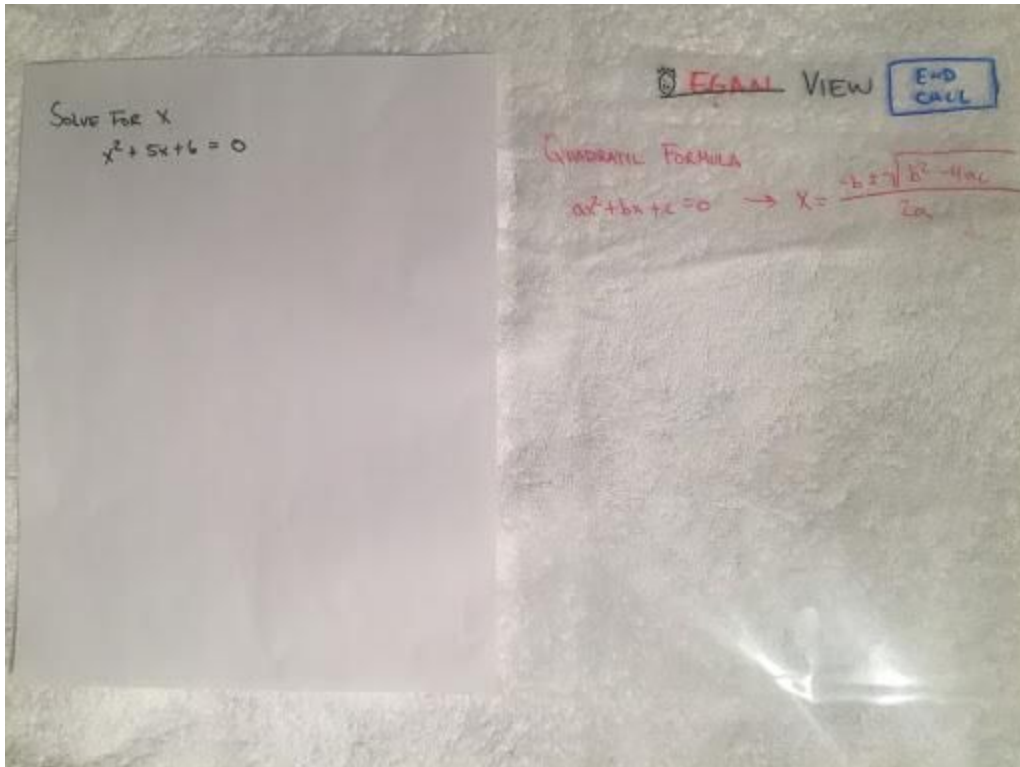
2a: User is presented with a list of peers available to help.



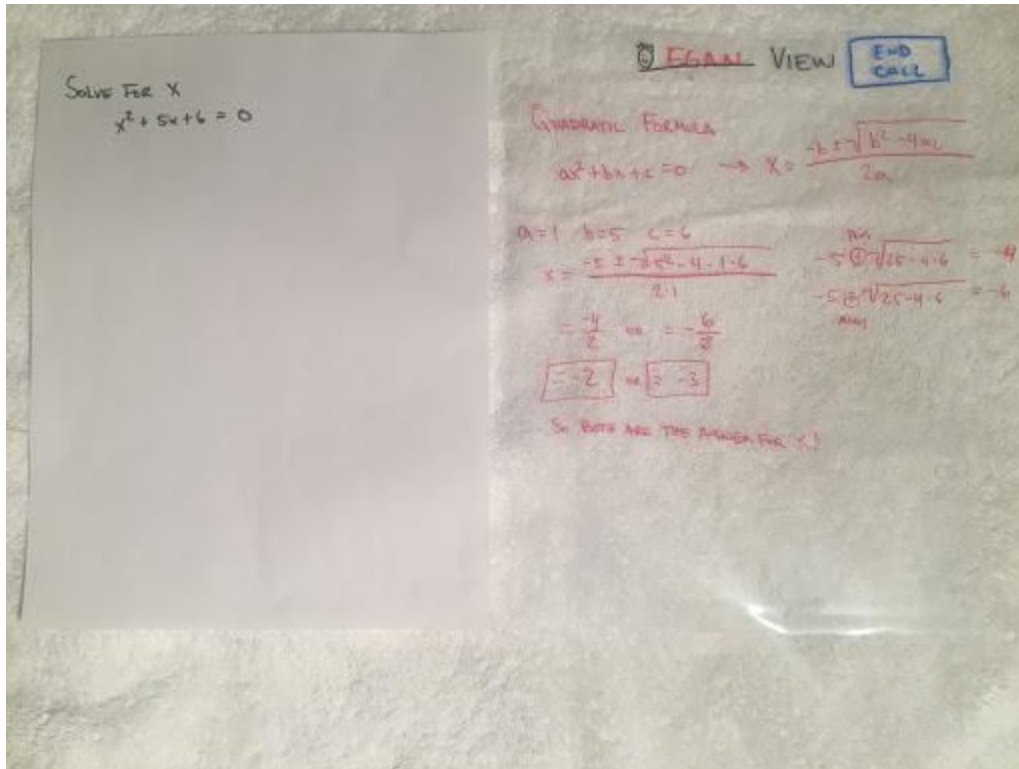
2b: User selects a peer and StudyBuddy connects the user with the peer.



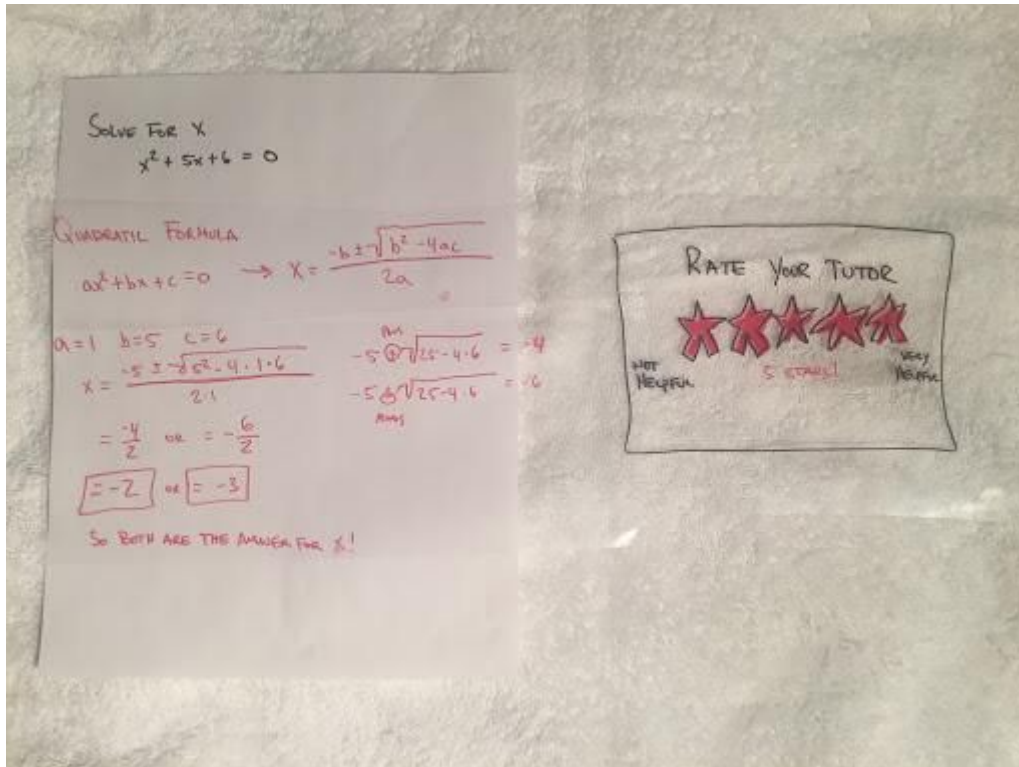
2c: Once user and peer are connected they can discuss the problem.



2d: Both the user and peer tutor can see each other's screens and walk through the problem.



2e: Peer tutor helps user solve the problem.



2f: User can rate the helpfulness of the peer tutor.

Testing Process

Methods

Our design has gone through a few different processes in order to build and improve upon our initial design. The first process was a series of heuristic evaluations on our initial prototype carried out by ourselves and peers from class. We made some minor changes from these evaluations and then carried out our first usability test. After reviewing the results from the first usability test and making additional changes to the prototype, we had two additional usability tests with members from our user base. We took time in between each usability test to examine results and implement any changes we thought were necessary in order to improve our design before the next usability test. Throughout this entire process we continuously reviewed our designs in team talk-aloud sessions in order to make sure we were in sync with our design processes and improvements to our prototype.

Usability Tests

For each usability test we began by explaining what our project is and what a usability test is. Then with each participant we would go over how we were going to conduct the test with them. At this point, we would see if the participant needed any clarification or if they had any additional questions before we began. We would then give the participant one task to perform at a time and would only provide assistance if it was required for the participant to complete the task. All of our participants were assigned the same two tasks in the same order. After the test was complete we would go over any observations made during the test and ask for any additional feedback the users would like to share.

We learned a few things about the testing process from our first usability test. We discovered that because our prototype has so many moving parts and screens, the process might go smoother if we had multiple team members dedicated to controlling the screens. To resolve this for future tests we had two team members act as computers in order to make the prototype move more smoothly. Also, we discovered that it was sometimes difficult to recall all of the nuances of how users interacted with our system. We decided that recording the process would be helpful so we could review the process and try to catch any things we may have missed.

Participants

Usability Test #1 Participant

The participant was a CS student and the usability test was carried out on campus where the student regularly studies. We chose this student because he has had experience with using AR glasses and we felt we could get valuable feedback from what he would typically expect from an AR interface. For this test we asked our participant to attempt our two tasks (Practice test-taking skills and peer to peer study help).

Usability Test #2 Participant:

Our second test was carried out with Boris, who is a previous participant from our contextual inquiries. Boris is preparing for the MCAT exam and is excited about the potential of our product. We carried out the test in Boris' home, where he would regularly study and asked him to perform the two tasks of finding peer help and practicing test-taking skills.

Usability Test #3 Participant:

Our third test was conducted with Laura, who is currently studying for the GRE. Laura was a little timid to participate in our test because she knew that it involved taking a practice test, and she was embarrassed because she thinks she is bad at math. We conducted the test at her home. We asked her to solve a math problem and consult a tutor for help if necessary, and to complete a practice test.

Testing Results

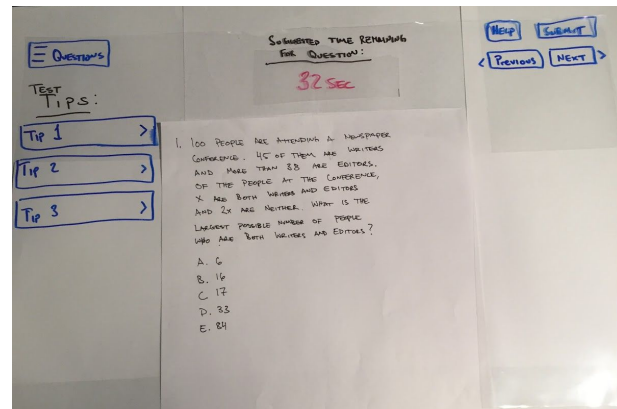
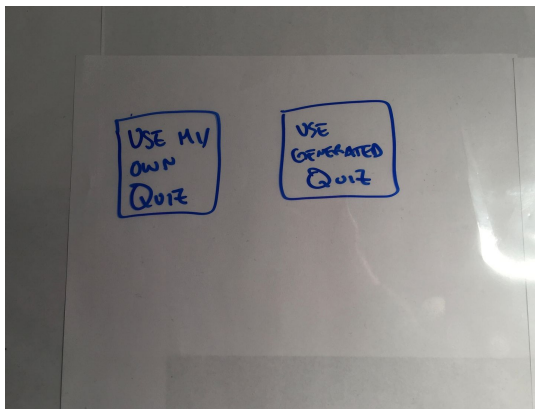
Heuristic Evaluation

The heuristic evaluations exposed many issues in our initial paper prototype. A few of these issues were low severity and required minor adjustments, however our design for the practice testing skills task had some serious problems that rated at a high severity level. The first main problem was that our design didn't inform the user that they needed their own test in order to practice their test taking skills. Later during the evaluation, we noticed that the user didn't even interact with the test taking tips section. This was a big issue because we thought this area was going to provide the most benefit in completing the task at hand, but in fact, was useless and completely overlooked by

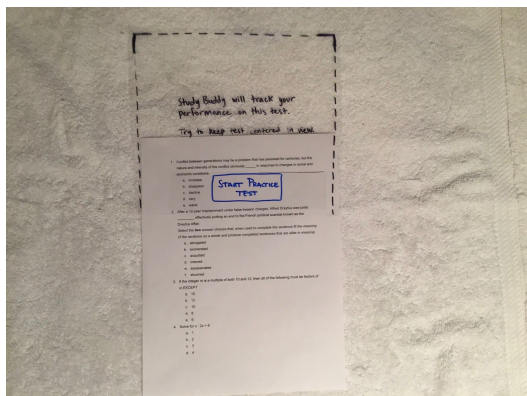
the user. This caused us to rethink our approach and come up with a new design that was more useful for our users.

The resolution to our first big issue was to show the user a screen that gives them the option to select a button indicating that they will be using their own test or a generated test from our service. This caused us to add some stuff to the practice test screen such as question controls that allowed them to navigate through their test. This solution was definitely not the best revision and we ultimately changed this design after our final user test. Our final design was to present them with a display before they start their practice session that clearly explains that they should have their own test and that it should always be kept in the view of the glasses.

Initial Revision:

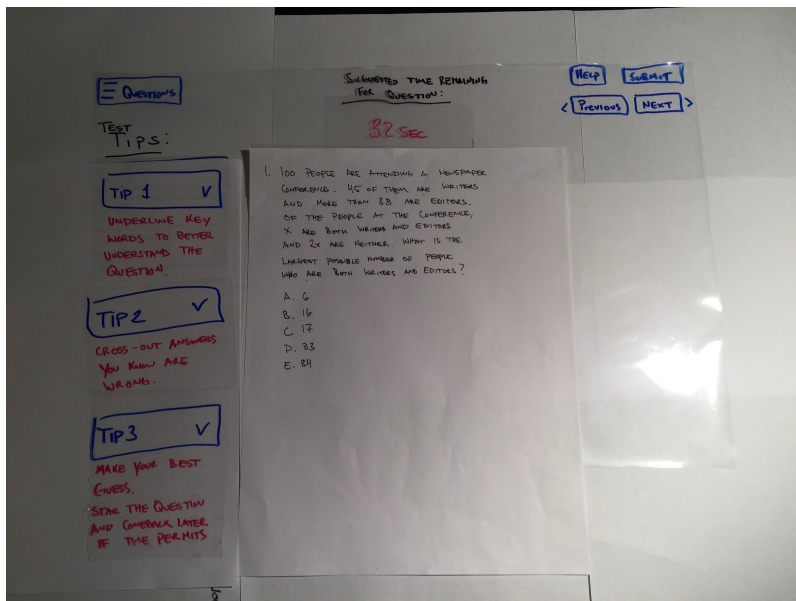


Final design:

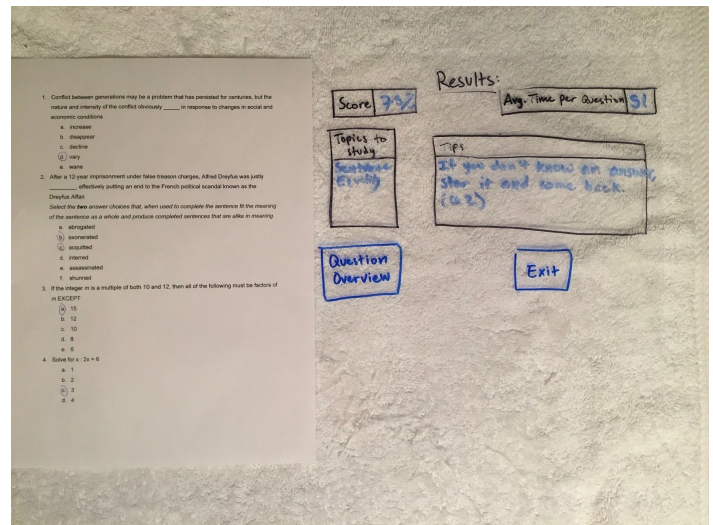
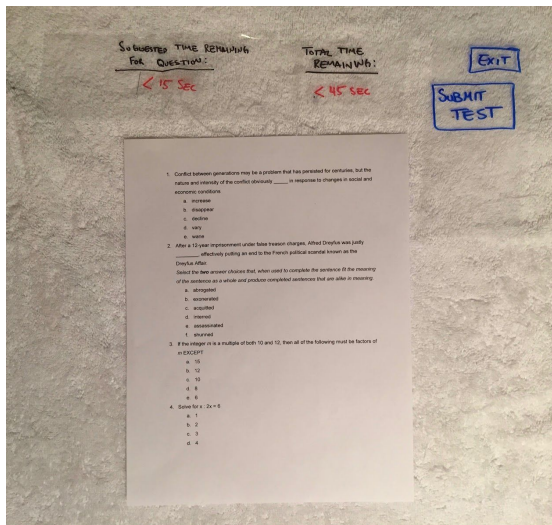


Our initial solution for the test taking tips issues was to provide different display for the tips section that would be easier to show and hide tips. We later realized after our second usability test that this was not the best solution and the problem could be improved. So we completely redesign the practice test taking feature so that it better simulated a real test taking experience. Also, rather than forcing the user to interact with test tips during their practice session, we placed the tips on a recap page that will appear once the user has completed their test. Moving the testing tips feature after the practice test session gives the users more time to interact with the feature and ultimately help them better understand the information it presents.

Initial Revision:



Final Design:



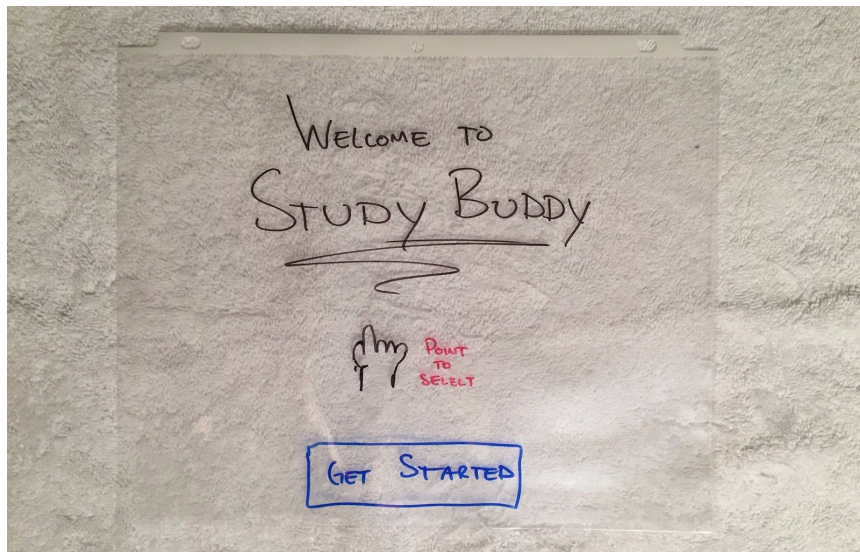
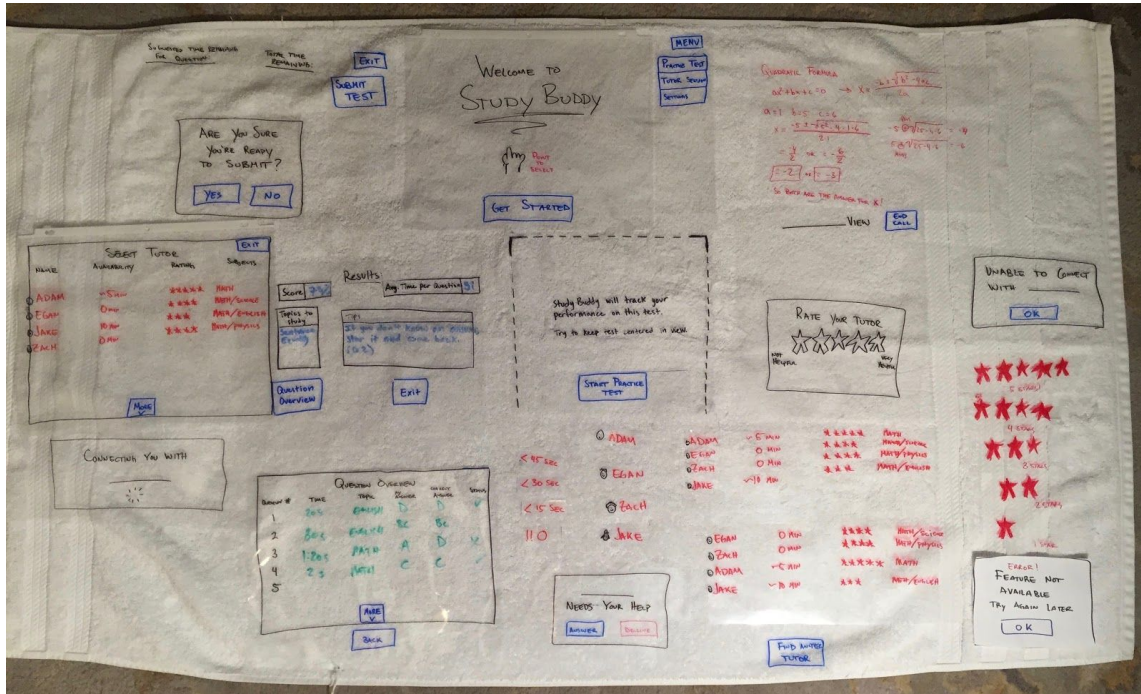
Usability Testing

The most transformative revision we made was changing the entire purpose of the practice test section of the application. We made this change in two parts - first, by adding the test overview section as a response to our first usability test, and second, by removing the tips section and putting it in the test overview as a response to our heuristic evaluation and second usability test. This revision is so important because it totally changes the concept we came up with for this task. We thought that users would be interested in getting tips while taking the test that would help them with time management and test-taking skills. We found out that the users didn't actually like this and preferred to take the test uninterrupted. Although it was difficult to part with a concept that we were excited about, we agree with our users that this new direction is better. It makes more sense to wait until the end of the test, when we know the user's test-taking strengths and weaknesses, to offer tips instead of firing off generic tips to every user on every question. This way, we can learn about the user's test-taking behavior and then make a suggestion on how they can improve. For example, if the user tends to spend a lot of time on questions that they end up skipping, we will suggest at the end of the test that the user should decide faster if they are going to skip a question so they don't waste as much time on unanswered questions.

One of the most important revisions we made was removing the part of our UI where the user declares what question they are working on. We weren't able to detect how big this problem was until our final usability test, because that was the first test in which we used a sheet of paper with more than one question. She forgot to press "next" when she moved on to the next question, and this threw off all of our results. We realized that the computer would have mixed up the times and answers, which would have thrown off the whole test overview. We decided that since it would be so easy to make this mistake when taking a practice test, it would probably happen more often than not. We decided the most seamless way to change the current question would be for the user to interact with the test the way they would naturally. This could mean circling an answer, underlining a keyword, or even looking at a question. We are assuming that the AR glasses have eye tracking technology (the hololens does) and that the glasses would be able to identify the question in focus through a combination of different metrics.

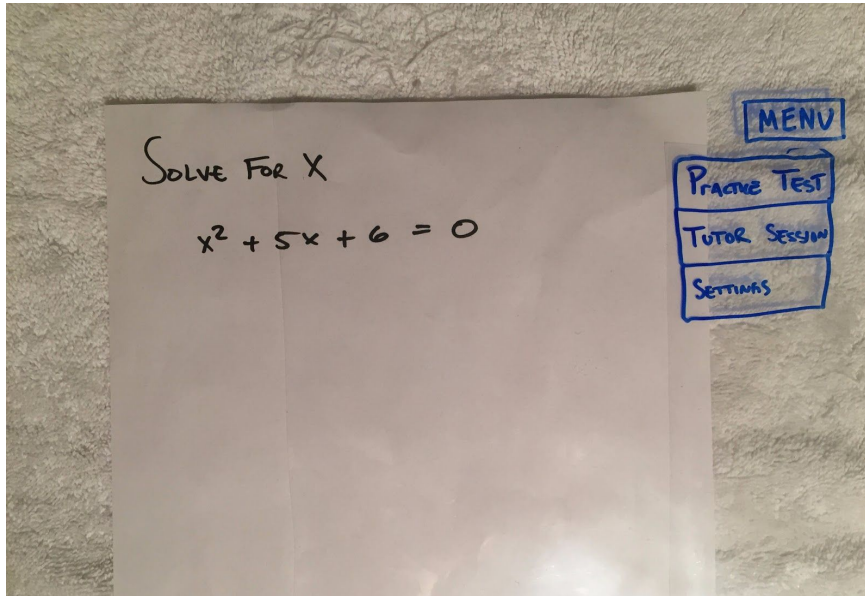
Final Paper Prototype

Master overview



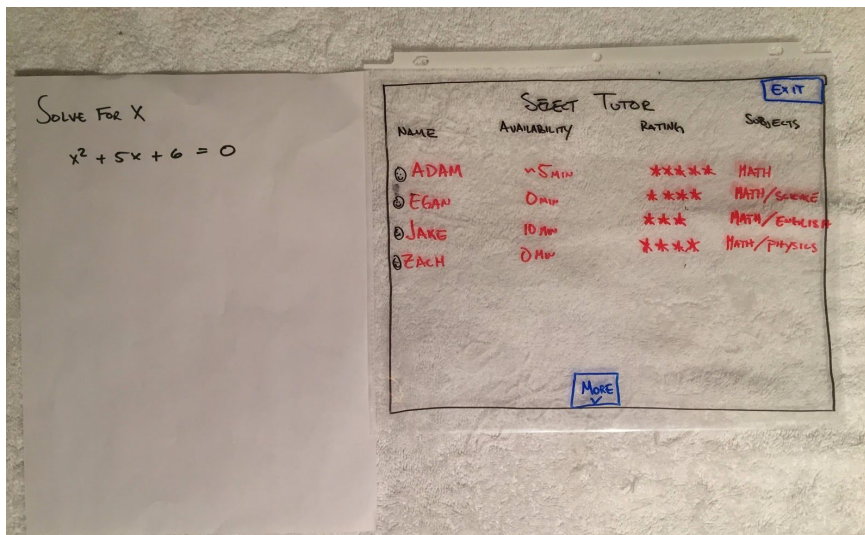
This is our welcome screen that will greet users when the first put on the AR glasses.

Task 1: Peer Help System

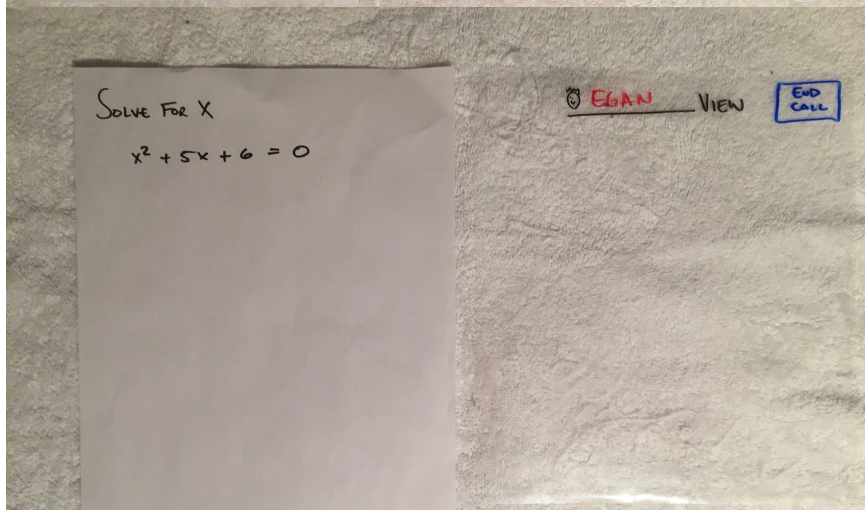


This is the home screen where users will be allowed to select the type of study session they want to perform. They can practice their test taking skills or they can study using our peer help system that connects them with a tutor upon request.

It's simple to prevent distractions while studying with the glasses on.

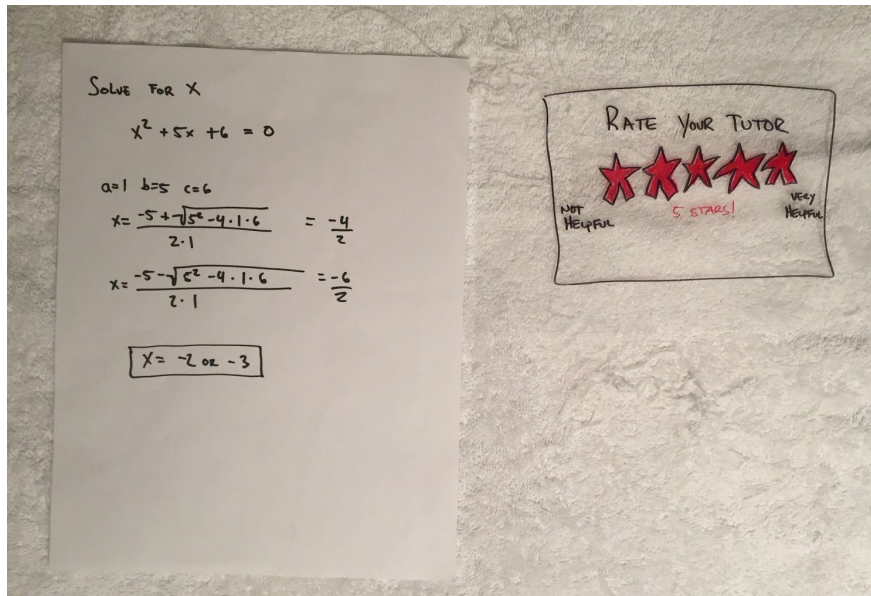


User is presented a list of peers that they can connect with to receive a quick and personal tutoring session for whatever they are currently studying.



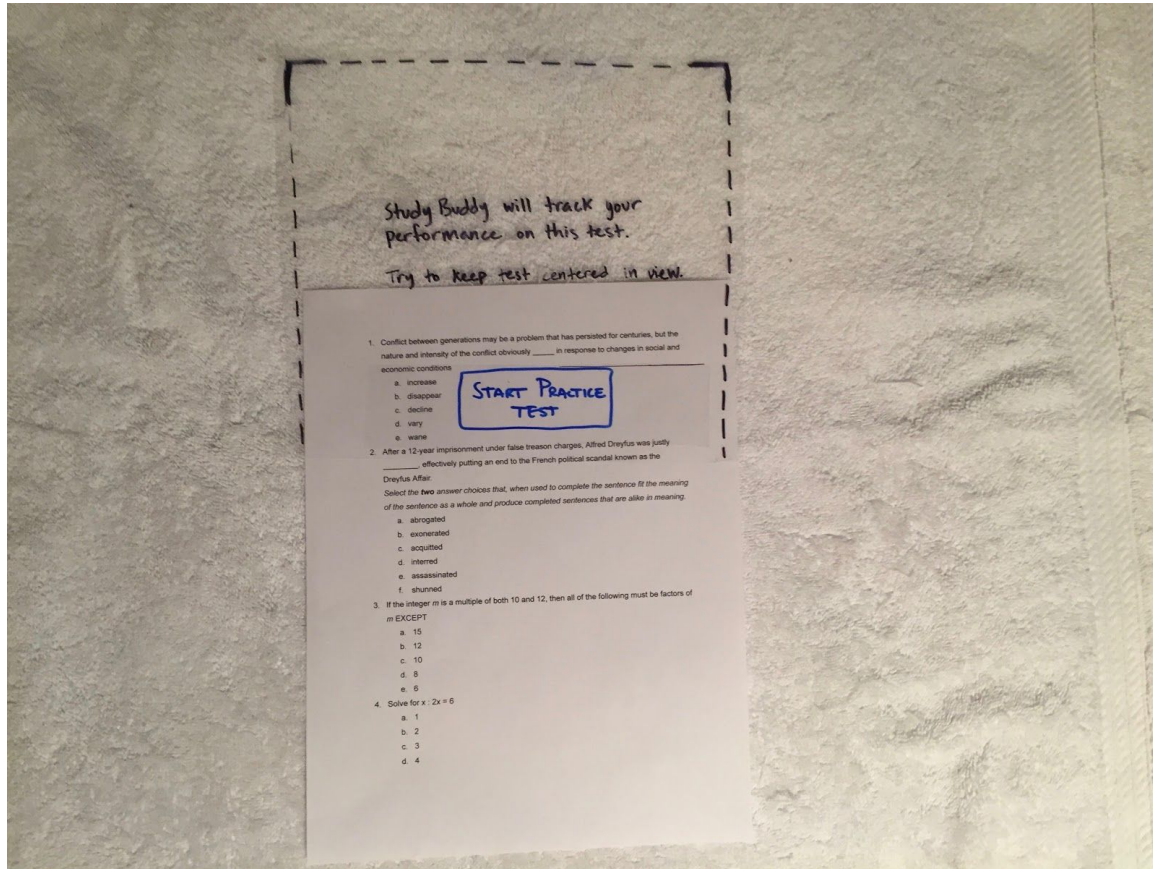
User selects a peer and StudyBuddy connects the user with the peer. Once user and peer are connected they can discuss the problem.

Both the user and peer tutor can see each other's screens and walk through the problem.

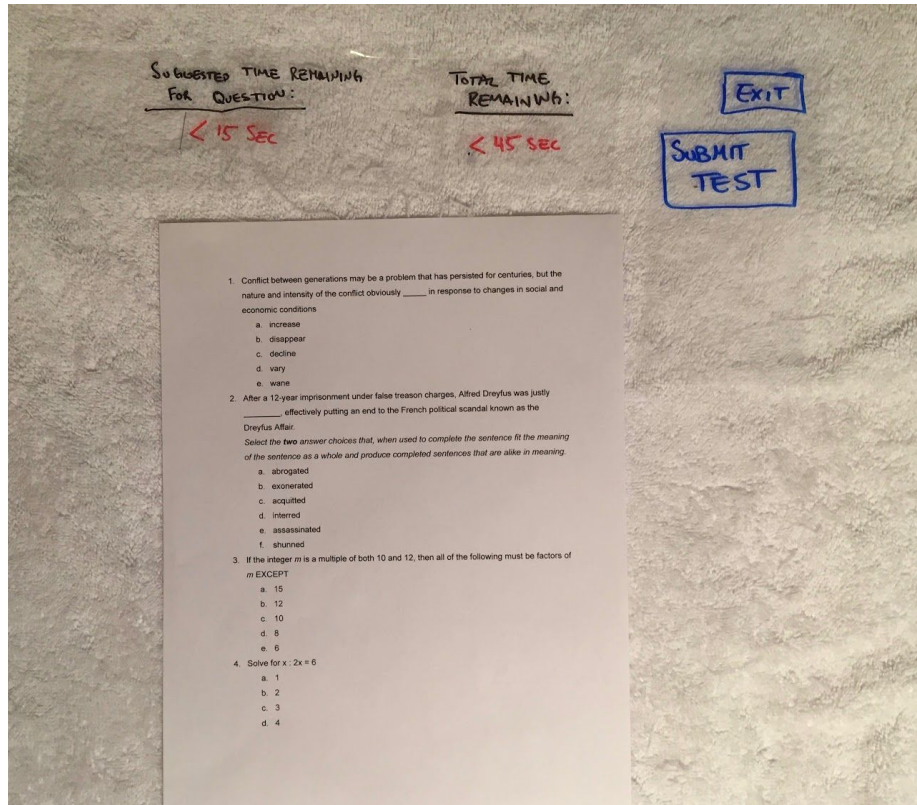


Upon finishing the call, user rates his tutor with a number of stars according to how helpful they were.

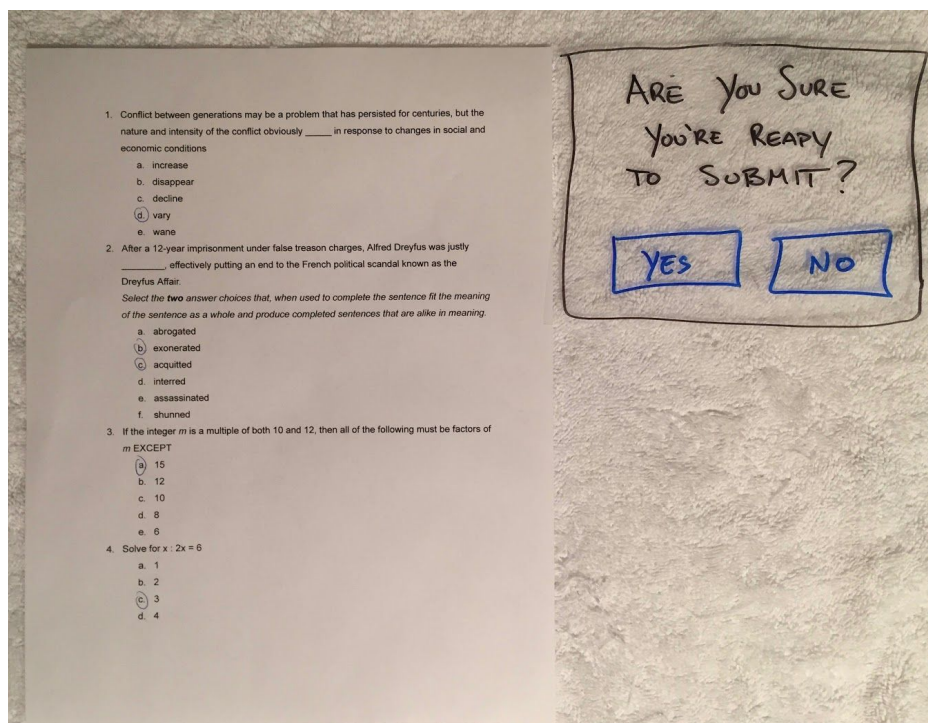
Task 2: Test-Taking Tips



When starting test taking practice, users will be presented this screen to inform them that they should have their own test and to center it in the screen so that we can track their behaviors to provide useful tips and suggestions post completion.



Suggested time clock begins ticking and resets whenever we detect the user has started a new question. The Total Time starts once they started taking the test. 'Exit' allows them to leave the practice test interface.



When user selects 'Submit Test' they will be prompted with a confirmation screen.

1. Conflict between generations may be a problem that has persisted for centuries, but the nature and intensity of the conflict obviously _____ in response to changes in social and economic conditions

- increase
- disappear
- decline
- vary
- wane

2. After a 12-year imprisonment under false treason charges, Alfred Dreyfus was justly _____, effectively putting an end to the French political scandal known as the Dreyfus Affair.

Select the **two** answer choices that, when used to complete the sentence fit the meaning of the sentence as a whole and produce completed sentences that are alike in meaning.

- abrogated
- exonerated
- acquitted
- interred
- assassinated
- shunned

3. If the integer m is a multiple of both 10 and 12, then all of the following must be factors of m EXCEPT

- 15
- 12
- 10
- 8
- 6

4. Solve for x : $2x = 6$

- 1
- 2
- 3
- 4

Results:

Score 75%

Avg. Time per Question 51

Topics to study

Sentences Ending

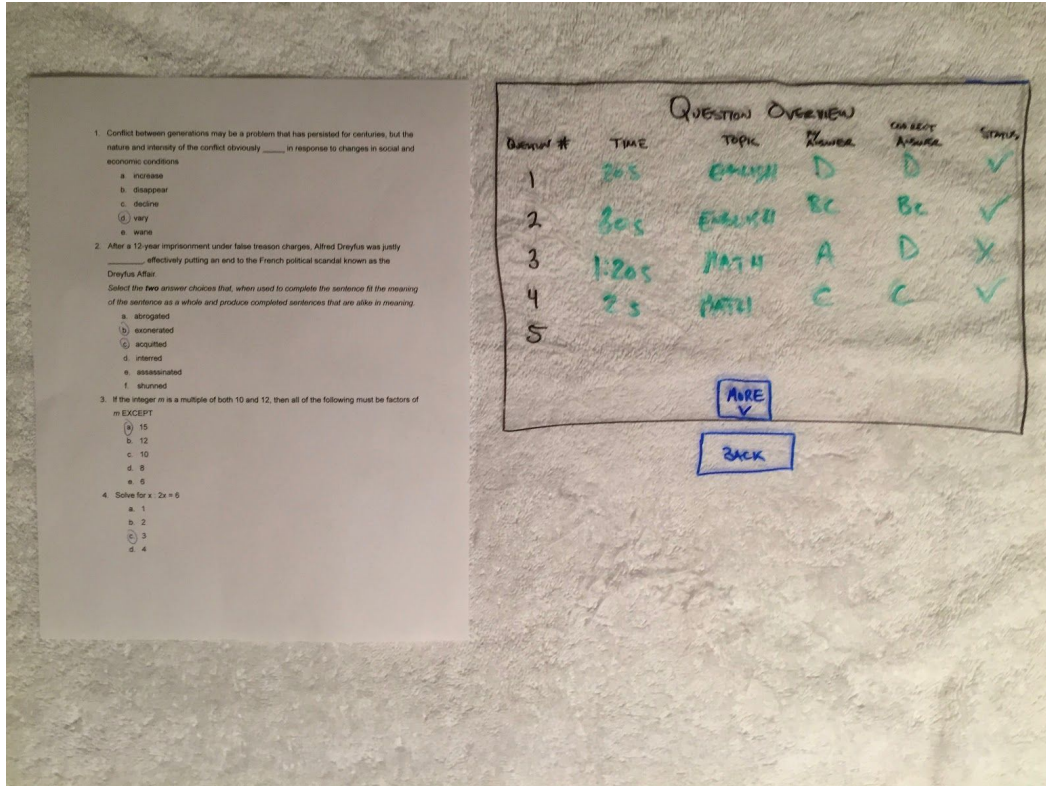
TIPS

If you don't know an answer, star it and come back. (Q2)

Question Overview

Exit

The user is presented with a recap of their practice test. They are informed about their score, how long the test took, how much time they spent on each question, study suggestions, and test taking tips based on their behaviors from the practice test. They can also get an analysis for each question by selecting 'Question Overview'.



Users will be able to view an overview for each question from their practice test. This can provide useful information that helps them better prepare for their actual tests. Users can analyze their time spent for each question, the questions topic, their answer, the correct answer, and if they were correct or not.

Digital Mockup

Design Decisions and Changes

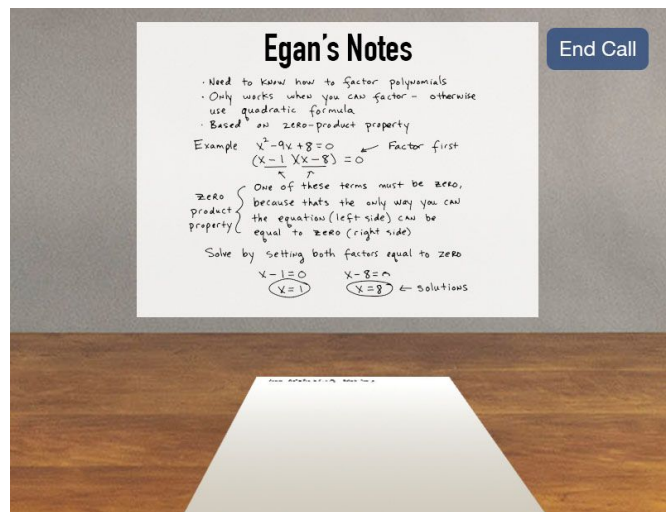
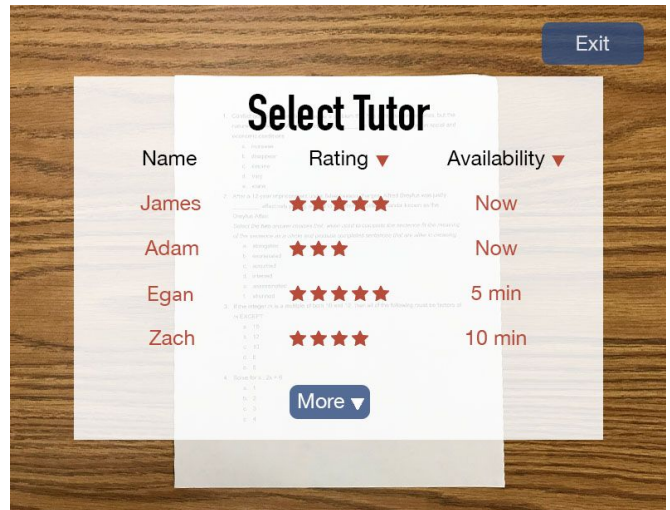
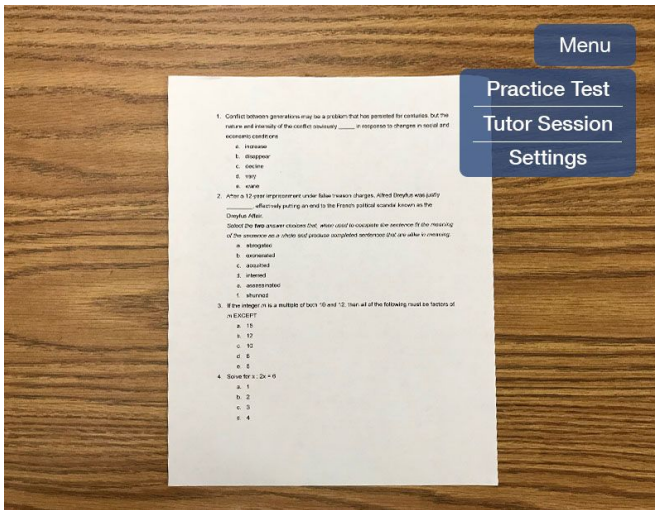
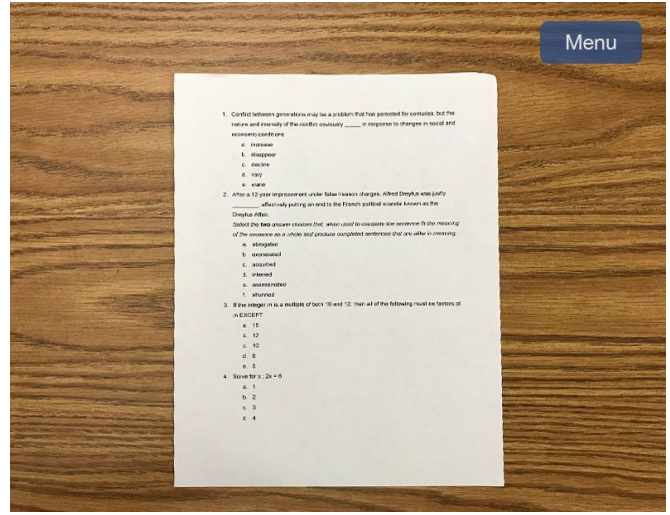
Our digital mockup reflects the feedback from our various usability tests as well as our heuristic evaluations. A few minor changes were made from the transition between our final paper prototype and the digital mockup.

The 'Subject' column was removed from the Select Tutor page. We deemed that column to be unnecessary once you are already looking for a tutor for a specific problem. We removed the column and added a screen that asks for the topic you would like tutor help with. Once the topic is selected then the user is shown tutors who match their needs.

We decided to display the 'Tutor View' in a different location (on a wall in front of the user) in order to show that AR display windows are moveable and adjustable based on the user's preference. We also added a small "bubble" that reminds the user where the 'Tutor View' display window is located.

Lastly, we decided to slightly change the design that informs the user to keep their tests in view. Our paper prototype used a dotted 3-sided outline but we decided to switch to a 4 corner outline.

Digital Mockup: Master Overview



Egan's Notes

End Call

Given $Ax^2 + Bx + C = 0$ solve for x

① $(x\sqrt{A} + \frac{B}{2\sqrt{A}})^2 = (Ax + Bx + \frac{B^2}{4A})$ Proof

② $(x\sqrt{A} + \frac{B}{2\sqrt{A}})^2 = \frac{B^2}{4A} + C = 0$

$(x\sqrt{A} + \frac{B}{2\sqrt{A}})^2 = (\frac{B^2}{4A} - C)$

③ $(x\sqrt{A} + \frac{B}{2\sqrt{A}}) = \pm \sqrt{\frac{B^2 - 4AC}{4A}}$ — split the sign

$(x\sqrt{A} + \frac{B}{2\sqrt{A}}) = \frac{\pm \sqrt{B^2 - 4AC}}{2\sqrt{A}}$ — $-\frac{B \pm \sqrt{B^2 - 4AC}}{2\sqrt{A}} = x\sqrt{A}$

$(\frac{2\sqrt{A}x}{2} + \frac{B}{2\sqrt{A}}) = \frac{\pm \sqrt{B^2 - 4AC}}{2\sqrt{A}}$ — $[\frac{-B \pm \sqrt{B^2 - 4AC}}{2A} = x]$

$\frac{2\sqrt{A}x}{2\sqrt{A}} + \frac{B}{2\sqrt{A}} = \frac{\pm \sqrt{B^2 - 4AC}}{2\sqrt{A}}$

$\frac{2\sqrt{A}x}{2\sqrt{A}} = \frac{-B \pm \sqrt{B^2 - 4AC}}{2\sqrt{A}}$

$2\sqrt{A}x = -B \pm \sqrt{B^2 - 4AC}$

$x = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A}$ — Too long, I missed some things.

How helpful was Egan?

not helpful ☆☆☆☆ very helpful

Given $Ax^2 + Bx + C = 0$ solve for x

① $(x\sqrt{A} + \frac{B}{2\sqrt{A}})^2 = (Ax + Bx + \frac{B^2}{4A})$ Proof

② $(x\sqrt{A} + \frac{B}{2\sqrt{A}})^2 = \frac{B^2}{4A} + C = 0$

$(x\sqrt{A} + \frac{B}{2\sqrt{A}})^2 = (\frac{B^2}{4A} - C)$

③ $(x\sqrt{A} + \frac{B}{2\sqrt{A}}) = \pm \sqrt{\frac{B^2 - 4AC}{4A}}$ — split the sign

$(x\sqrt{A} + \frac{B}{2\sqrt{A}}) = \frac{\pm \sqrt{B^2 - 4AC}}{2\sqrt{A}}$ — $-\frac{B \pm \sqrt{B^2 - 4AC}}{2\sqrt{A}} = x\sqrt{A}$

$(\frac{2\sqrt{A}x}{2} + \frac{B}{2\sqrt{A}}) = \frac{\pm \sqrt{B^2 - 4AC}}{2\sqrt{A}}$ — $[\frac{-B \pm \sqrt{B^2 - 4AC}}{2A} = x]$

$\frac{2\sqrt{A}x}{2\sqrt{A}} + \frac{B}{2\sqrt{A}} = \frac{\pm \sqrt{B^2 - 4AC}}{2\sqrt{A}}$

$\frac{2\sqrt{A}x}{2\sqrt{A}} = \frac{-B \pm \sqrt{B^2 - 4AC}}{2\sqrt{A}}$

$2\sqrt{A}x = -B \pm \sqrt{B^2 - 4AC}$

$x = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A}$ — Too long, I missed some things.

Exit

Try to keep the test centered in view so StudyBuddy can track your performance

Start Practice Test

Suggested time remaining for question: 0:17 Total time remaining: 2:12

Exit

Submit

1. Conflict between generations may be a problem that has persisted for centuries. But the nature and intensity of the conflict ultimately _____ in response to changes in social and economic conditions.

a. increases
b. disappears
c. declines
d. stays
e. varies

2. After a 12 year imprisonment under false charges, Alfred Dreyfus was partly _____ afterwards paying a nod to the French political system known as the Dreyfus Affair.

Select the two answer choices that, when used to complete the sentence fit the meaning of the sentence as a whole and produce a completed sentence that are also in meaning.

a. atonement
b. acquiesced
c. acquiesced
d. atonement
e. acquiesced
f. atonement

3. If the integer n is a multiple of both 10 and 12, then all of the following must be factors of n .

a. 15
b. 12
c. 11
d. 6
e. 5

4. Solve for x , $2x + 6 = 0$

a. 1
b. 2
c. 3
d. 4

Exit

Results

Score: 75% Avg. time per question: 0:51

Topics that need review:

Sentence Equality
Algebra
Problem Solving

Tips:
If you don't know an answer, star it and come back.
Determine as quickly as possible if you want to skip.

Question Overview

Are you sure you want to submit?

Submit Cancel

Question Overview

Question: 1

Time: 1:08
(a little too slow)

Topic: Algebra

Correct Answer: A

Status: Correct

Tips: It can be overwhelming to have 5 answers to choose from. Try to cross out unlikely options to narrow the possibilities.

Exit

1. Conflict between generations may be a problem that has persisted for centuries. On the nature and intensity of the conflict, country _____ in response to changes in social and economic conditions.

- a. increase
- b. disappear
- c. decline
- d. vary
- e. wane

2. After a 12-year imprisonment under false treason charges, Alfred Dreyfus was justly _____, effectively putting an end to the French political scandal known as the Dreyfus Affair.

3. Select the best answer choice that, when used to complete the sentence, fits the meaning of the sentence as a whole and produces a complete sentence that is clear in meaning.

- a. straggled
- b. commended
- c. acquitted
- d. informed
- e. demonstrated
- f. advanced

4. If the integer n is a multiple of both 10 and 12, then all of the following must be factors of n : EXCEPT

- a. 15
- b. 13
- c. 11
- d. 8
- e. 6

5. Solve for x : $2x + 9 = 6$

- a. 1
- b. 2
- c. 3
- d. 4

1. Conflict between generations may be a problem that has persisted for centuries. On the nature and intensity of the conflict, country _____ in response to changes in social and economic conditions.

- a. increase
- b. disappear
- c. decline
- d. vary
- e. wane

Select Topic

2. After a 12-year imprisonment under false treason charges, Alfred Dreyfus was justly _____, effectively putting an end to the French political scandal known as the Dreyfus Affair.

3. Select the best answer choice that, when used to complete the sentence, fits the meaning of the sentence as a whole and produces a complete sentence that is clear in meaning.

4. If the integer n is a multiple of both 10 and 12, then all of the following must be factors of n : EXCEPT

- a. 15
- b. 13
- c. 11
- d. 8
- e. 6

5. Solve for x : $2x + 9 = 6$

- a. 1
- b. 2
- c. 3
- d. 4

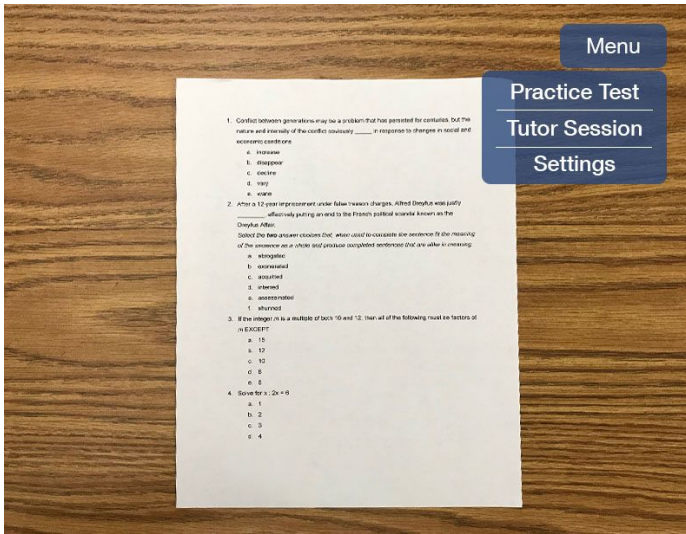
Analytical Writing

Verbal Reasoning

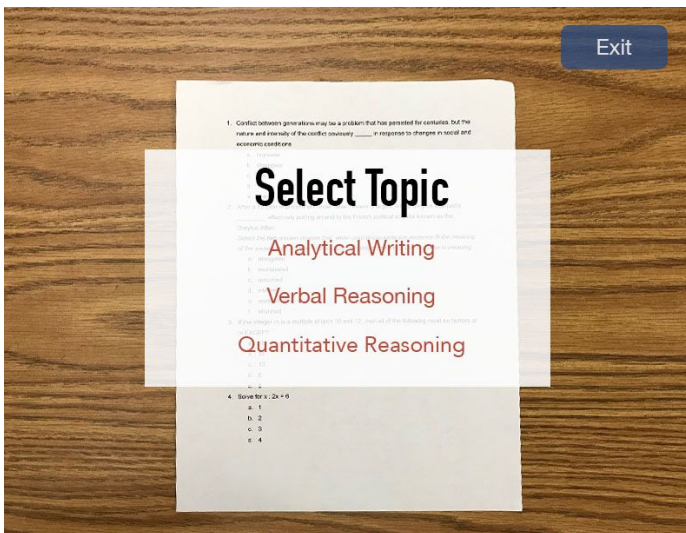
Quantitative Reasoning

Exit

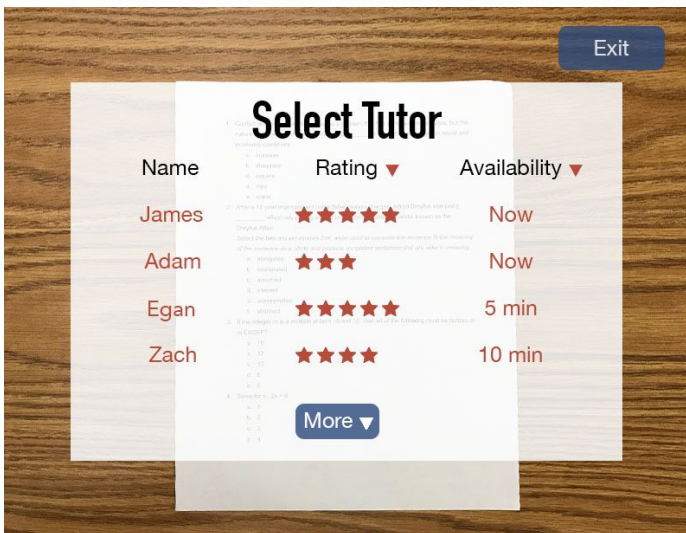
Task #1 Detailed Walkthrough: Peer Help System



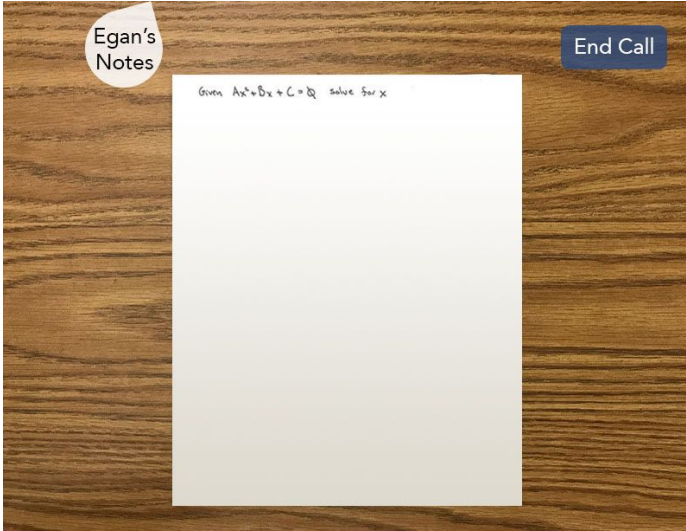
While the user is studying, they can instantly find help by opening the menu and selecting 'Tutor Session'.



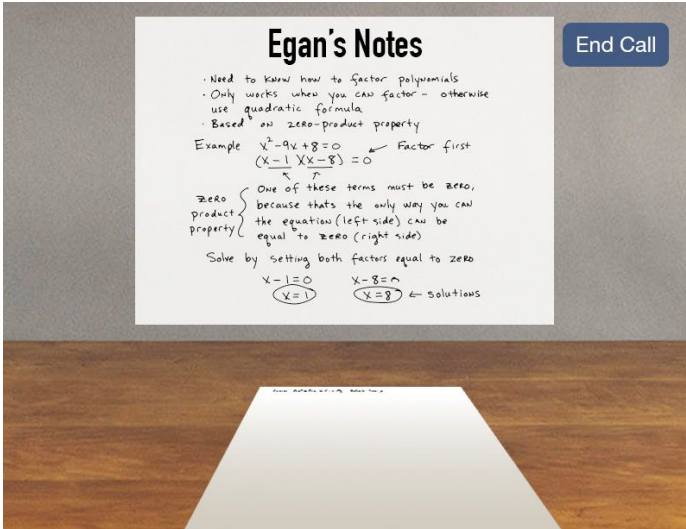
The user is given a list to choose from containing all of the topics on the exam they are studying for. The topics populated at the top of the list are the topics in which the glasses think the user is asking for help on.



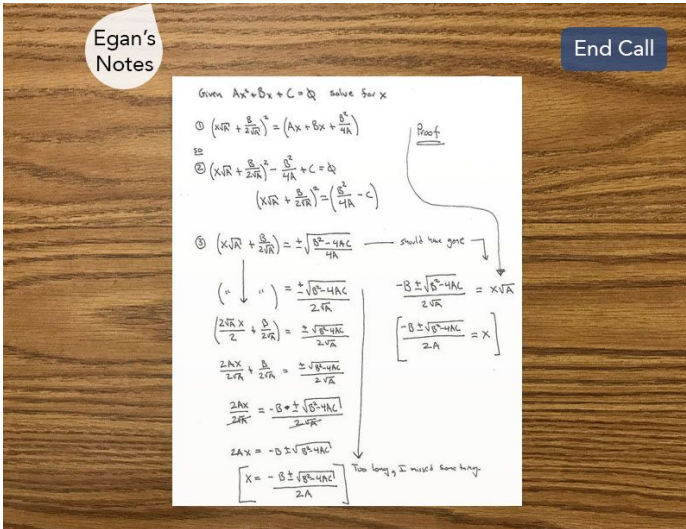
The user is presented a list of peers that they can connect with to receive a quick and personal tutoring session for whatever they are currently studying.



User selects a peer and StudyBuddy connects the user with the peer. Once user and peer are connected they can discuss the problem.



Both the user and peer tutor can see each other's screens and walk through the problem.



With the assistance of the peer tutor the user can work their way through the problem.

Given $Ax^2 + Bx + C = D$ solve for x

① $(\frac{Ax}{2A} + \frac{B}{2A})^2 = (\frac{Ax}{2A} + \frac{B}{2A})^2$ Proof

se $(\frac{Ax}{2A} + \frac{B}{2A})^2 = \frac{B^2}{4A^2} + C - D$

How helpful was Egan?

not helpful ☆☆☆☆ very helpful

$\frac{2Ax}{2A} + \frac{B}{2A} = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A}$

$\frac{2Ax}{2A} + \frac{B}{2A} = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A}$

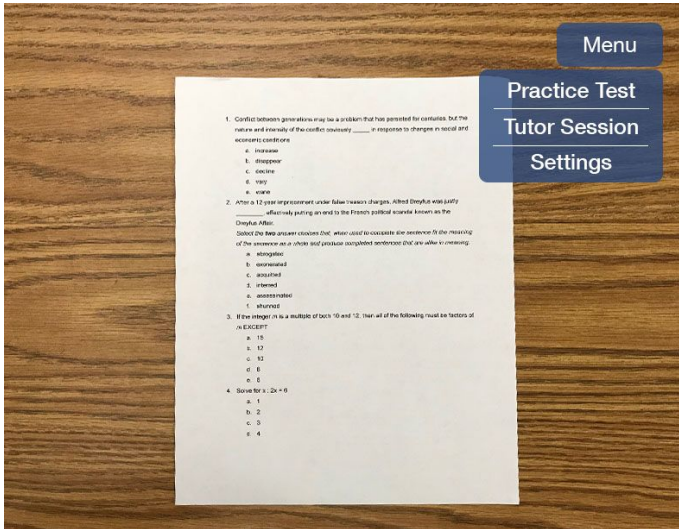
$\frac{2Ax}{2A} = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A} - \frac{B}{2A}$

$2Ax = -B \pm \sqrt{B^2 - 4AC}$

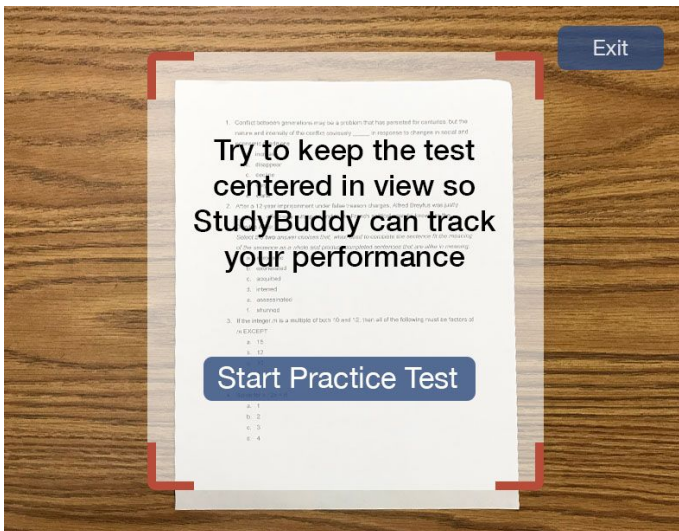
$X = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A}$ Too long, I missed some things.

Upon finishing the call, the user rates the tutor with a number of stars according to how helpful they were.

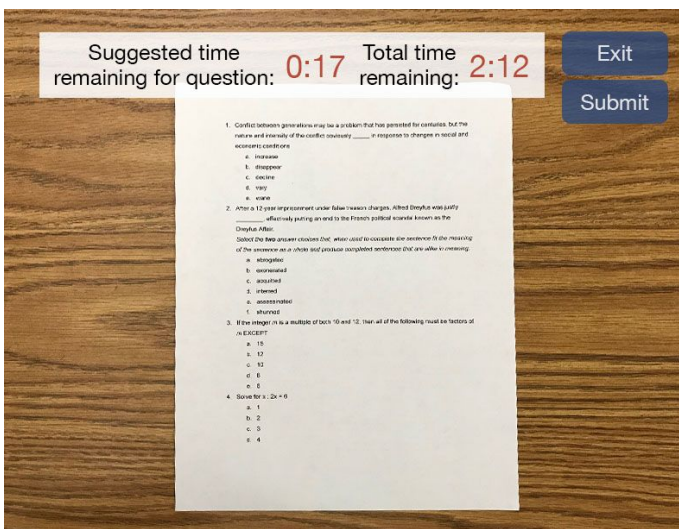
Task #2 Detailed Walkthrough: Test Taking Tips



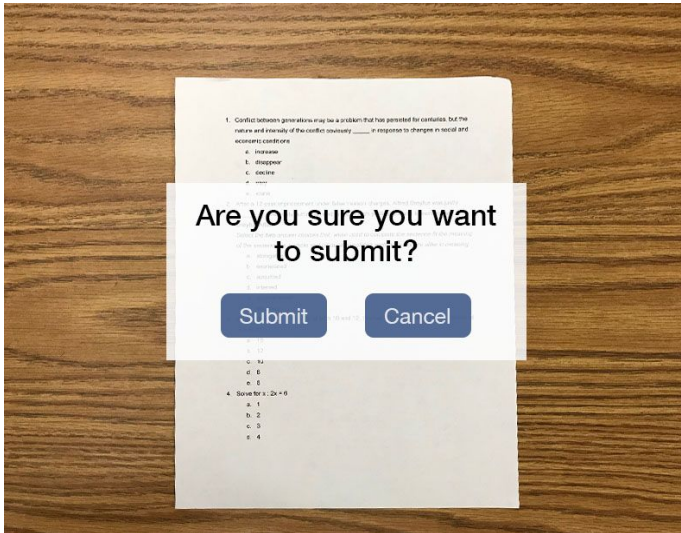
While the user is studying, they can instantly practice their test taking skills by opening the menu and selecting 'Practice Test'.



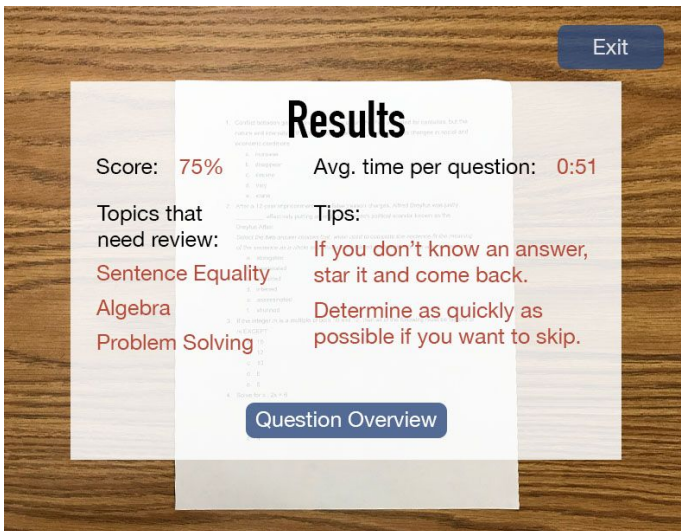
When starting test taking practice, users will be presented this screen to inform them that they should have their own test and to center it in the screen so that we can track their behaviors to provide useful tips and suggestions post completion.



Suggested time clock begins ticking and resets whenever we detect the user has started a new question. The Total Time starts once they started taking the test. 'Exit' allows them to leave the practice test interface.

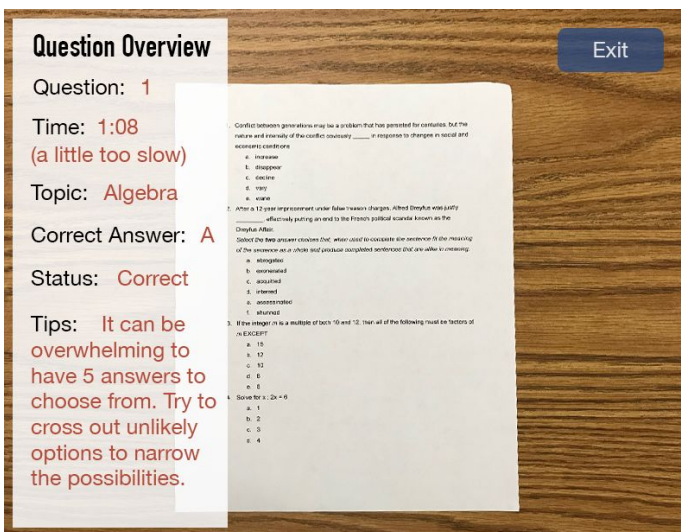


When user selects 'Submit Test' they will be prompted with a confirmation screen.



After confirming their submission, the user will be presented with: test score, avg. time per question, suggested topics to study, and tips about how they could improve their test taking skills based on their behaviors while taking the practice test.

They can also get an analysis for each question by selecting 'Question Overview'.



Users will be able to view an overview for each question from their practice test. This can provide useful information that helps them better prepare for their actual tests. Users can analyze their time spent for each question, the questions topic, their answer, the correct answer, and if they were correct or not.

Discussion

One of the main things we learned from the iterative design process was that we often put things in our design that did not really make sense to our users. This was due to the fact that we had different expectations and understandings about our design from that of our users. We also learned how hard it is to remind ourselves that we are not our users, and that our users have a different backgrounds, technical skills, and needs from ourselves. The process of iterative design was very powerful in helping us convey our ideas and discover quickly from our users what actually worked well and what did not work well.

The iterative design process helped us to realize that our early designs were often giving our users too many options and too much information. This caused our users to feel overwhelmed or distracted. Our final design ended up being a much simpler and more subtle interface in order to let users focus on their task at hand while getting help when needed.

In our earlier designs for the practice test task, we were trying to give our users frequent hints throughout their practice tests and the ability to jump around between which questions they were selecting. Through our usability tests, we noticed this causing our users to be overwhelmed and distracted by our interface while trying to take their practice tests. In the final design we only gave the user some timers to help during the test, and the options to submit or exit, then after submitting the test, they would get tips and feedback. This allowed our users to focus on the practice test the same way they would during the exam.

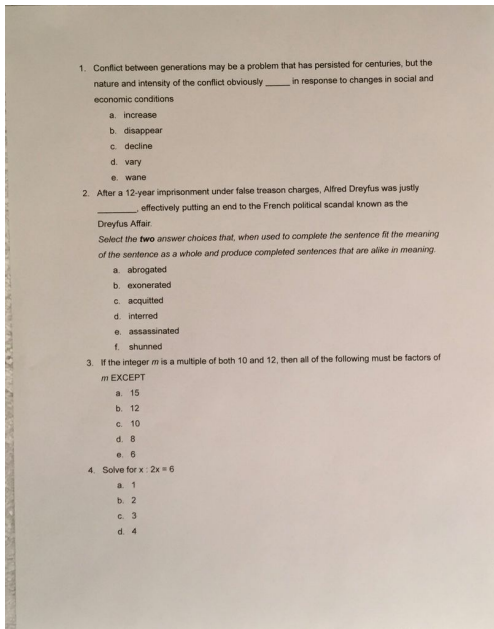
Our P2P tutoring task did not change significantly from our first designs. One difficulty we noticed about this task from our users was the ability to start the task and resume their study session. The earlier designs for this task required the user to go to the main menu and select the P2P tutoring option, and then upon finishing they were brought back to the main menu, and the notes their tutor wrote were lost. In our final design we made this task less intrusive. We changed it so that the feature was an option easily accessible from the user's study session. We also changed it so that upon finishing the tutoring session, the user's study session is resumed and the tutor's notes can be pulled up when needed.

We believe that our design could possibly make some more minor improvements with more iterations, but not anything large. We think that all major flaws in our design have been worked out, and that our design is now in a state where it is very intuitive and useful to our users.

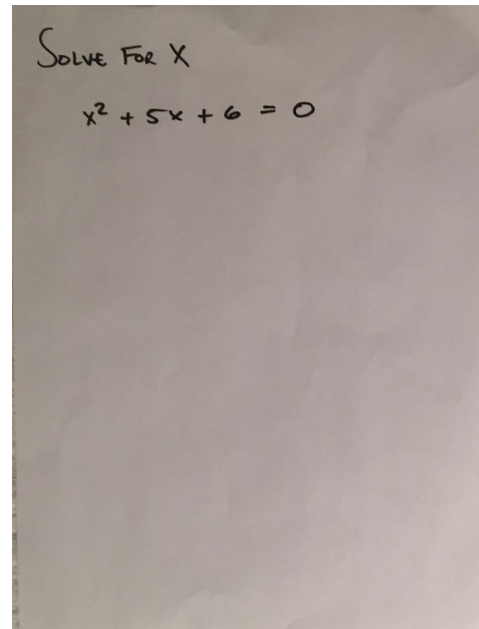
Appendix

Attach copies of all materials involved in your testing. Includes any instructions or task descriptions you handed out or read aloud to your participants. Include identified critical incidents from your usability testing. The appendix materials and screenshots do not count in your page limit.

Materials:



Practice test given to user to quickly simulate a real exam



Math problem given to user that they were asked to study and solve.

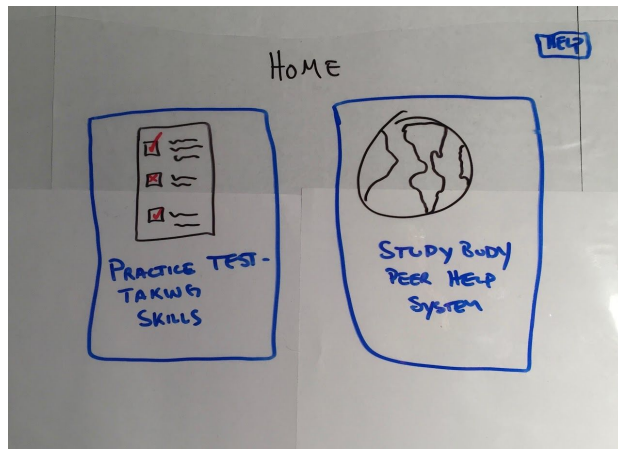
Instructions:

We tried to give relatively minimal instructions to our users before testing in order to ensure that our product was as intuitive as possible. We simply told them that they were studying and taking practice tests in order to prepare for an exam, and we told them that they were using our glasses to aid their preparation. These instructions were spoken to the users. The rest was all intended for the user to solve on their own.

Critical Incidents:

Our earlier designs had some serious issues that caused our design to not be useful to the users

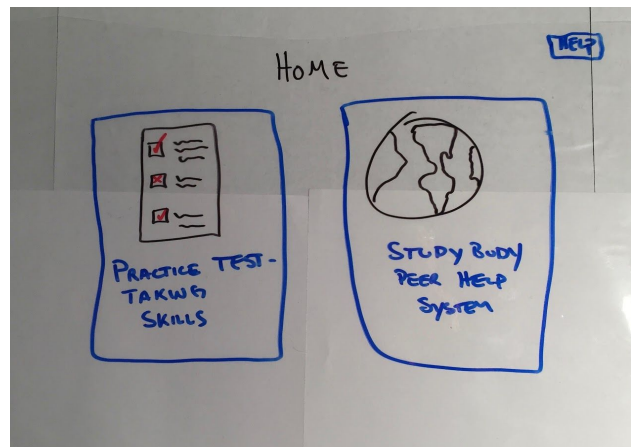
1. **Incident:** After getting P2P study help, user was taken back to the home screen, instead of simply resuming their study session



Severity: 3 - This incident was high severity because it prevented our users from being able to study aside from using our features for help.

Revision: Let user start a study session and request help with a button in their view and then resume when finished, rather than having to go to the main menu to request help.

2. **Incident:** After taking practice test, user was taken directly back to home.



Severity: 4 - This was given high severity because users were expecting the glasses to give them some feedback on the test they were given rather than just letting them move on.

Revision: Show user their score, and which answers were right/wrong. Give option to recap.