

INFO H-564 Prototyping for Interactive Systems

TABLES - *Tutor Assisted Browser based Learning Environment for Students*

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Introduction

Tutor Assisted Browser-based Learning Environment for Students (TABLES) is a collaborative online synchronous learning center for learning assistance. Our proposed project is intended to recreate a MATH tutor center which provides guidance and assistance to students on mathematics concepts. The TABLES project will provide online access in a collaborative learning environment (through a 'table'), moderated by a tutor, who is expert in a particular subject domain. TABLES is built to help students and teachers interact in real-time, which affords them the opportunity for group learning which is critical in a math learning environment. A combination of tutor-based and peer assisted learning strategies help students consistently engage in the concepts and learn faster. Site Observations have provided us with several insights into this proposed design solution. TABLES must consist a student and tutor interface each of which must be specifically designed to recreate the experience of a physical learning center. Through the help of queues, a virtual whiteboard and innovative chat sessions we intend to improve collaboration across the student population and facilitate a more holistic experience for all individuals involved. The virtual whiteboard is intended to provide a range of benefits such as cross collaboration across geographical locations which has been shown to improve learning outcomes. In conclusion this proposed project, TABLES has the potential to create a repository for common problems and solutions that would eventually assist all new incoming students that join the learning center. By leveraging the advantages of online synchronous learning environments we propose to create a scalable, reliable and efficient learning environment which is able to connect a diverse variety of students with individual expert tutors.

Functional Design Concepts

This project is for the development of a virtual online version of the Math Assistance Center. The proposed name for the project is TABLES (Tutor Assisted Browser-based Learning Environment for Students).

Key Elements

The proposed TABLES project will consist of a number of primary modules:

1. [Authentication](#)
2. [Student Direction \(Table Selection\)](#)
3. [Student Table](#)
 - a. [Question Queue](#)
 - b. [Whiteboard](#)
 - c. [Chat Session](#)
4. [Tutor Interface](#)
5. [Admin Interface](#)

In addition, supporting modules will provide database storage/access.

Description

The TABLES project will provide online access to a collaborative student learning environment (a "table"), moderated by a tutor, who is expert in a particular subject domain.

[Authentication](#)

Student interaction with TABLES project will begin with the login process. A splash screen will provide a login button, which will use the university's Central Authentication System (CAS) to verify the student's credentials, then provide additional information about the

student's course enrollment. This information will be used with the TABLES database to present the student with options for joining a particular learning environment, or table.

Students will provide information and photos to complete a profile that will be used to help identify the students to others, and to guide the students.

Student Direction

The student's course enrollment information will be used to filter the tables made accessible to the student. As a part of the table selection process, the student will be asked to provide the question he or she wishes to ask. Previously asked questions and answers are stored in the TABLES database, and the database will be searched to see if the question has already been answered. If so, the student will be provided with links to previous sessions dealing with his/her question. The student can either explore these possible solutions, or proceed to selecting a table.

If the student finds a previous session that provides an acceptable answer, then the student is done, or can ask a new question.

If the student proceeds to selecting a table, he/she is presented with a selection of possible "tables". This selection will essentially be a menu, but the user interface should suggest an actual table or collaborative space. The 'table' will display a few key items of information:

- Table topic (Course title or general subject topic)
- Current Question
- Question queue
- Number of students at the table
- Approximate wait time
- Tutor (with a link to the tutor's profile)

Student Table

The table will have three main components:

-
- Question queue
 - White board
 - Chat session

In addition, the table has a few general features, such as a display of the people at the table, and indicators to show the current question and who is actively using the whiteboard.

Question queue

When joining the table, the student's question is added to the table's question queue. The tutor conducts the table's business, and can select questions in queue sequence, or in the sequence that seems most efficient. For example, a simple question might be handled ahead of a complex one. The tutor handles multiple tables, so if the tutor is not actively conducting the table's activity, students may work together as they wish using the chat tools and whiteboard.

Whiteboard

The whiteboard provides graphic collaboration for the students and the tutor. The whiteboard provides tools for typing text and symbols, as well as for freehand drawing. Only one participant can use the whiteboard at a time, and this participant is considered to have the "pen". Students can request the pen, and tutor controls the pen, unless the control has been passed to the student group while the tutor is not conducting the session. The whiteboard data will be saved and associated with the current question.

Chat session

A chat room session will run alongside the whiteboard, and will include all participants at the table, along with the tutor. Chat board items will be saved and associated with the current question.

If a student's question is the current question, he/she can "accept" the solution, thereby closing that question. A student can leave a table at any time, and students can rate a tutor.

Tutor Interface

The tutor will conduct multiple table sessions at one time, and will have a special user interface to facilitate managing the tables. The Tutor UI will feature:

- Table overview with general table information
- Focused table with full detail view
- Question closeout
- Tutor profile

Table overview

The table overview will allow the tutor to see the general status of his/her tables at a glance:

- Number of participants
- Current question
- Thumbnail view of whiteboard
- Latest chat item
- "Call" button indicator, with timer
- Alert showing students joining or leaving the table

All tables will show the number of participants, current question, thumbnail version of the whiteboard, and latest chat item. A special alert will display for tables that are requesting the tutor's input. Also, the tutor will be notified when a new participant joins or leaves one of the tables.

Focused table with full detail view. The UI will display the focused table with full detail:

- Participant list
- Current Question

-
- Question queue/Question selector
 - Whiteboard with pen control, cut-paste graphics library
 - Chat session with auto-complete features
 - "Remove Student" button
 - Temporary table feature
 - Button to request help from (or pass a question to) another tutor.
 - Student rating widget

The tutor will see the question queue, and will have a method for selecting which question to make the current question. The whiteboard will be visible and editable, along with tool that allows the tutor to see which students are requesting the pen, and a way to pass the pen permission to a student.

The tutor will have additional tools for streamlining the workflow: cut-and-paste style drawing items that are frequently needed for the whiteboard, and auto-complete-style features for frequently repeated chat session comments. Also, the tutor will have a method for creating a "temporary" table, where a question and the connected students can be moved to solve difficult questions. A method to ask for help from other tutors will be available, along with a method to pass a question (and students) to another tutor.

The tutor will have tools to rate students, or to remove a student from a table.

Question closeout. When questions are closed (i.e., the student accepts the solution), the question session will require processing before it can be archived.

- Closed questions will accumulate in a queue for processing
- Tools for adding notes to clarify the solution.
- Tools for adding whiteboard transcriptions, and metadata tags/keywords to provide search capability.

The question session is placed in a queue, and the tutor will have a special interface for closing out a question.

This will involve providing any necessary meta-data (tags, keywords, etc.) for the question, adding any additional information to clarify the solution, and transcribing any whiteboard text still in graphic form, so that the text can be searched.

Tutor profile. The tutor will have a web form for creating and maintaining a profile, which will be available for students looking for a table session.

Admin Interface

TABLES admin personnel will be responsible for:

- Maintain lists of courses
- Map courses to course level designation.
- Maintain lists of topics, and mappings between topics and courses
- Tutor certification and experience levels
- Table assignments and scheduling for tutors
- Table Interface
- Monitor student and tutor profiles

Course list. TABLES Admin personnel will maintain a list of courses for which they provide support. This list should map directly to the course groups returned by the Central Authentication System (CAS) when students login. The Admin Interface will provide a form for course list maintenance.

Course Level Designation. The course list should be linked to a standard course level designation, (K-12, Undergraduate, Graduate-Masters, etc.)

Course Topic List. The course list will be linked to a list of topics that are appropriate for each course, and admin personnel will add/delete/update topics as required. When students log-in, they will see a list of topics that correspond to their course enrollments as

part of the table selection process. If student question submissions suggest topics that are not on the list, Admin personnel should revise the topic list to meet student needs.

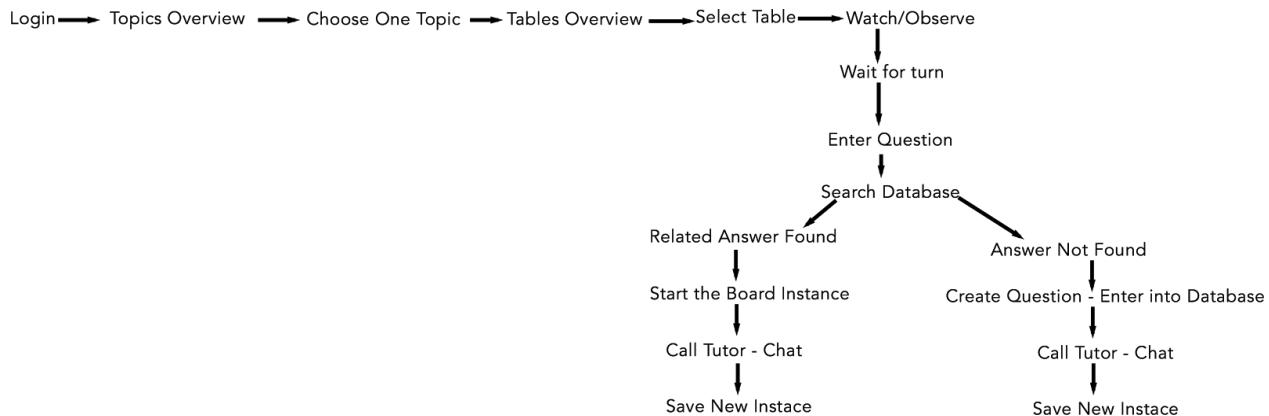
Tutor Certification. Tutors must be certified for the course and course level for the tables they assigned to cover. This will require a testing module, with test results reported back to admin personnel. The certification level will be part of the tutor profile, and be used to manage tutor work assignments.

Table assignments and scheduling. This feature will require a scheduling module for tutor work assignments, and a general table interface that displays which tutors are assigned to which tables. Admin will set hours and manage tutor workload using the schedule module.

Table Interface. The Table Interface will display all the tables set up by admin personnel. The tables can be displayed by course or by tutor, and will display the current information for that table (course assignment, tutor, topics, number of students at the table, approximate wait time, and whether the tutor has been requested). A small form for each table will allow admin personnel to make assignments and changes to the table.

Monitor profiles. Admin personnel will have the ability to monitor profiles for tutors and students, and make changes (or create/delete profiles) as necessary.

Flow Chart of UI Structure



Early Ideation

Team brainstormed around multiple ideas and now we are in position to finalize the idea from below listed ideas.



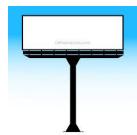
Identification of drugs through technology

Today medication reminders and verification of which drug the patient is taking a big task. It is a common problem for patients suffering from Alzheimer's and Dementia as their cognitive abilities do not allow them to remember things. This project aims to have a tablet application with image recognition software and a mirror to verify the tablet's' shape and color. We plan to explore the possibilities of this concept and see how it can be brought into day to day use.



Self checking shopping carts

People spend endless minutes in queues waiting to check out their items. By attaching a Self checking system to shopping carts queues will be avoided. This will also be useful when customers want to know if products have discounts or are on sale. In addition to that, self checking shopping carts will be convenient. Human error will be avoided.



HCC portal for out of home advertising

"Out-of-home advertising (aka OOH advertising or outdoor advertising) or out-of-home media (aka OOH media or outdoor media) is advertising that reaches the consumers while they are outside their homes. [Wikipedia] " Out of home advertising media distributed across placed-based networks in venues including, but not limited to cafes, bars, restaurants, health clubs, colleges, arenas, gas stations, convenience stores, barber shops, and public spaces. We are planning bridge the gap between advertisers and advertising inventory owners. Advertisers will use the portal to reach the appropriate audience by knowing parameters including, but not limited to do geographic locations, gender, privacy, government approvals, expenses, a scope of the inventory, etc. We will also help inventory owners to design the advertisement smartly by using all the possible options including emerging technologies, HCC practices to design the advertisements to attract and engage the audience, interactive advertising. These improvements will help inventory owners to attract the advertisers by giving more appropriate and engaged audience.



TABLES

Tutor Assisted Browser-based Learning Environment for Students (TABLES) is a collaborative online synchronous learning center for math assistance. Our proposed project is intended to recreate a MATH tutor center which provides guidance and assistance to students on mathematics concepts. However, over the time the team felt that we can apply a generic concept to our designs rather than considering only one Course - "MATHEMATICS"

Reasons for selecting TABLES:

- We had a limited time space
- We wanted to make an impact on something close to us
- Proximity of the MACLab enabled us to get feedback and observe at any time.

The MACLab restrictions served as the basis of our prototype development which are:

1. Limited hours and space

The MACLab does not operate 24 hours. It operated from 9am to 6pm. This time was mostly inconvenient for students because they have classes during those hours. Additionally, the MACLab can only accommodate a limited number of students at a time.

2. Loss of information

Solutions to math problems were written on white boards and are cleaned after. This creates a problem because solutions are not archived. Archiving the solutions has numerous benefits such as saving time and easier reference.

3. Limited Accessibility

The MACLab is only limited to IUPUI students.

4. Limited Resources

There is also a limit to the number of resources at the MACLAB.

First Round of Prototype

Our first round of prototypes covered all aspects of the collaborative tools. This included the administration role, student and tutor role. We used different prototyping techniques for our first round

1. Slides
2. Paper Prototype
3. Use of Post-it notes to walk the user through the functionality

Screens for Students

In this student role we tried to cover main two scenarios,

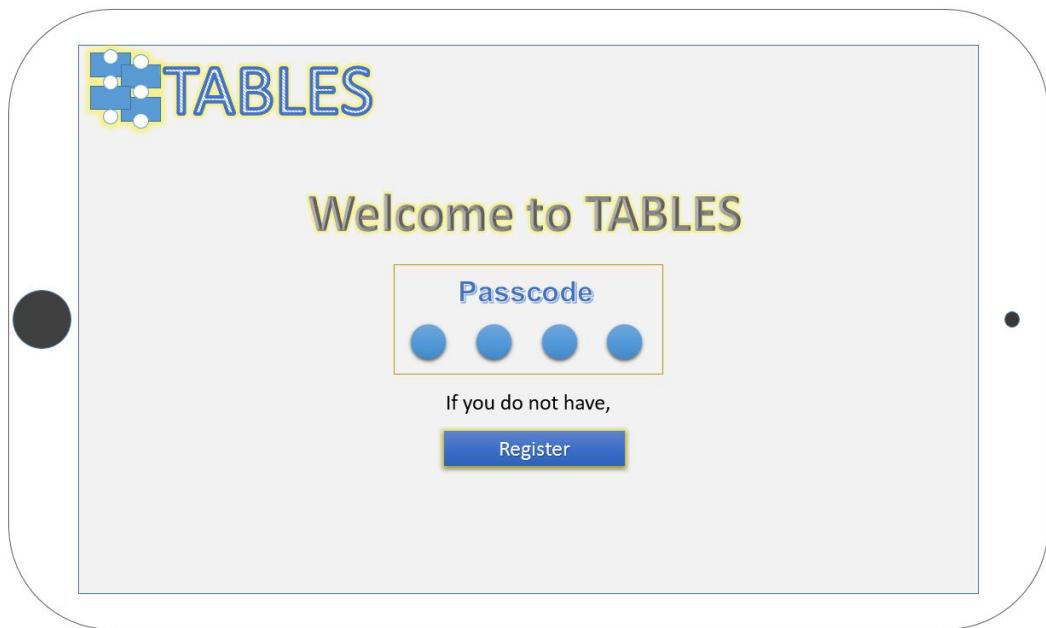
#1: Student registration process

#2: Selecting a topic of discussion where she can raise her own question

Scenario 1: Student registration process

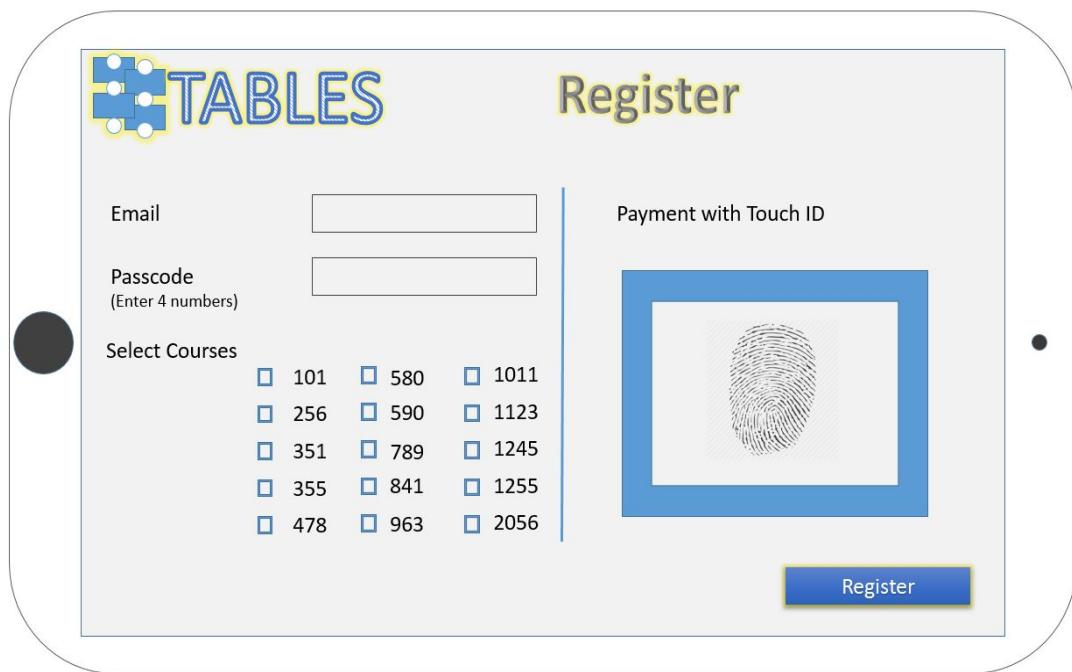
Screen1

Main screen of the iPAD app where any user has to enter the passcode or register



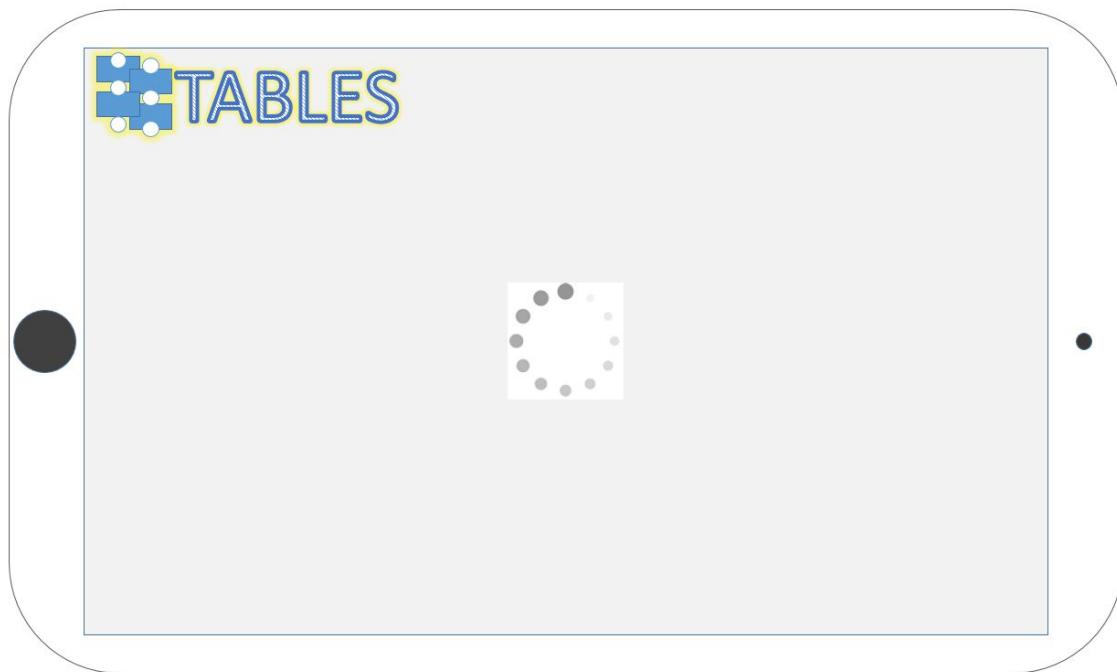
Screen 2

Considering the prototype development for Student role, the screen displays option for student registration. The payments will be accepted using biometric ID. As this is an iPAD application, we can use Touch ID feature



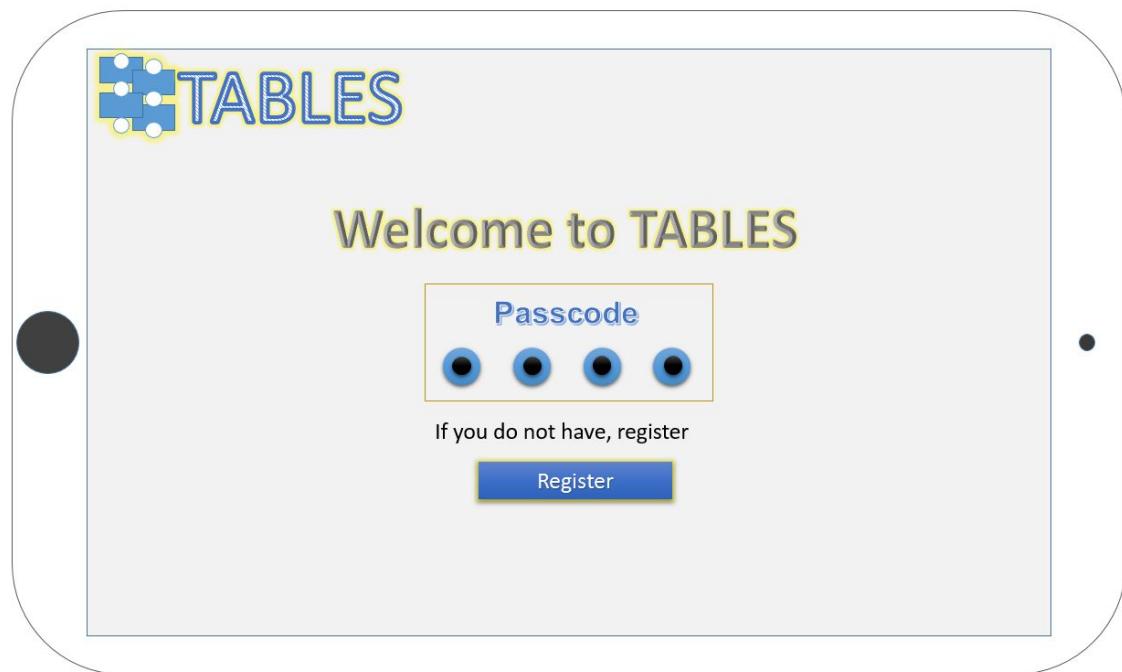
Screen 3

Screen displays progress while payment is being processed



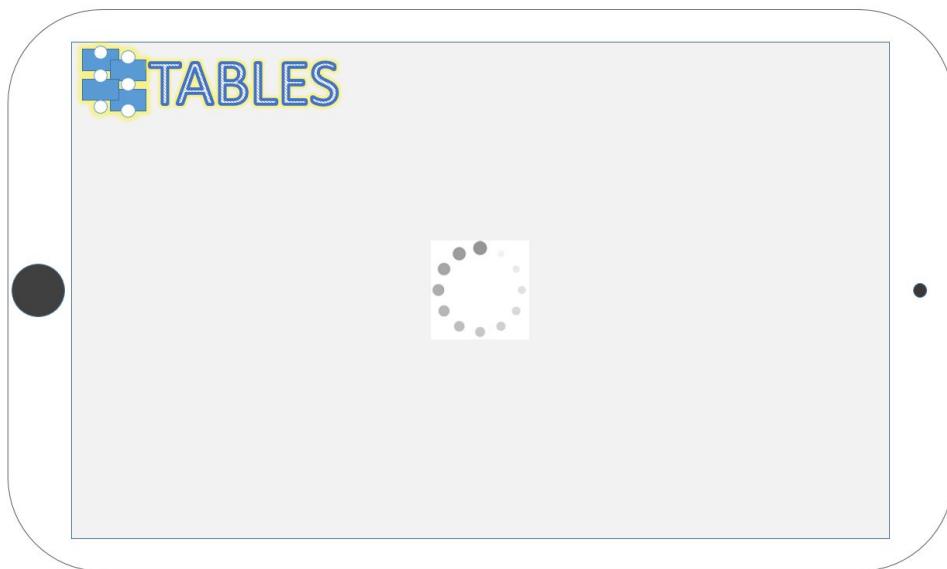
Screen 4

After processing the payment, the main screen is displayed again for student to enter the passcode and start accessing the app



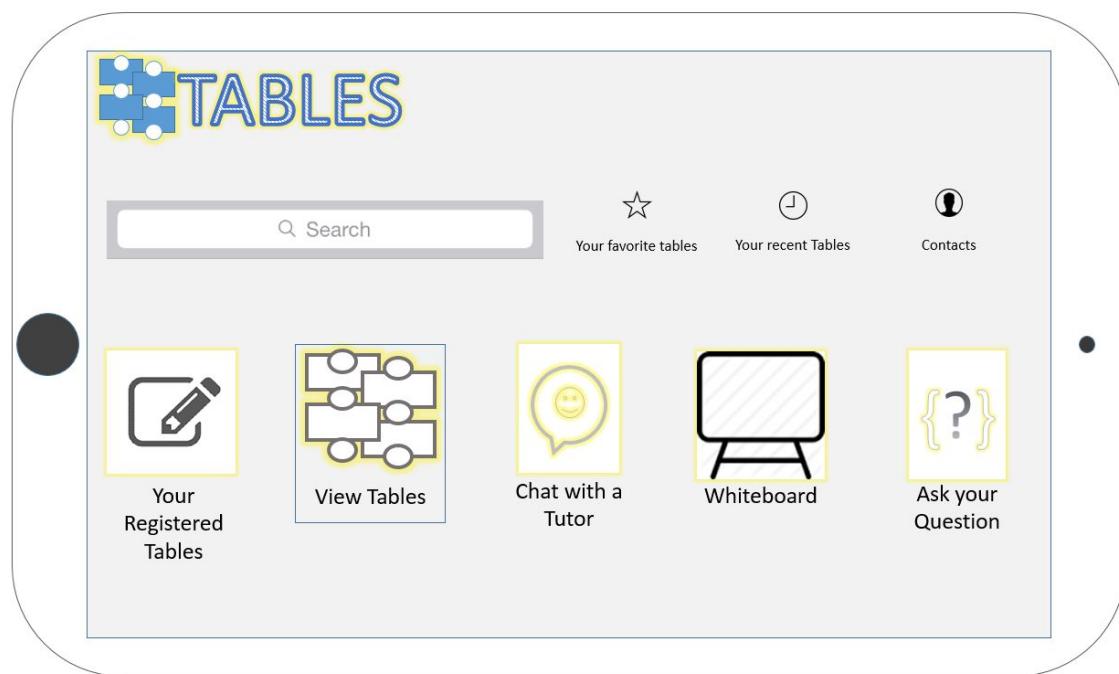
Screen 5

Screen displays progress while student is being permitted access to the app



Screen 6

Main screen displayed to the student after successful login

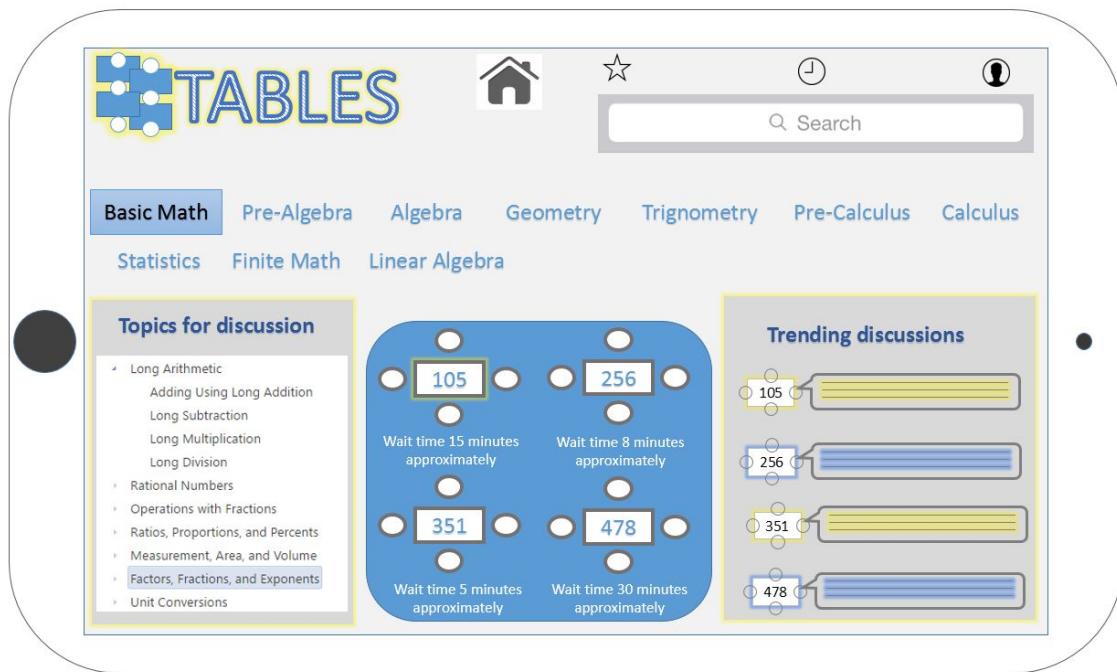


Scenario 2: Selecting a topic of discussion where she can raise her own question

Scenario 2 covers the workflow explained in [Flow Charts of UI Structure](#).

Screen1

Assumes student has already logged in and from the main screen selected the option to view tables. This screen shows the student all the math courses that he has registered for in a tab manner. By default, the first tab displays its contents. So the student can see the first course and topics available for discussion, the table numbers of the selected topic, 'Factors, Fractions and Exponents' and the trending discussion on the displayed tables.



Screen 2

Student selects the '105' Table and sees the table scenario, which displays question queue on the table and the highlighted dot is the student whose question is being solved on the whiteboard. It also displays way to raise the question, join table, Whiteboard where tutor is solving the raised question. Student can rate solution displayed. Student can also, download or upload a solution and go back to the tables screen or home screen using the top menu buttons.

The screenshot shows the TABLES application interface. At the top, there is a navigation bar with icons for download (blue arrow), upload (yellow arrow), group (puzzle pieces), and home (house). Below the navigation bar, the word "TABLES" is displayed in large blue letters next to a yellow puzzle piece icon. On the left side, there is a vertical list of five colored circles (yellow, green, blue, black, orange) each associated with a blue rectangular input field. Below this list is a text input field labeled "Write your question:". To the right of the input fields is a large rectangular area containing the text "Solving problem of" followed by a yellow circle icon. Below this, the equation $f(x)=3(2x-2),(0,4)$ is shown. At the bottom right of this area is a "Join this table" button. At the bottom center is a "Rate this solution: ★★★★★" button.

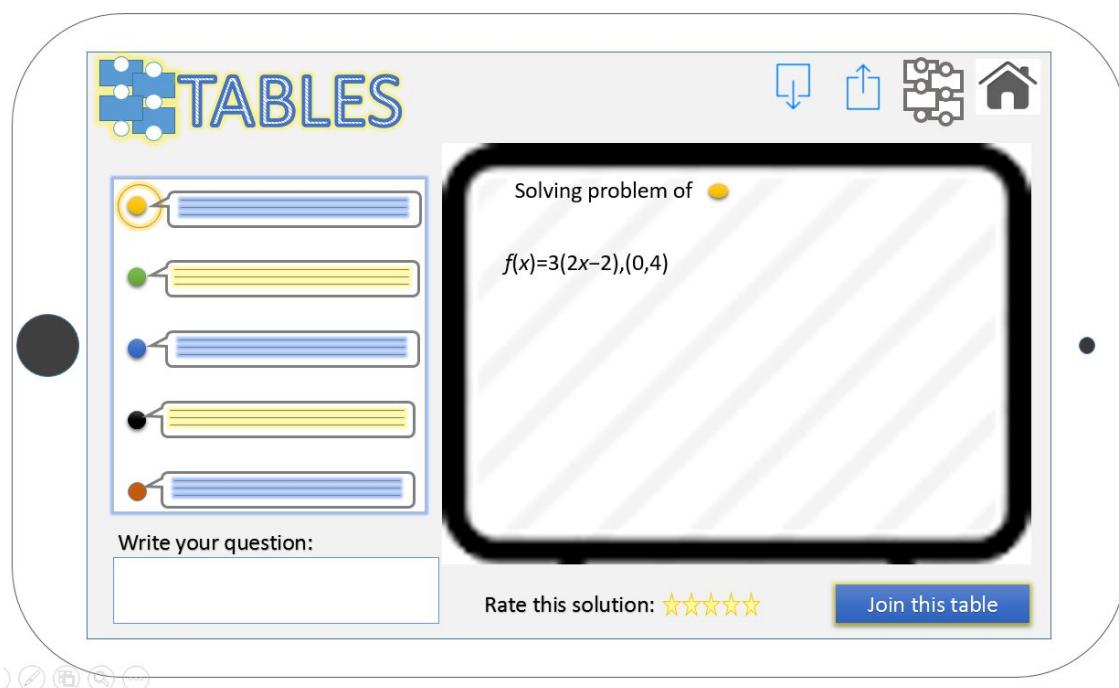
Screen 3

Student then clicks on the download solution button, yellow highlighted, from the top menu and saving the solution screen is displayed.

This screenshot is similar to the previous one but includes a prominent message "Saving the solution" in a large, bold, yellow font at the bottom left of the central solving area. The rest of the interface, including the navigation bar, problem statement, equation, rating button, and join button, remains the same.

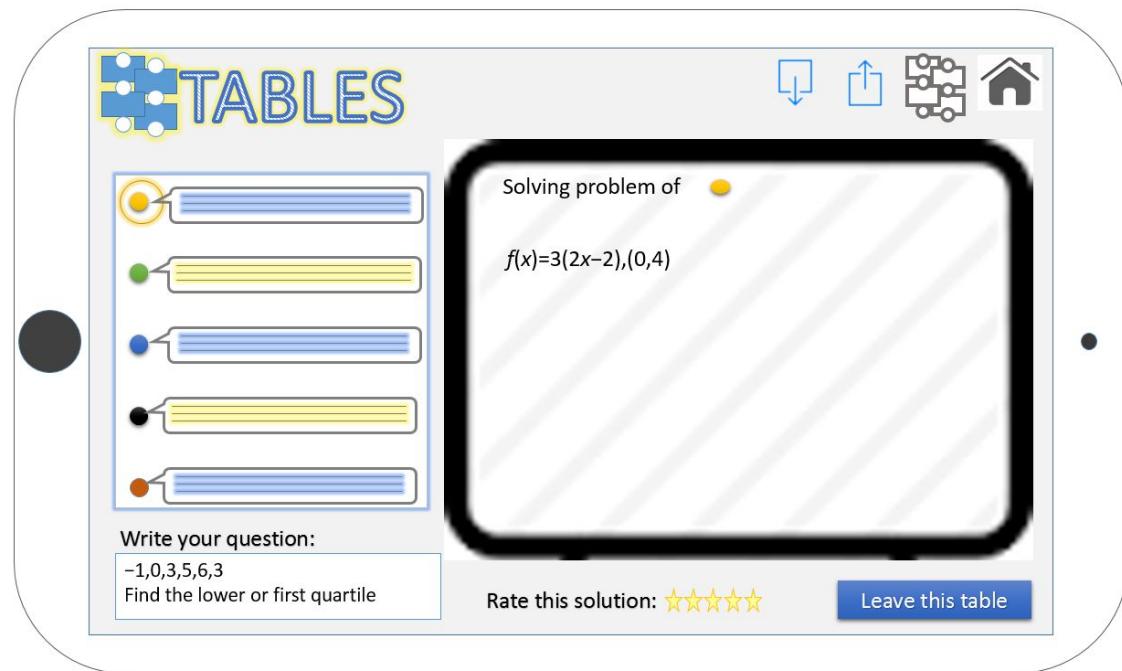
Screen 4

Student returns to the 105 table screen after downloading the solution. Now she can write/raise her question.



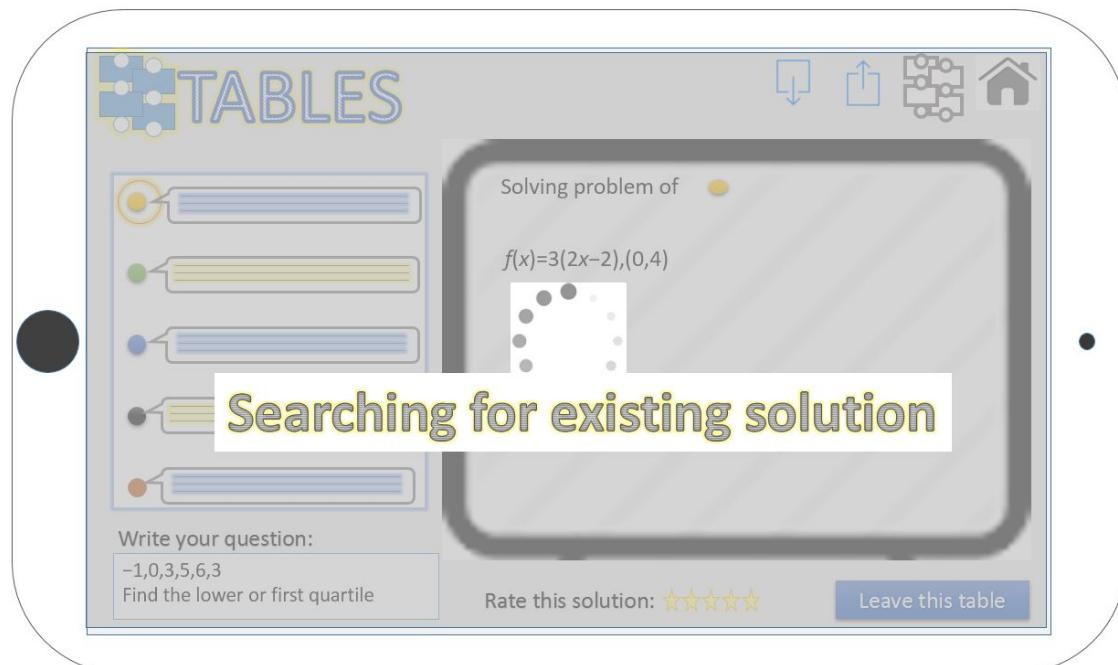
Screen 5

Student writes.raises her question.



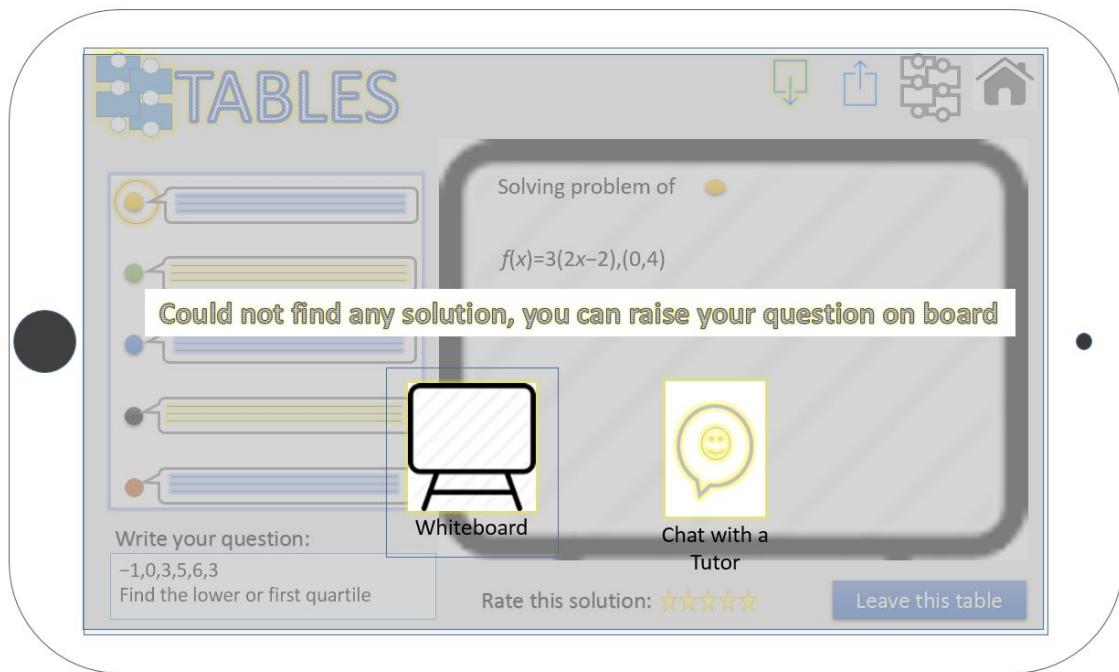
Screen 6

App searches for an existing solution, so as to avoid redundant work for tutor to solve the question again.



Screen 7

App fails to search for any existing solution so student is asked to go back to the 105 table screen using whiteboard option or chat with a tutor



Screen 8

Student returns to the 105 table screen and sees the time she will have to wait until Tutor picks up her question to solve on the whiteboard

The screenshot shows the TABLES application interface. At the top, there is a navigation bar with icons for download, upload, sharing, and a home button. Below the navigation bar, there is a sidebar on the left containing five colored tabs (yellow, green, blue, black, orange) each with a small circular icon. A text input field below the tabs says "Write your question:" followed by "-1,0,3,5,6,3" and "Find the lower or first quartile". On the right side, a large rectangular frame displays a math problem: "Solving problem of" followed by a yellow dot icon, and the equation $f(x)=3(2x-2),(0,4)$. Below this frame, there is a rating section with the text "Rate this solution: ★★★★★" and a "Leave this table" button.

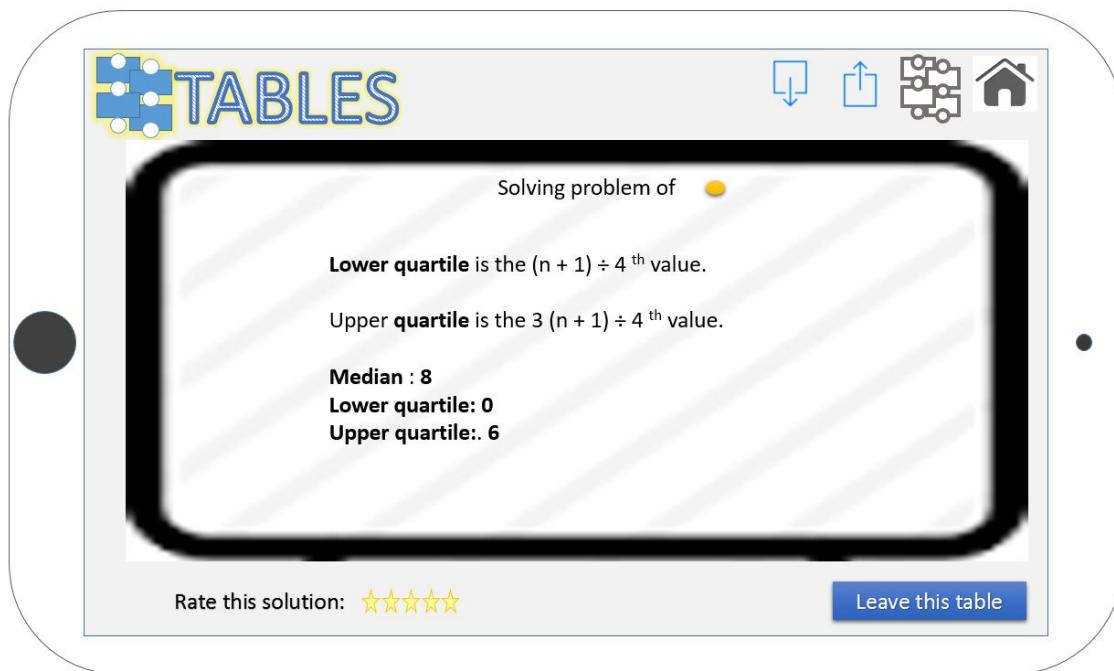
Screen 9

Screen displays second option where system finds an existing solution. Student can view the solution or again chat with the tutor.

This screenshot is similar to the previous one but includes a prominent message "Found existing solution" in large yellow text overlaid on the right side of the main frame. The rest of the interface elements are identical to Screen 9, including the sidebar with colored tabs, the "Write your question:" field, the math problem frame, the rating section, and the "Leave this table" button.

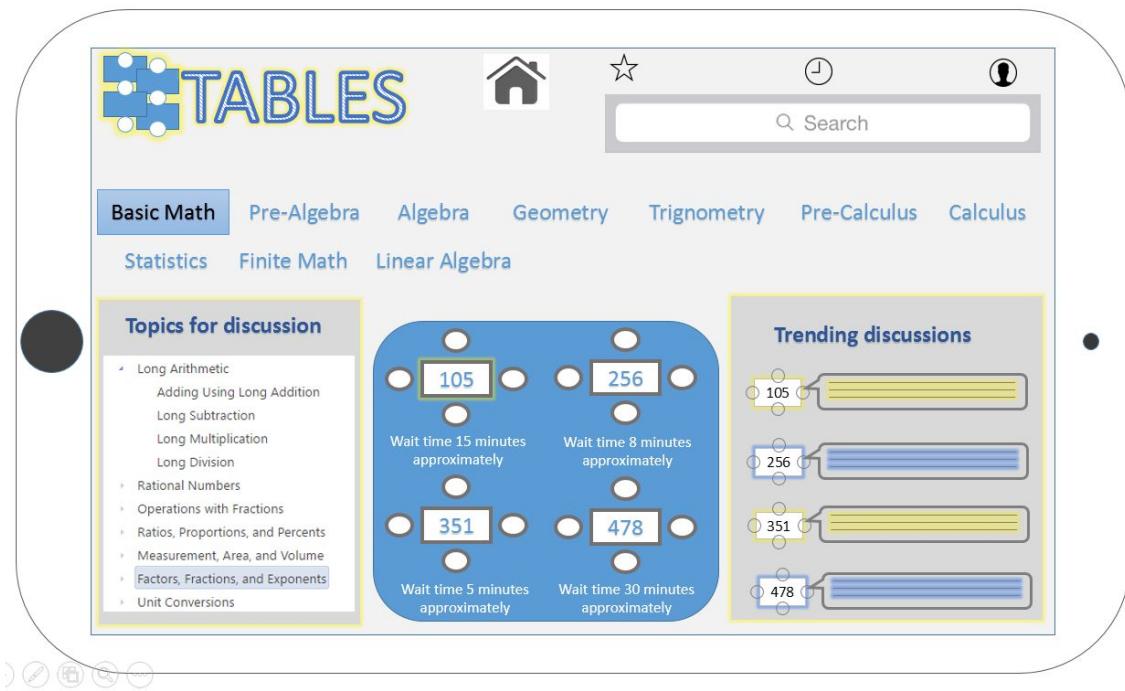
Screen 10

Student selects view solution option and sees the whiteboard where she gets option to rate the solution or downloads the solution and can leave the table without waiting for her question to be solved by tutor.



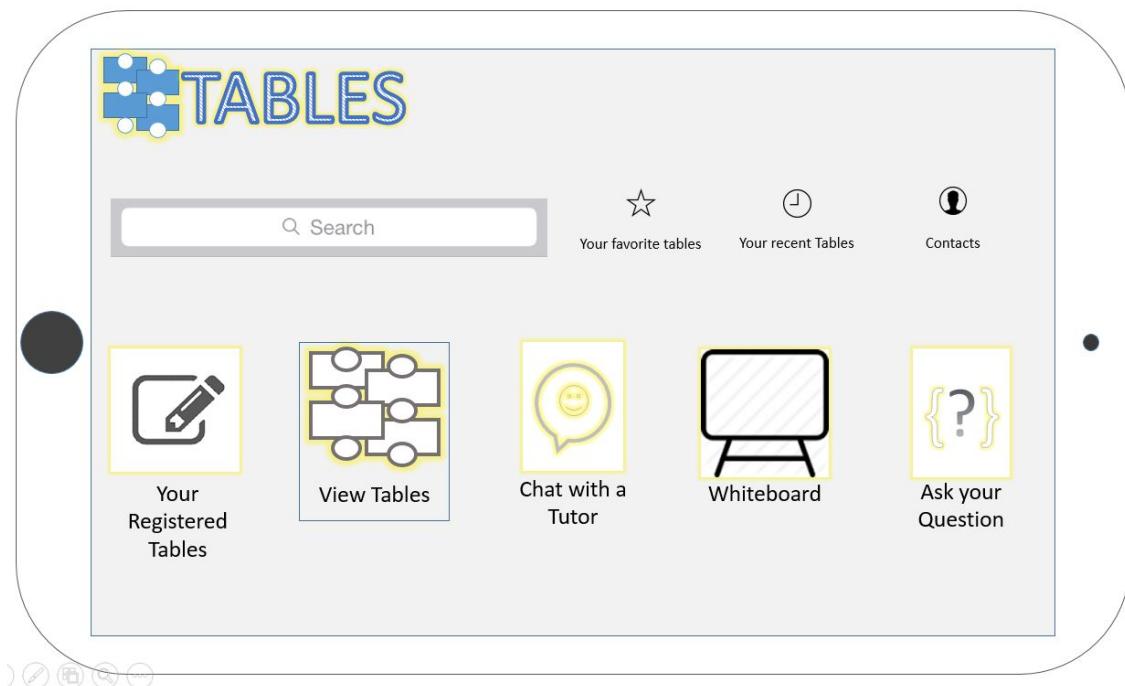
Screen 11

Student may return to the topic screen after downloading the solution. Now she can choose other topics or courses



Screen 12

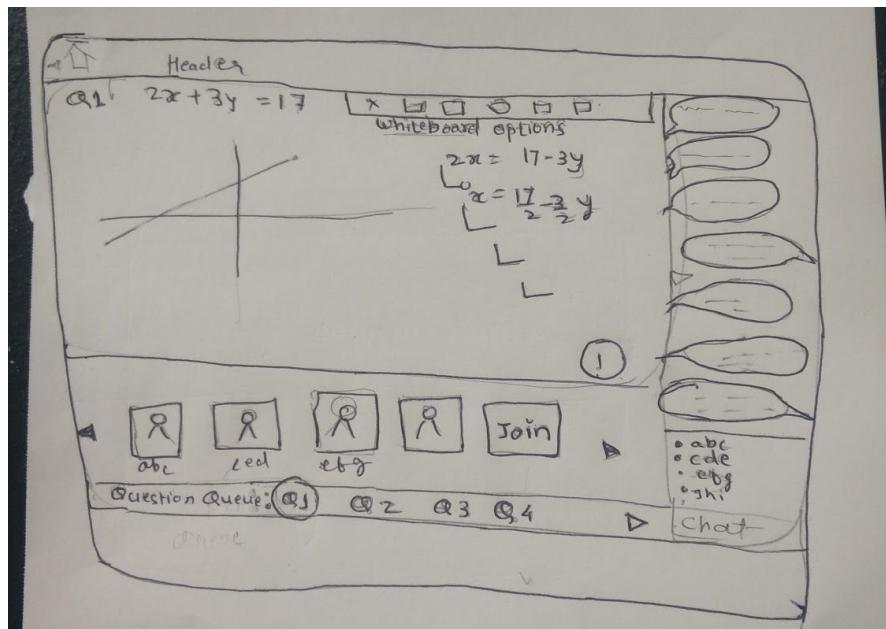
Student may also return to the main/home screen to choose other options that are available



Screens at the table

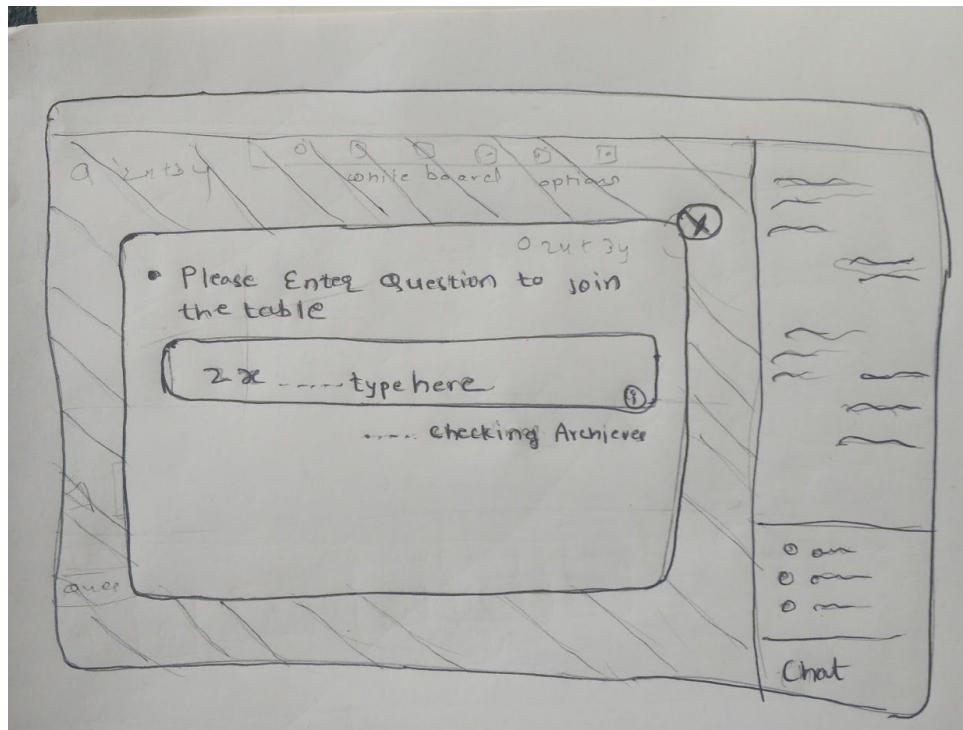
Screen1

You are now at the table. In order to join the table you need to click on "Join" button and you will see the next screen



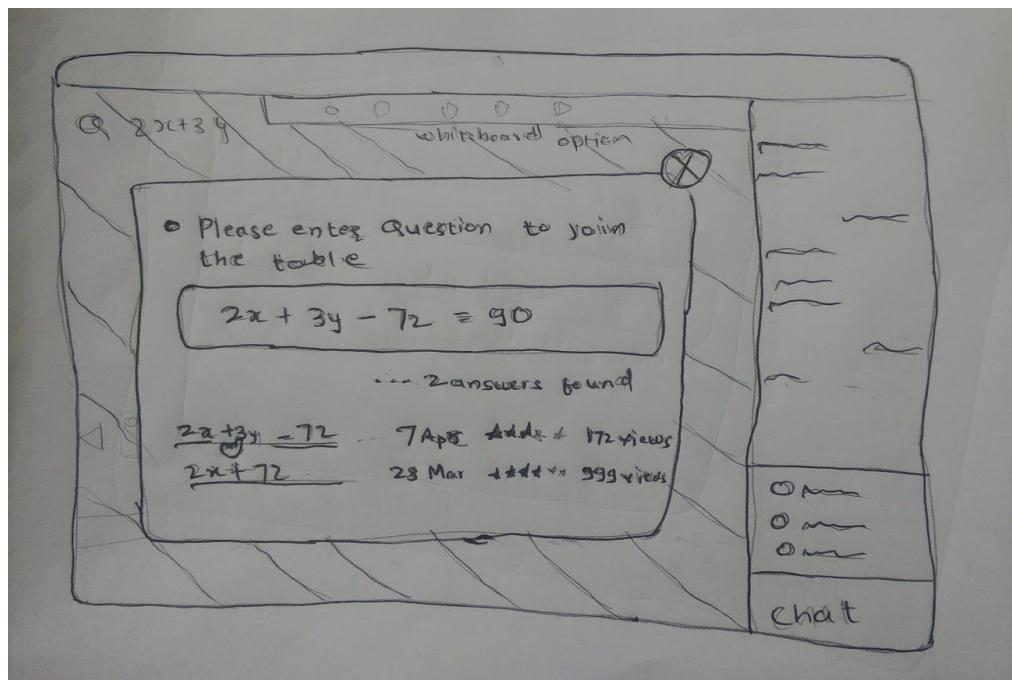
Screen2

Before Joining the table you need to enter your question first, and then system will do auto search as you type the question.



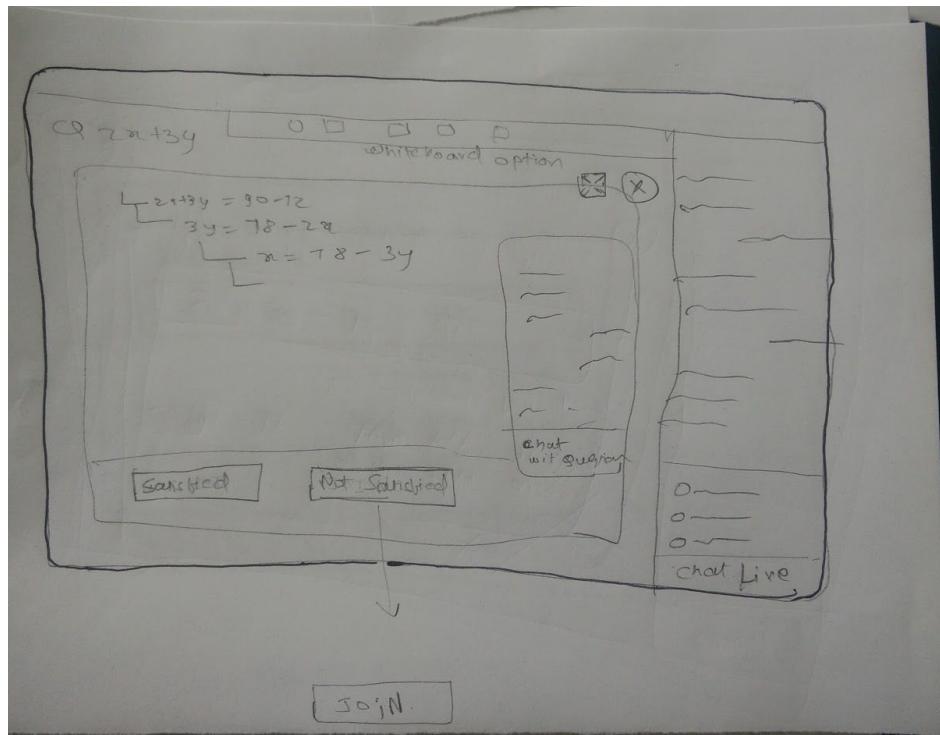
Screen3

Once you typed the question, system is now showing you the related answers found and you can click on any of the answers. **JOIN option Missing**



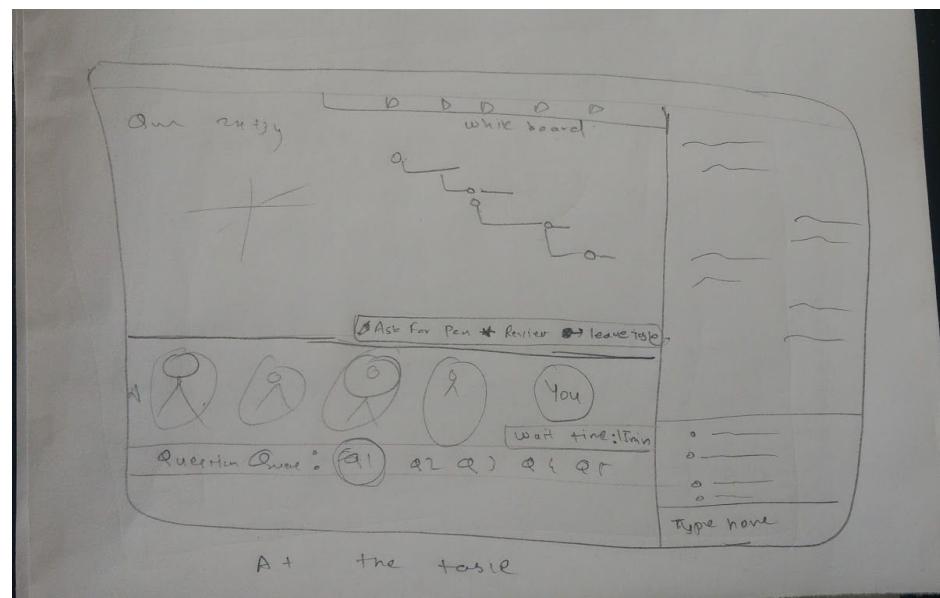
Screen4

This screen shows you archived answers white board and associated steps and chat. If you are not satisfied with the answers you can join the table.



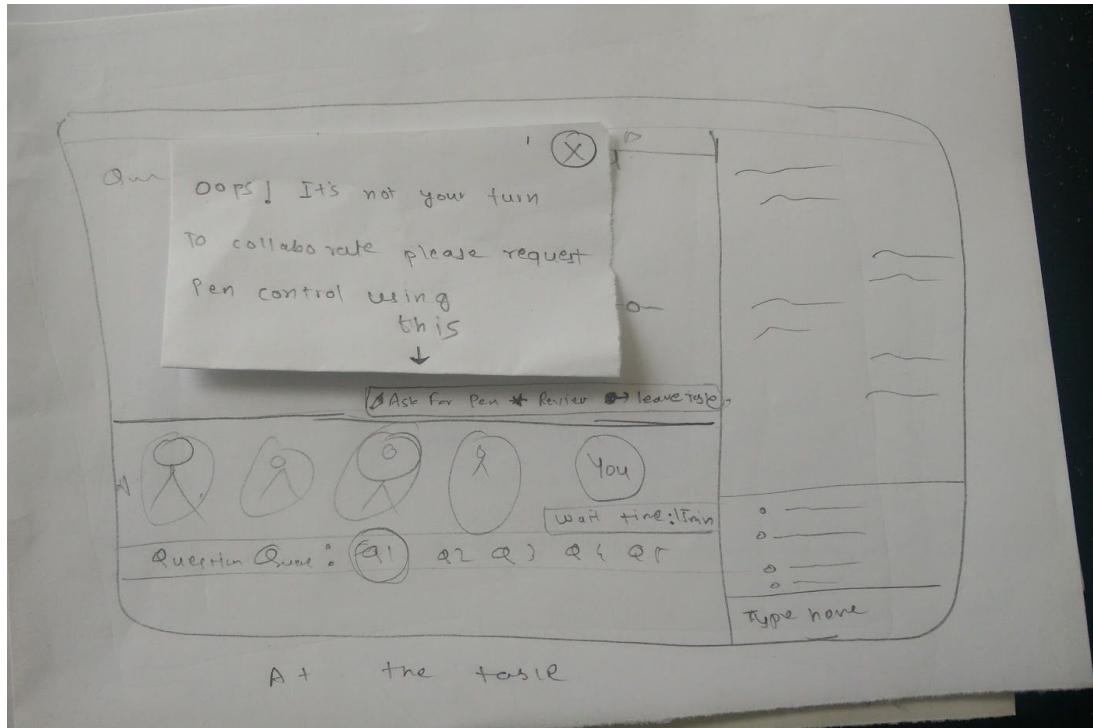
Screen5

Now you are sitting on the table at last with your question in question queue. And you can collaborate to solve the problem.



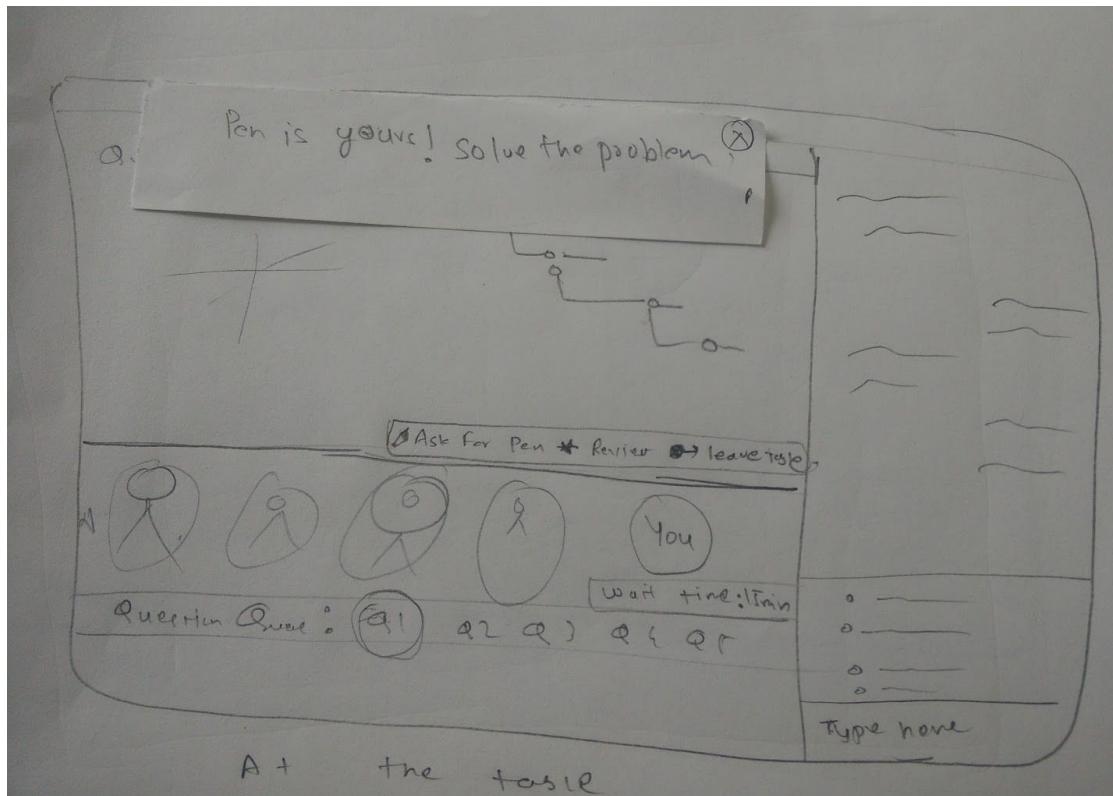
Screen6

Ohh! Wait but before start collaborating you need to ask the permission to access the pen on whiteboard. But you can always chat.



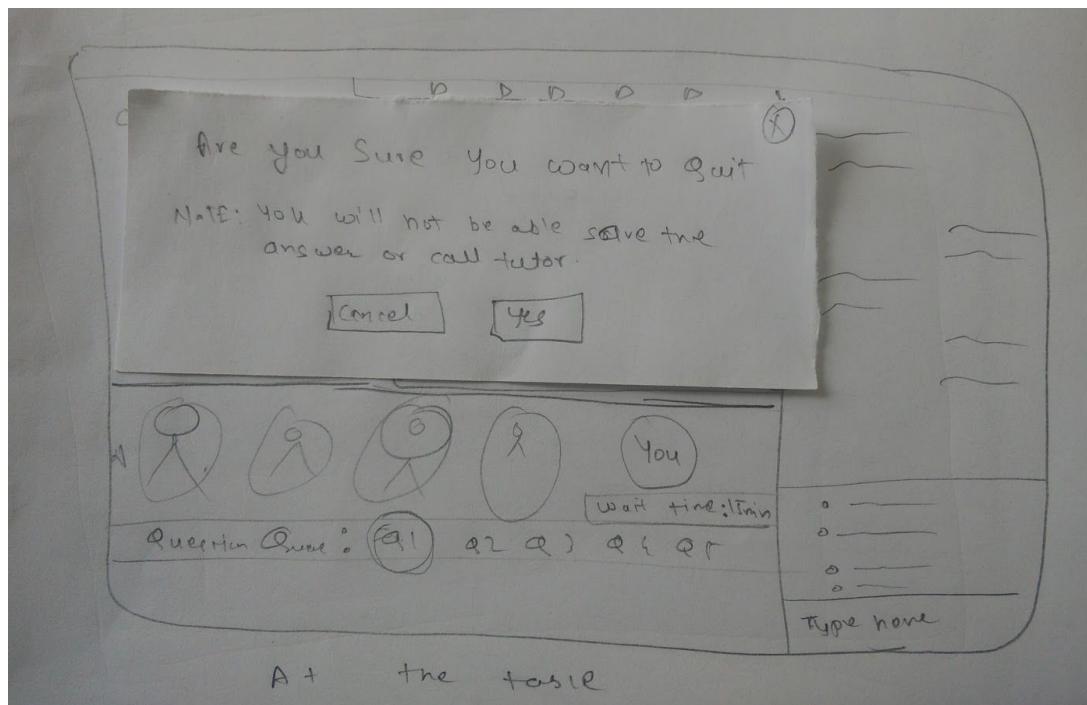
Screen7

Once you are allowed to write you can solve the problem on whiteboard.



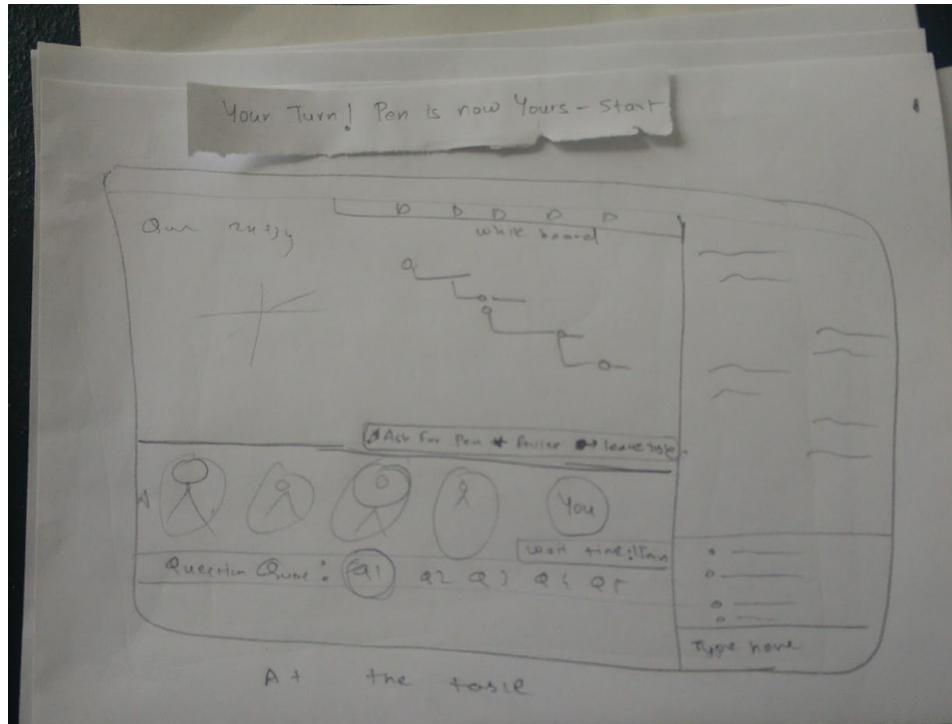
Screen8

Want to leave the table, Okay. But make sure that you won't be able to much after you leave the table



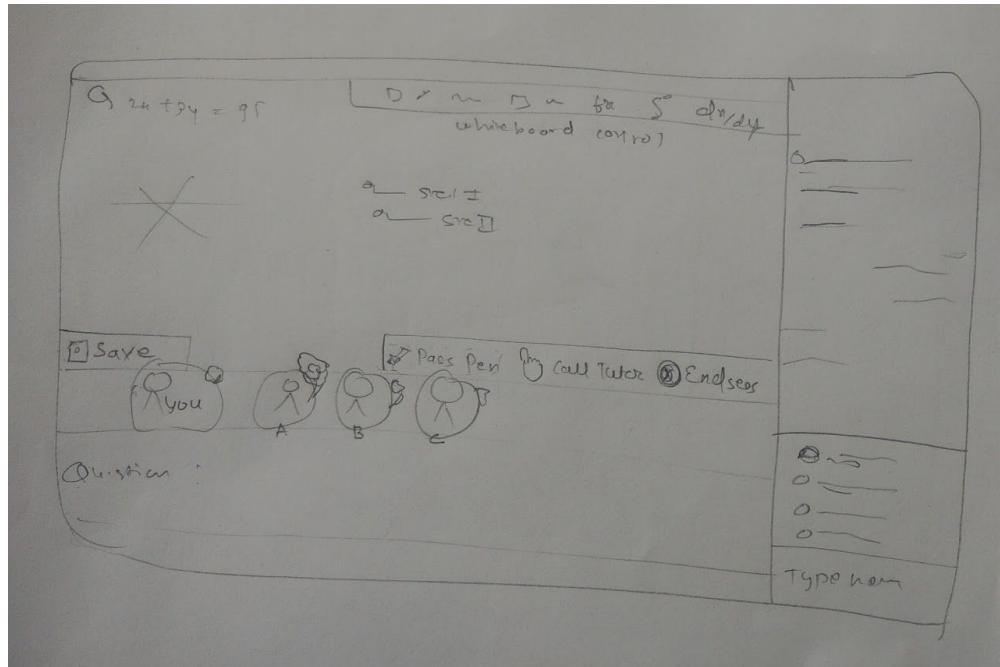
Screen9

Finally, it your turn and you are the admin of the Pen now. You will see the more options in the next screen.



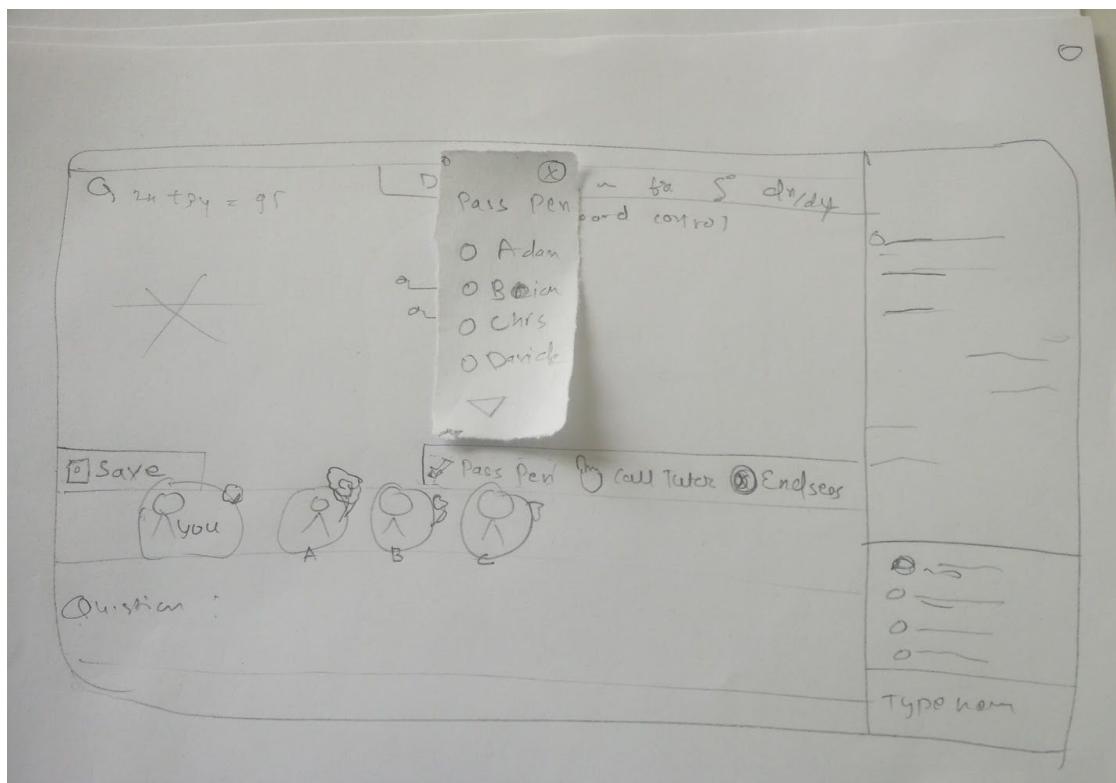
Screen 10

You can see the changed options. Now you can ask people to collaborate, also stop them if they spamming or going in wrong direction.



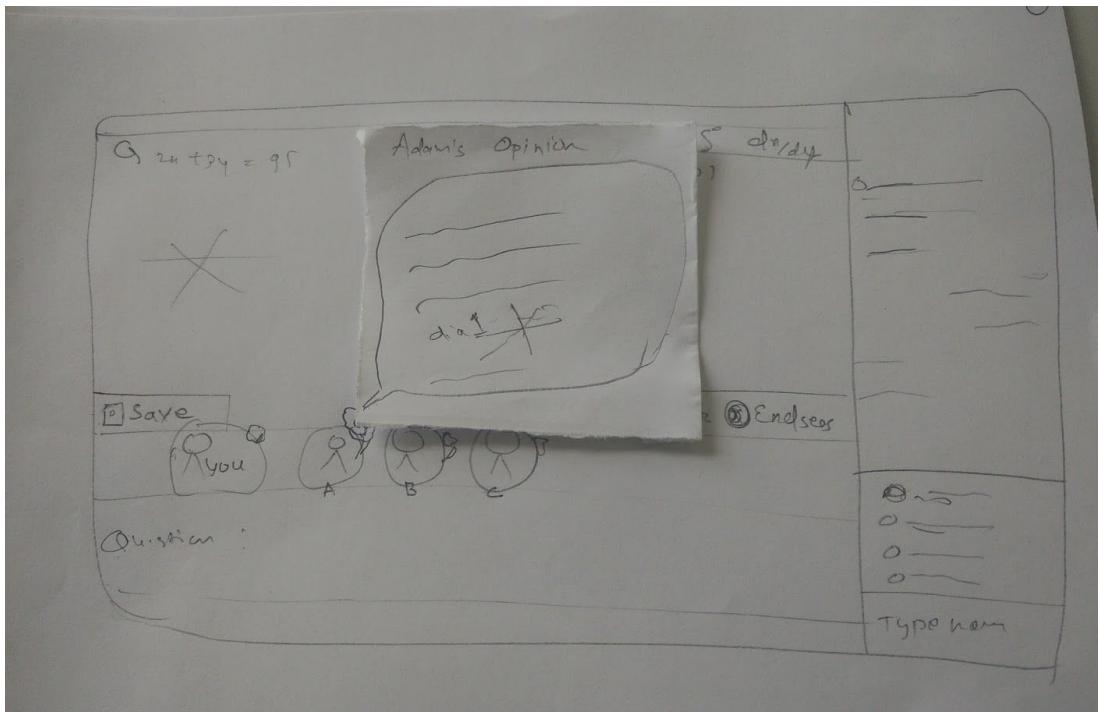
Screen 11

In order to pass the control of the pen you must first select the name of the person you need to pass the control of the pen so as that person can collaborate.



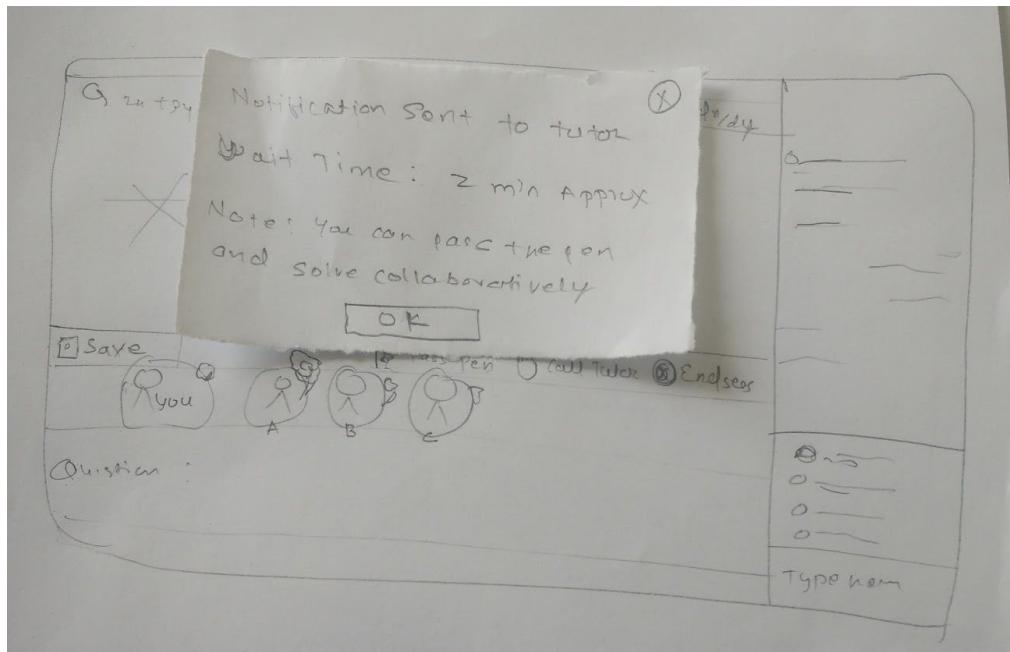
Screen 12

Also if you want to see what is individuals opinion bubble option on the profile pic will provide you filtered chat for that person's opinion for simplification



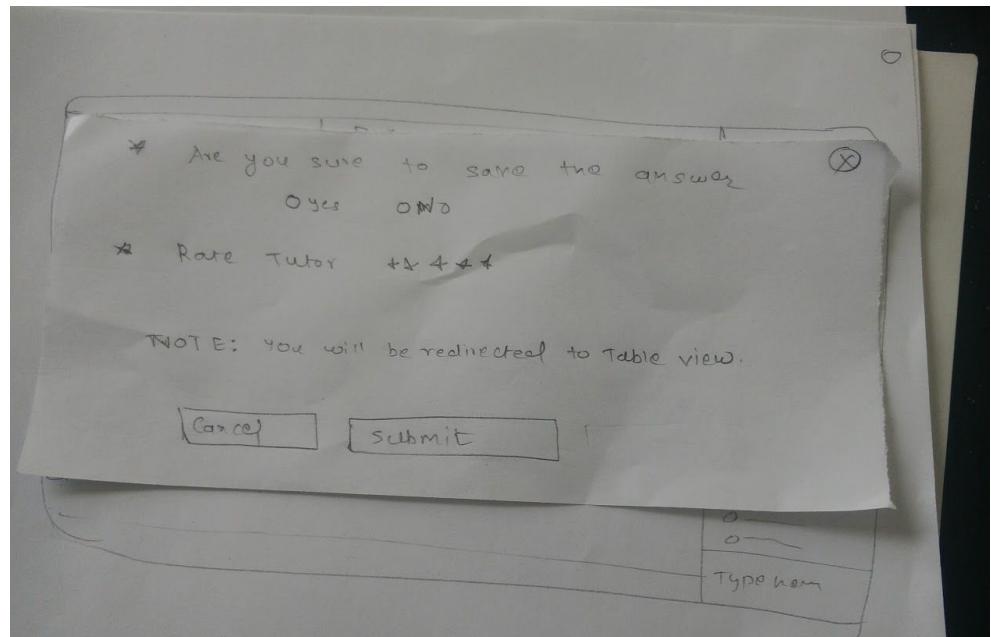
Screen 13

Nobody is able to solve the problem, okay let's call the tutor. Meanwhile you can continue solving it collaboratively.



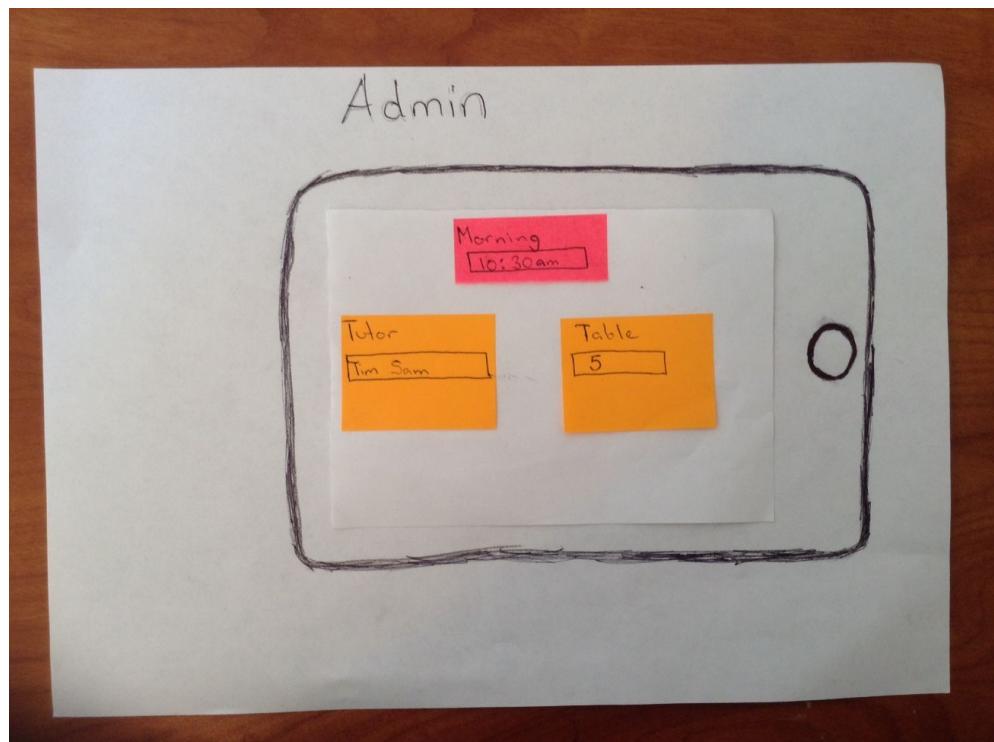
Screen 14

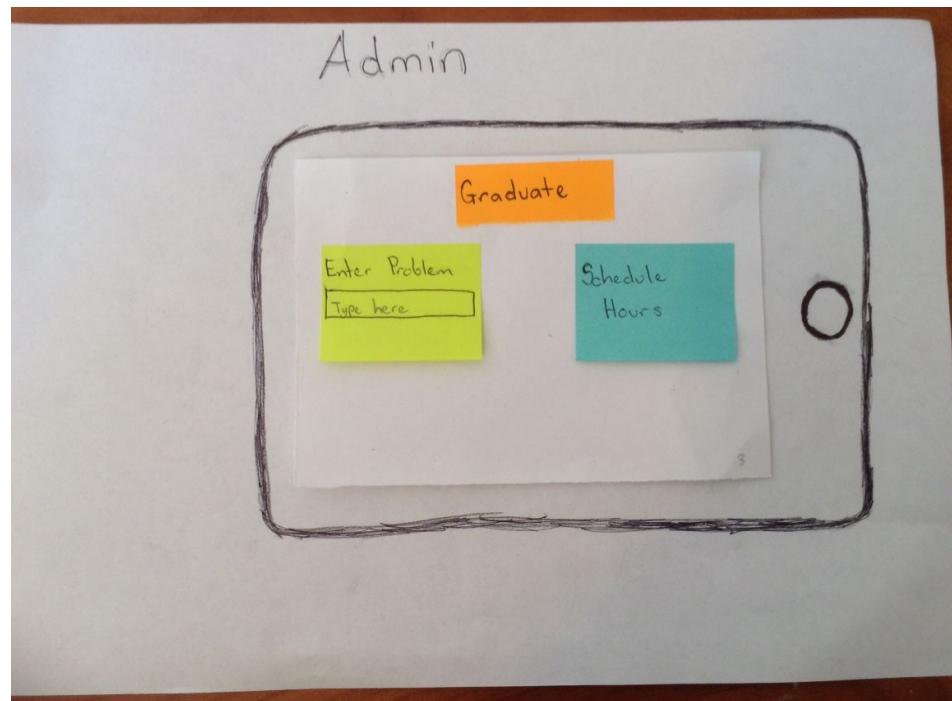
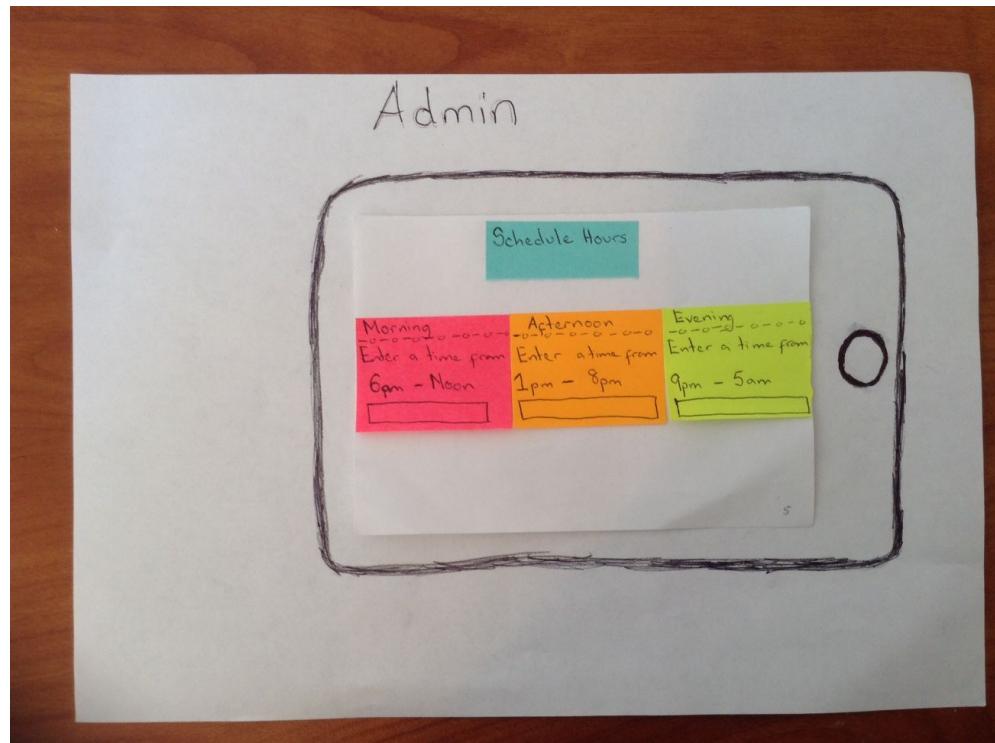
Are you sure you got the answer, if yes rate the tutor and submit the solutions to the archives.

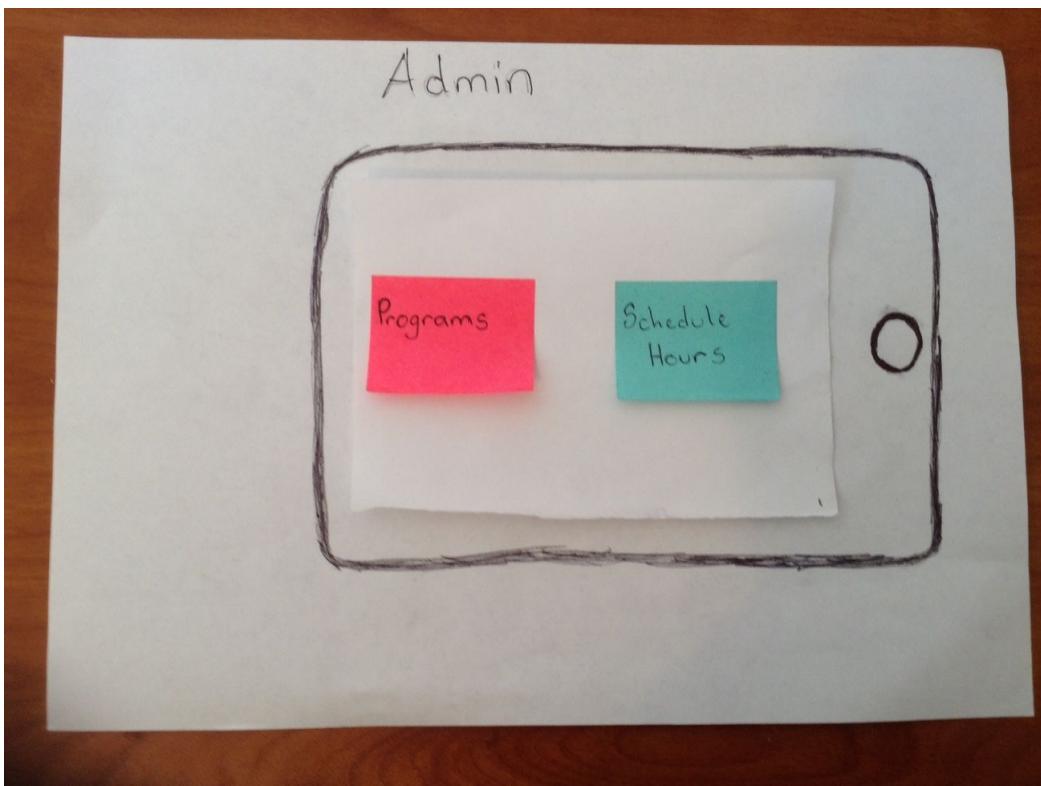
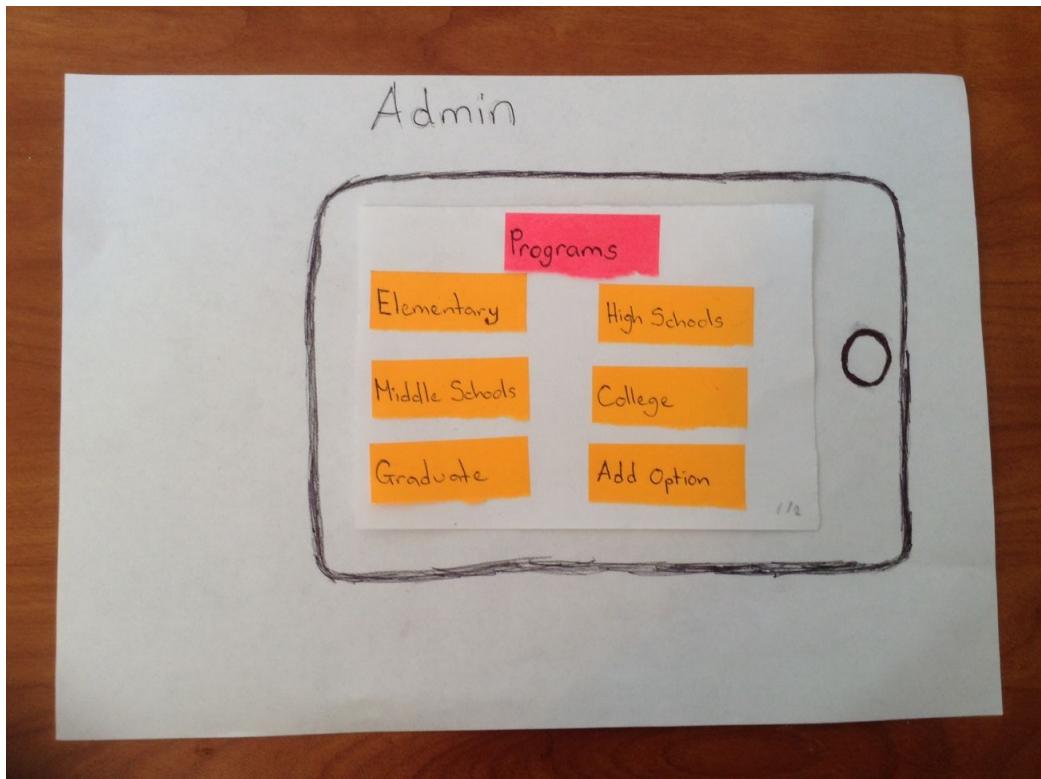


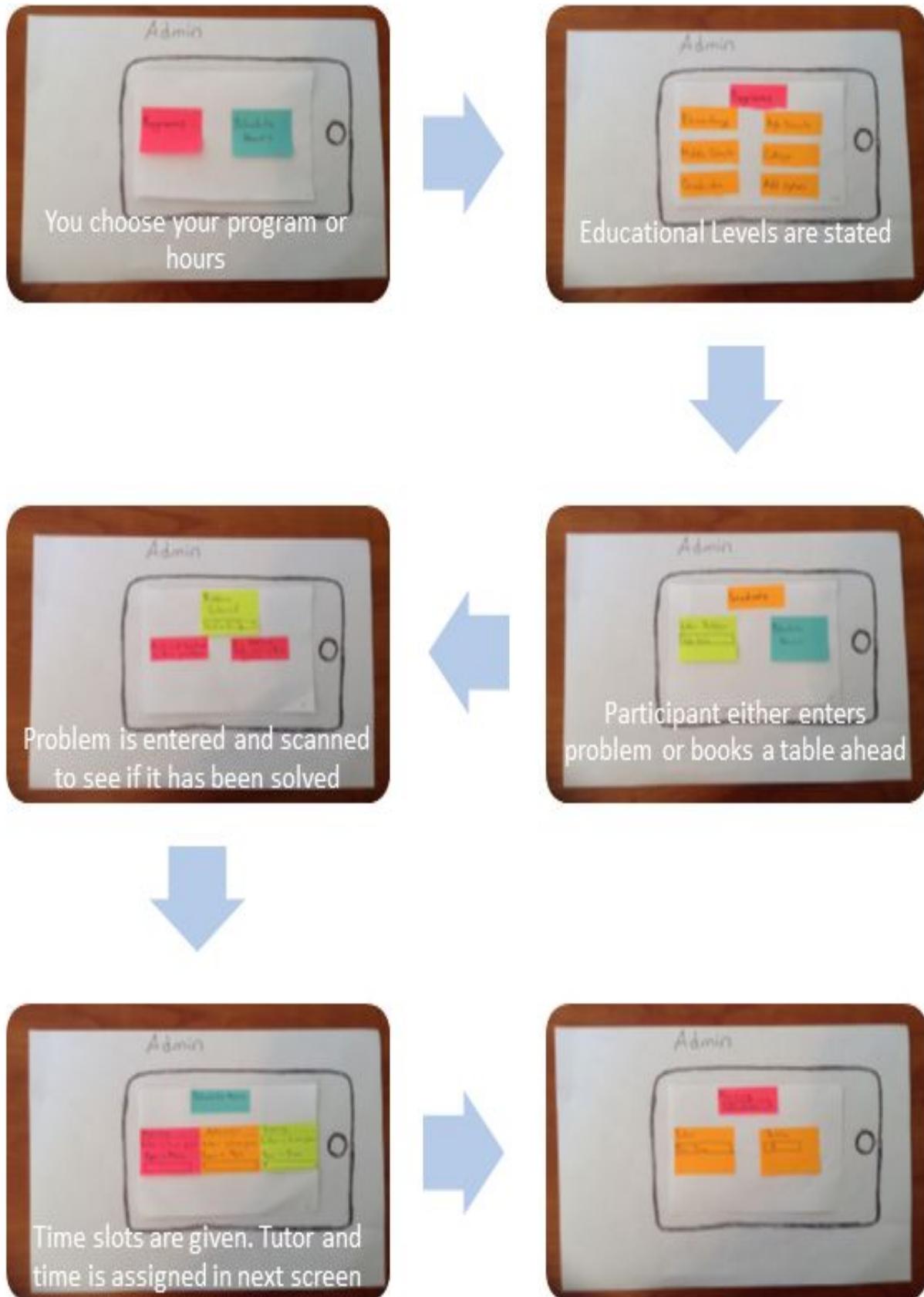
Administrator Duties

The six images are what was used to test the administrator duties. These images are further explained in a flow chart below.









The above diagram represents the Administrative screen. It is the administrator's duty to make the learning environment as conducive as possible. This includes making sure that tutors are assigned to tables, students can schedule appointments easily and so on. The admin has 6 main screens. These are grouped as:

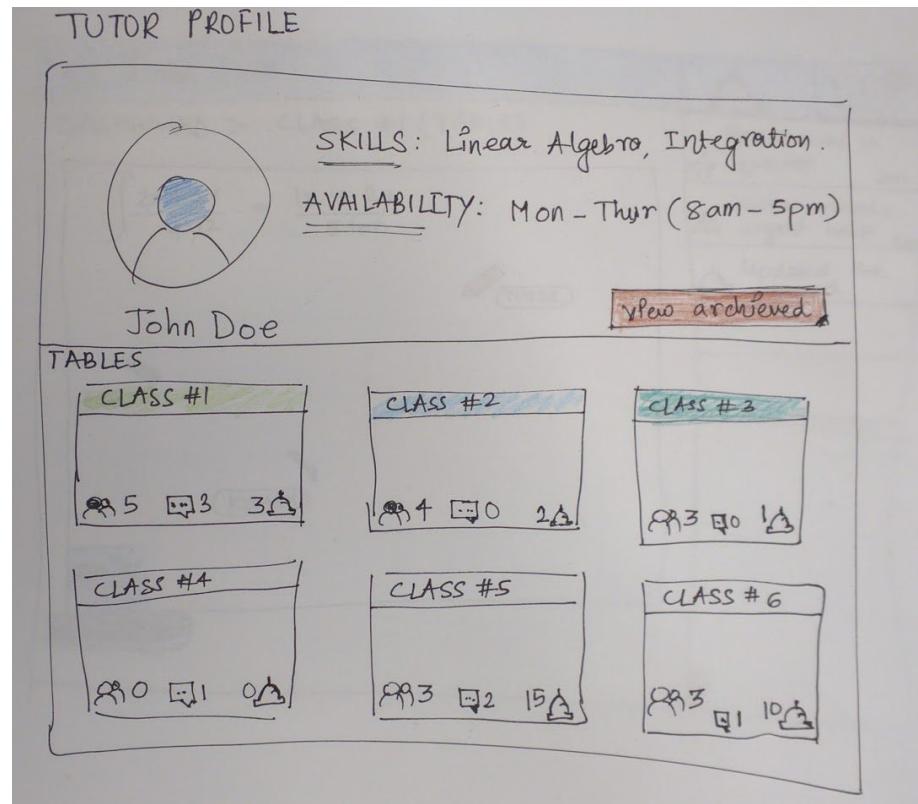
1. The participant either selects between Programs or Scheduling Hours to book a table
2. Either books a tables , enters the problem or selects his program
3. Tables and tutors are assigned to the participant.

We tried to make this process as quickly as possible since time is used to determine how quickly a problem gets solved on the table.

Tutor Duties

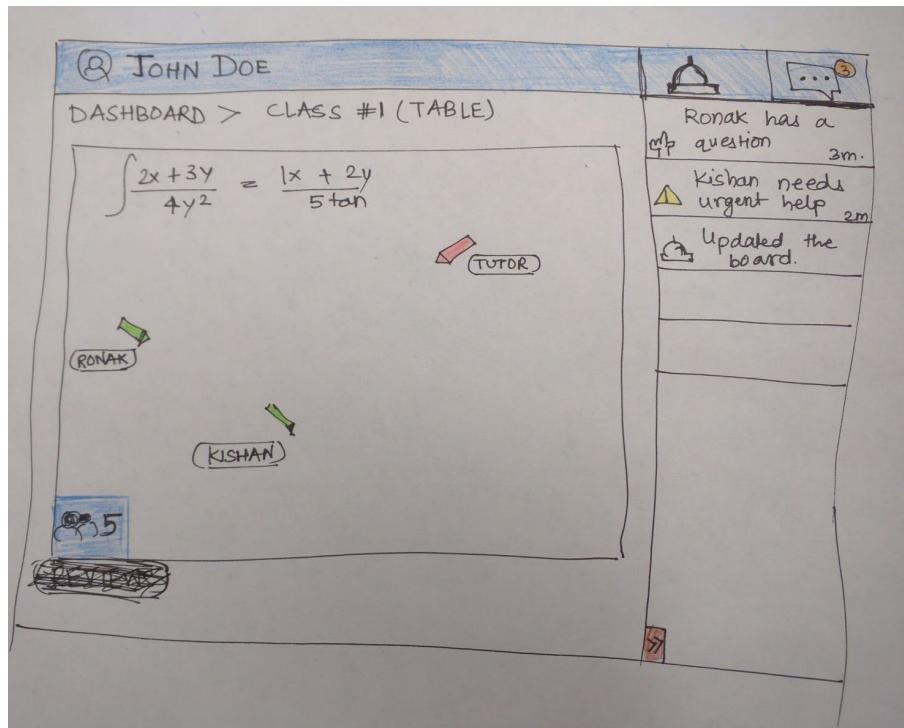
Screen 1: Tutor Dashboard

Tutor can see the classes (each class here is a whiteboard) he is involved in, and also the number of messages received for each of those classes. He can also check the notifications on that particular board.



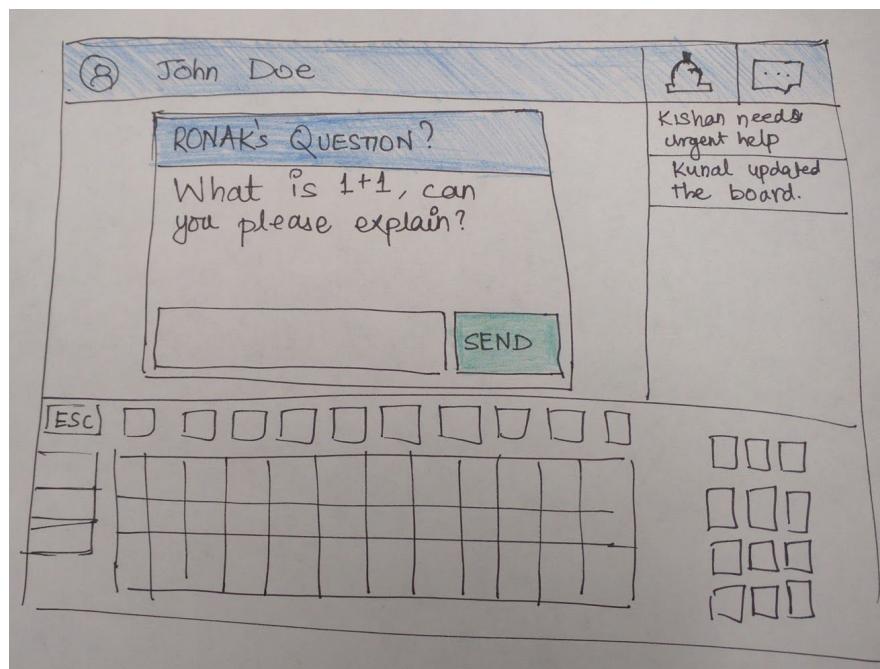
Screen 2: White board view

Here the tutor can see what's going on, on the screen. The red cursor is the active cursor and the green ones are observers. On the side panel, it can be seen that what notifications has been received by the tutor. Tutor here taps on the first notification and then he is brought to the next screen.



Screen 3: Answering to questions on the whiteboard

Tutor here can respond to messages, which are sent to him by the students.



Screen 4: Solved problem

This is how a solved problem looks like. It will be tagged with the person's name who solves the problem. Right now, the tutor solved the problem so it's tagged with his name. Tutor can also archive the problem for future reference. (The archive icon is the one which looks like 'print' icon - this was found in our user testing)

A hand-drawn sketch of a mobile application interface. At the top, there is a header with a profile picture of a person with glasses and the name "John Doe". To the right of the name are three icons: a lightbulb, a speech bubble, and a gear. Below the header, the text "Dashboard > CLASS #1 (Table)" is written. The main content area contains a math problem and its solution:

$$\int \frac{2x+3y}{4y^2} dx = \frac{1x+2y}{5+an}$$

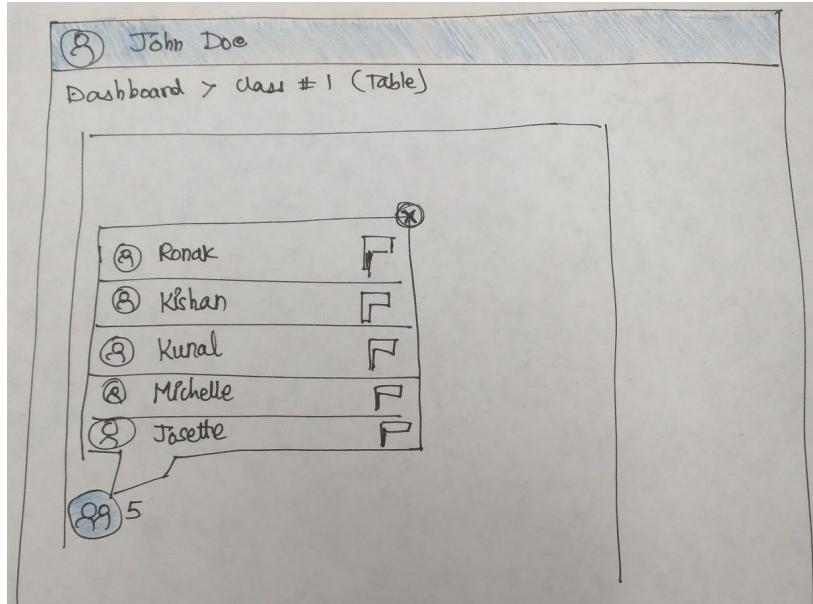
SOLVED

$$\therefore 2x+3y = 2y$$
$$\therefore 5xy = 3y+1x$$
$$\therefore xy = \frac{3y+1x}{5}$$
$$\therefore xy = 2$$

To the right of the solution, there is a green button labeled "TUTOR" with a checkmark icon. At the bottom left, there is a blue box containing the number "085". At the bottom right, there is a double arrow icon pointing left.

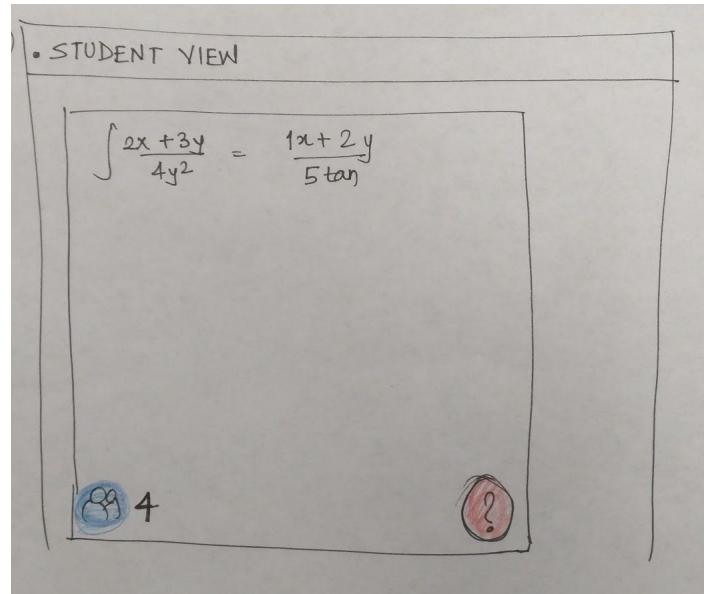
Screen 5: Flagging a user

Tutor can flag a student for inappropriate behavior and then the student's access will be revoked from the system for some amount of time.



Screen 6: Alternate student's view

If the student is stuck on a particular problem, he can then ask the help with the help of 'help' button at the bottom-right corner.



She will then see the pop-up which will ask him if he wants to ask the tutor to help with this problem as shown in the screen below.

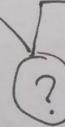
Student view

$$\int \frac{2x + 3y}{4y^2} = \frac{1}{5} \tan$$

Stuck on this
problem?

ASK TUTOR | Later

Q9 4



Informal Walkthroughs

We followed a custom approach of conducting the usability test for feedback. Initially we set up scenarios and task for cognitive walkthroughs. We also helped the participants navigate using wizard of oz. We asked them to think aloud while performing the tasks and also created a video of the session for later analysis. We organized our team efforts as dividing the tasks into facilitator, media manager and note taker. The participants were more of experts.

The following are some areas of improvements that were drawn to our attention when we showed the prototypes to two people during the session:

- The chat feature that showed student discussions was not clear. Participants had difficulty reading a long list.
- It was difficult for participants to notice the archive button.
- They find the numbers associated with courses hard to understand and did not recall their course numbers off head.
- The two participants did not find the auto-check feature easily
- It was not clear to them if the equation displayed could be clicked on.
- The participants did not know how to join the group chat
- User brought up an interesting point of badges and endorsement for the tutor to gain recognition
- They also ask if in the wait-time can somebody else take the pen?
- Some elements and icons of the prototype were not clear to the users, we believe it was more because of the wireframe nature of the prototype and it can be solved when we have more concrete prototypes.

-
- They did not understand what pen control meant. This may be because they had no prior knowledge about the MACLab. Pen control is a concept familiar with visitors at the MACLab
 - Finally, participants did not understand what it meant to flag a student

Second Round of Prototypes

During this second round of prototype, we developed our first round of Hi-fidelity prototype using Sketch. The changes made were based on the feedback from informal walkthrough session. Marvel was used to make it interactive.

Link to the Second prototype

<https://marvelapp.com/iff8b6>

Before and After - a few snapshots

#1 Table screen - Before

The screenshot shows a digital whiteboard interface. At the top, there's a navigation bar with a house icon, a search bar, and a toolbar with icons for magnifying glass, pencil, and eraser. To the right of the search bar is a 'DISCUSSIONS' button. Below the toolbar, a question is displayed: "Q. 1. Find the x and y intercepts of the equation $3x + 4y = 12$ ". To the left of the question is a graph showing a line on a Cartesian coordinate system. On the right side of the screen, there's a vertical stack of messages in colored bubbles. The first message is orange and says "What's going on guys?". The second message is green and says "Can someone help me with this? $3x + 4(0) = 12$ ". The third message is blue and says "3(0) + 4y = 12". The fourth message is orange and shows the steps "3(0) + 4y = 12" and "0 + 4y = 12". The fifth message is blue and shows "4y = 12" and "y = 12/4". The sixth message is blue and shows "y = 3". The seventh message is blue and shows "4y = 12". The eighth message is blue and shows "x = 12/3" and "x = 4". At the bottom of the screen, there are four user profile pictures and a 'JOIN' button. Below these are buttons for 'QUESTION QUEUE' and 'QUESTION 1', 'QUESTION 2', 'QUESTION 3', and 'QUESTION 4'. On the far right, there's a 'JOIN CHAT' button.

#1 Table screen - After

The screenshot shows a digital learning environment. At the top left is a house icon. On the right, a sidebar titled "DISCUSSIONS" contains a conversation about solving the equation $3x + 4y = 12$. The message history includes:

- What's going on guys?
- Can someone help me with this?
 $3x + 4(0) = 12$
- $3(0) + 4y = 12$
 $0 + 4y = 12$
- $4y = 12$
 $y = 12/4$
- $y = 3$
- $4y = 12$
- $x = 12/3$
 $x = 4$

In the main workspace, a graph of the line $3x + 4y = 12$ is plotted on a coordinate plane. Below the graph are four tool icons: a paper airplane, a pencil, a ruler, and a calculator. To the left, under "QUESTION QUEUE", are four user profiles with labels: "QUESTION 1", "QUESTION 2", "QUESTION 3", and "QUESTION 4". A large blue "JOIN" button is positioned in the center. A note on the right says: "You can observe the table, if you have a question of your own, kindly hit 'Join'". At the bottom right is a "JOIN CHAT" button.

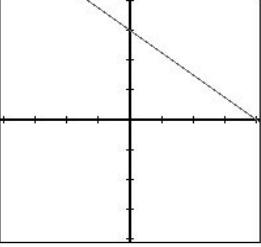
Modifications

- Tools were removed from the top and placed closed to Question Queue to make it prominently visible
- Tools icons were changed to appear more meaningful
- Join button separated in a different section to be more intuitive

#2 At the Table screen - Before

Q. 1. Find the x and y intercepts of the equation $3x + 4y = 12$.

To find the x-intercept, set $y = 0$ and solve for x.


$$\begin{aligned}3x + 4(0) &= 12 \\3x + 0 &= 12 \\3x &= 12 \\x &= 12/3 \\x &= 4\end{aligned}$$

To find the y-intercept, set $x = 0$ and solve for y.

$$\begin{aligned}3(0) + 4y &= 12 \\0 + 4y &= 12 \\4y &= 12 \\y &= 12/4 \\y &= 3\end{aligned}$$

Therefore, the x-intercept is (4, 0) and the y-intercept is (0, 3).

DISCUSSIONS

What's going on guys?
Can someone help me with this?
 $3x + 4(0) = 12$? I am also stuck!
 $3(0) + 4y = 12$
 $3(0) + 4y = 12$
 $0 + 4y = 12$
 $4y = 12$
 $y = 12/4$
 $y = 3$
 $4y = 12$
 $x = 12/3$
 $x = 4$

SAVE Pass Pen Call Tutor End Session

You are in the session

QUESTION QUEUE

QUESTION 1 QUESTION 2 QUESTION 3 QUESTION 4

Type here

Solved!

Q. 1. Find the x and y intercepts of the equation $3x + 4y = 12$.

To find the x-intercept, set $y = 0$ and solve for x .

$$\begin{aligned}3x + 4(0) &= 12 \\3x + 0 &= 12 \\3x &= 12 \\x &= 12/3 \\x &= 4\end{aligned}$$

To find the y-intercept, set $x = 0$ and solve for y .

$$\begin{aligned}3(0) + 4y &= 12 \\0 + 4y &= 12 \\4y &= 12 \\y &= 12/4 \\y &= 3\end{aligned}$$

Therefore, the x-intercept is $(4, 0)$ and the y-intercept is $(0, 3)$.

DISCUSSIONS

- What's going on guys?
- Can someone help me with this?
 $3x + 4(0) = 12$
I am also stuck!
- $3(0) + 4y = 12$
- $3(0) + 4y = 12$
 $0 + 4y = 12$
- $4y = 12$
 $y = 12/4$
 $y = 3$
- $4y = 12$
 $y = 12/4$
 $y = 3$
- $x = 12/3$
 $x = 4$

QUESTION QUEUE

YOU ARE IN THE SESSION

Type here

#2 At the Table screen - After

Modifications

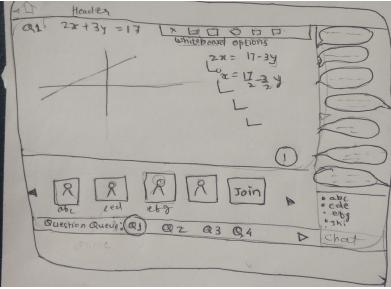
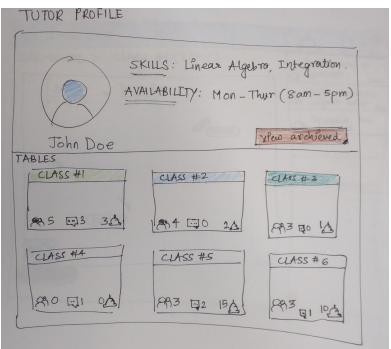
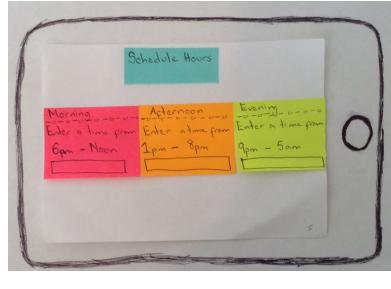
- Question Queue highlighting the current user question
- Prominent Pen control
- Prominent display of "You are in the session"

Prototype Testing

Prototype testing was done in 3 phases.

First round

Prototyping technique: Paper Prototypes using sketches, powerpoint slides and post-it notes to walk the users through functionalities of different user roles.

Participants	Experts from the class	
Usability Methods	Cognitive Walkthrough, Heuristic Evaluation	
Techniques/Screenshot/Benefits of each		
Paper Sketches	Post-it	Powerpoint Slides
 		
We used wizard of oz technique and gained insights about the interaction of student at table	We tested post its for understanding the application navigation and information architecture and it proved useful.	We created few screens using powerpoint to understand the user's perspective on visual appearance. Although it was not hi-fidelity it gave

		important directions for next phase.
--	--	--------------------------------------

Second Round of Prototype Testing:

Since this was first round of Hi-fidelity prototype with focus on student role functionalities, we thought of testing it with the domain experts. We chose a tutor and a student from MAC lab. The Tutor's suggestions were utmost important and valuable which helped us improve the hi-fidelity prototype tremendously. While on the other hand the MAC Lab Student was quite happy to see that he can sit at home and join the table to get his Math problems solved. Both the participants were able to understand the concept very well, so the tasks they performed were quite smooth except for a couple. We recorded the user actions so that it helps us understand to which level the information architecture for the app is correct and actions are intuitive.

Participants: MAC Lab Tutor, MAC Lab Student, 3 Experts (Austin and two of the team members)

Usability Method: Think Aloud

Participant Feedback is included in Appendix

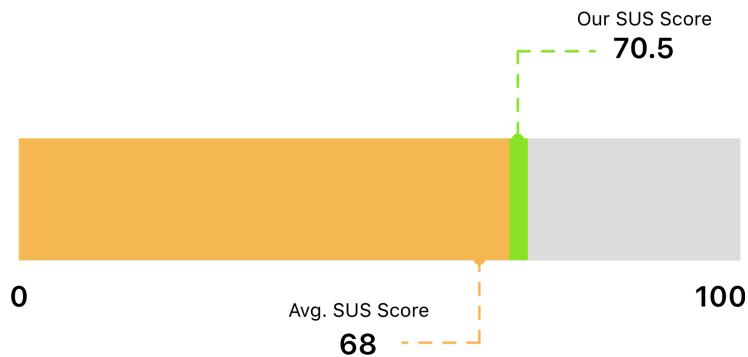
Third Round of Testing

During this round of testing we approached participants who were students, however, not specifically MAC lab users. This time we were seeking feedback on our Generic Project concept and not specific to MATH Tutor. MAC Lab students and tutors knowing the system concept had a different feedback and inputs during the second round of the Hi-Fidelity Prototype testing. Based on their feedback the team got back together and brainstormed again on the interaction flaws to improve the prototype.

We have already displayed the screenshots of Before-After in the section "[Second Round of Prototypes](#)"

We designed a [task sheet](#) with 5 small tasks for the users. We also gave the students the SUS response survey, based on which we could evaluate the Usability of our app and to our satisfaction it was way beyond SUS score. [SUS Sheet](#) is available in the appendix.

Participants: 9 Graduate Students



Generic Feedback

- 'Passing the pen' was confusing
- Dashboard was redundant at the same time it was unclear
- 'What's the table number' - Most of the users suggested to use topic name as an indicator
- Some Positive User Quotes that will keep us motivated

"I am excited to see the live action"

"Nice, clean and easy to use interface"

"This is so much better, I can sit at home and get my problems solved"

Design Wishlist

Due to the limited time, we were only able to implement the student functionality of the prototype. We evaluated all the four functions of the TABLES during our first round of prototype testing, we decided to narrow down the scope to the student and at the table functions, the major ones. The whole functionality testing confused the users as they found it difficult to grasp the whole concept with paper prototyping.

After 3 rounds of prototype testing and having Hi-fidelity prototype now we feel comfortable with User Expectations and experience. So we want to enlist following features on the design wishlist

1. Better design for Student Dashboard
2. Study and improve the Whiteboard interaction - specifically controlling Pen tool
3. Design Chat feature interaction - a general discussion and a private chat with user
4. Design prototype for Tutor function since tutor is second major component of the system after student
5. Design prototype for Admin Function
6. Make whiteboard design more generic and not restrict it just to Math Course.
Getting inputs from various academic fields to cater their collaboration needs
7. Reiterate on application navigation and information architecture strategies

Lessons Learned

- We feel it is best practice to start prototype testing with a low fidelity prototype before investing much time and effort in a high fidelity prototype. This is because you will incorporate many changes from user testing.
- Multiple usability test on your prototypes will help you refine your prototype further. We were able to test our prototype three times and helped us discover a new dimension towards our project.
- To be constructive and critical about the changes made to the prototype based on user feedback. Not all user feedback was useful. Some was based on misunderstanding the idea. Therefore making drastic changes based on such feedback could have had adverse effects on our idea.
- We feel that Participatory design would have helped us improve different interactions and features. Involving the end users and working alongside will be useful at least in projects which involve a complicated workflow.
- For brainstorming we considered system as whole and then narrowed down to student functionality. Then we started designing only for students. We feel we somehow underestimated the scope. Also we learned that we need to keep the buffer time for design phase as well since we uncovered many gray areas during our usability studies.

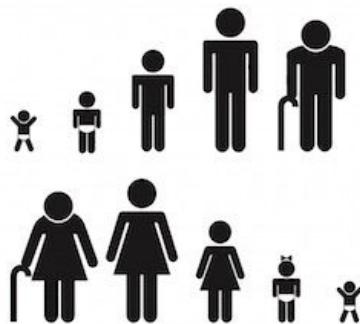
Appendix - Prototype Testing and Usability Evaluation Process

Evaluation Demographics

Gender



Age Group



23-30

Profession

- UI Designers
- Math Lab Tutors
- Math Lab Students
- Other Students

Second round prototype - User evaluation

Participant feedback

Tutor Evaluation

- Had difficulty joining the table
- Did not know how to join a class
- Did not understand the archived problem
- Raised need of adding a 'raise hand' option as a way of alerting the tutor
- Had difficulty chatting with tutor and with pen controls
- He added that in the MACLab setting, a student need permission from the tutor before writing on the board
- Also, that the chat should be made available to students even though they are not on the table
- He said that in the MACLab, questions are not solved on first come, first serve basis
- He added that he preferred multiple windows on the taskbar
- He did not understand the 'wait time' concept
- He wanted more tools not just a pen control. For instance, eraser, highlighter and colors
- The pen icon should be highlighted when in use
- He suggested a private chat feature
- He did not understand what the active dashboard was for

Student Evaluation

- He did not understand the signing in process
- He wanted to join the chat without asking a question
- He did not easily find the join chat button
- He did not understand the 'wait time' feature

Third round prototype - User evaluation

Task Sheet - Preparation for third round prototype testing

Task #1: Signup for the TABLES App

1. Select Signup
2. Click to fill in the personal details
3. Select Education level - Graduation Level
4. Select first four courses

Task #2 : Select a registered course to ask your problem to a Tutor or other students

1. Go to mathematics course
2. Enter into any table
3. Join the table
4. Type your problem
5. Search your problem
6. Verify the solution
7. What will you do if you are not satisfied with your solution?

Task #3 : Wait for your turn or Start collaborating to solve other students problems

1. You want to help other student solve their problem
2. Ask for pen
3. dismiss the notification
4. Assume you are collaborating

Task #4 : Pass the Pen

1. Your wait time over, it is your question
2. You are not able to solve the problem, you might wan to take the help of fellow student
3. What will you do
<Observer to watch and note the User actions>
4. You have to pass the pen to Kunal

#Task 5 : Tutor Help

<Observer to watch and note the User actions>

1. Seeking tutor help
2. Notification sent to tutor
3. Problem solved
4. Tutor has solved your problem
5. Leave the table

* Dismiss the notification to see the next action

* Is it clear that the pen is passed and you do not have control over the pen

SUS Evaluation Sheet

Goal is to achieve a 100% rating										
Strongly Disagree 1 2 3 4 5 Strongly Agree	P1	P2	P3	P4	P5	P6	P7	P8	P9	Avg
1. I think that I would like to use this product frequently	3	4	5	4	5	4	4	4	1	4.17
2. I found the product unnecessarily complex	3	1	3	3	1	2	2	2	5	2.17
3. I thought the product was easy to use	3	4	4	4	5	4	2	4	2	4.00
4. I think that I would need the support of a technical person to be able to use this system	3	2	2	2	1	2	2	1	5	2.00
5. I found the various functions in this product were well integrated	3	4	4	4	5	4	5	4	2	4.00
6. I thought there was too much inconsistency in this product	3	1	4	4	1	2	2	3	5	2.50
7. I would imagine that most people would learn to use this product very quickly	3	4	5	5	5	4	5	4	1	4.33
8. I found the product very cumbersome to use	3	2	3	3	1	2	2	1	4	2.33
9. I felt very confident using the system	3	5	3	3	5	4	4	4	2	3.83
10. I need to learn a lot of things before I could get going with this system	2	1	1	1	1	2	3	1	3	1.33
SUS score	80	85	85	82.5	75	75	77.5	70	75	70.50

Participant Feedbacks - with Participant Quotes

Participant #1

- Solved, Completed - Not making sense
- Why pen, pencil and chalk provided?
- First icon looks like I can tag something

Participant #2

- Confused about 16, 74 thinks it is a percentage value
- Table is not clear
- Wait time not visible easily
- Can I join the table and see what they are discussing
- Why can't I see other student's name, may be I can see my friends
- Ask for pen interaction is not clear
- Wastage of time in passing control as it may happen that 3rd person can solve the question immediately but I have to wait for 30 minutes to get the pen control and that third person has to wait to get his turn to solve
Suggestion - Multiple users solving the questions at a time

Participant #3

- Confused about circles on mathematics table page
- Thought the triangle image on Mathematics page is a question
- Table numbers not understood - Topic names can be displayed
- Expectation - without joining the table I want to search for an archived solution
- Join chat and join confusing - two join options
- 4 icons not clear- 1st Eraser, 2nd Pen identified
- Found the archived solution but why do I see the discussion? Is it archived discussion for that solution?

Participant #4

-
- I don't want to see my own profile when I sign in
 - User understood the total questions solved on the Mathematics Course are related to today's activity but overdue and completed not clear
 - Question queue number is not readable, can they be displayed in sequence?
 - After leaving table it should take me back to Tables and not home
 - While waiting to download the solution it should ask me if I want to join the table?
 - Text should be associated with icons
 - Ask for pen action and interaction is not clear
 - Raise question should be presented right from the join table, when the student gets the pen control

Participant #5

- User found it hard reading the table information. So he found selecting a particular table difficult.
- Did not know that he had to click on the pen in order to select it. He wanted the pen feature to be automatically selected since that is what they use.
- He had difficulty understanding how to enter the problem.
- He did not understand what the achieved solution suggestions meant. He suggested a name tag for the achieved solutions.
- The participant did not understand what the icons meant; especially the 'finger' icon which represented notification to tutor.
- Overall, the participant thought there were too many procedures involved before arriving at a solution to the problem.

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