INTERACTIVEDELIGHT INC.

iLab

Team Radish Project 3

"More Immersive is More Better"

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Executive Summary

In the process of developing an application for the Apple iPad, team Radish came across research on the concept of anchored instruction, which aligned itself closely with our core ideas. Our major problem space was that textbooks were not immersive or engaging, which actually hindered a student's ability to learn. Anchored instruction would allow us to incorporate not only an immersive environment, but an engaging one. After developing our physical prototype based on our concept, we conducted usability testing with three separate two-person groups who were instructed to interact in the iLab environment. These group interactions led us to insights that were not only helpful towards creating our second iteration, but actually helped in backing our initial research. After we decided on the changes and rationale behind our final prototype we developed a storyboard (see Power Point slides) in which our personas would walk through our iLab assignment as or usability testers had, which would allow us to expand upon all the functions in a visible way, as well as a verbal one. We then conclude that an immersive environment, which encourages collaborative efforts and allowed for virtual interactions with the ability to fail without fear is the ideal approach for a learning tool.

Introduction

Classical learning strategies of memorizing information from a text book does not have as much of an impact on what a student retains compared to giving them free reign to explore the topic at hand. The problem we chose to focus on was the problem of e-textbooks not taking advantage of the technological resources available to them, and not involving the student in the learning process beyond shoving the information at them. Team R's core was to exploit technology in a way that utilized anchored instruction to engage the student in an immersive environment that gave them a safe place to fail and learn from their mistakes.

We chose to focus on learning environment in the field of Chemistry, and in specific chose to use a possible example lab from an introductory college course. Our rationale was that the class is difficult; it can be dangerous and costly if mistakes are made. In the real world, if you make a mistake you have to start over. In the worst case you lose your job, or hurt yourself or someone else in the process. These are the thoughts and feelings of those far greater than us reflecting on a method of learning that works. The *iLab* gives students a chance to explore, experiment, and fail without having to worry about the costs involved, or whether or not they've just created the next anthrax.

We began by researching learning and teaching methods, current digital textbooks, and our own experiences in the HCI/d program. We used our research to decide what model of learning to focus on (anchored instruction), who our target user group would be (college students), and even what course we would focus on for testing and prototyping purposes (introductory chemistry course). This focus would allow us to examine and explore our problem space in a very small instance that can be later adapted and modified to cover other subjects and cover more age groups.

Personas

Our group decided to focus on college students enrolled in an introductory Chemistry class. We chose college level courses as they are more able to decide what resources their students will use, whereas high schools and junior highs are state regulated as to what textbooks the instructors use. The following is a quote that led us to the decision to focus on college-level education.

Ironically, one of the biggest detriments to higher-order thinking is a standardized curriculum. Teachers feel like they must cover an unreasonable amount of content, and thus dispensing or lecturing on this content becomes the only viable model of "covering" all of it.

Fortunately for most higher education, the systems are not so rigidly defined or locked into a set curriculum as many public schools. Unfortunately, we inherit these students who are likely ill-prepared to handle increased responsibilities because they were exposed to such directed teaching. [1]

1) Ryan Kettering
18 yrs, freshman at Big State University

Ryan's Background: Ryan is a freshman in college at a large, state university. He is majoring in Telecommunications and Chinese. He lives with his high school sweetheart, Mark, who is also a T-com major. Both Ryan and Mark are from a small town and grew up with small-town values. They are currently adjusting to the more liberal atmosphere of a large university, and to living together in a small space with their pet fish, Eduardo and Jacobo.

Ryan hated the busy work he was subjected to in high school. His form of studying centered around cramming the night before a test, and dumping what he could remember into his exam. He never felt like he truly learned anything, just how to store information for the amount of time he might need it. He was initially excited about college, thinking it would be a chance for him to actually learn something useful. However, he is starting to see it's just high school 2.0.

Ryan has an easy-going personality, but follows all instructions given to him. He generally tries to please everyone and meet all expectations. He completes every assignment on time or earlier. He bought all of his textbooks for his first term online, months in advance. He is quick-witted, sarcastic and has a heart of gold.

Ryan's Goals:
- Earning dual degrees in Chinese and Telecommunications.
- Doing well in his classes to please his parents.
- Increase his future earning potential.
- To go for further studies abroad in China.
- To eventually move to a large city, preferably in the Bay Area or San Diego.

Ryan's Needs:
- Acquire the knowledge he will need to be successful in his future field.
- To develop a sense of cultural sensitivity.
- To adapt to the environment of higher education.

Ryan's Scenario: Ryan decided to get his required science class out of the way, so he is taking Chemistry 101 and is starting to get a little behind. He remembers very little of Chemistry in high school (sophomore year was so long ago!) He has a test coming up and knows that he needs to review the material, but he is having a hard time figuring out where to start.

2) Carolyn Manibo
   22yrs, Senior at Rick's College

Carolyn's Background: Carolyn is a Filipina senior majoring in psychology and English, even though it is her second language. She is in the last year of her program and her classes are very narrowly focused. The classes she is taking compound on concepts and terms taught earlier in her program. Her psychology courses have many terms to memorize and they are difficult to keep organized. Her professors refer to things she learned back in earlier classes, but has since forgotten. During lectures, she finds herself Googleing terms and concepts she does not know, which negatively impacts her note-taking process. This can be tricky for her to do because she also uses her laptop to take notes. She is often frustrated

because her professors speak quickly and she is too embarrassed to ask them to repeat.

Carolyn is fairly technically savvy. She has an iPhone from her current internship and loves to chat with her sorority sisters during lectures she considers boring. She has made many friends in her program, and they often form study groups before tests.

As the first person in her family to attend an institution of higher education, there is tremendous pressure on her to succeed. Her family has heavily sacrificed to help her afford her education. She is expected to eventually attain gainful employment to help pay for her eight younger siblings' educations.

Carolyn's Goals:
- To gain entrance to a prestigious law school.
- To be able to afford her education, as well as the education of her siblings.
- To acquire the skills she needs to succeed in her future study of law.
- To be able to support her current and futures families.

Carolyn's Needs:
- LSAT preparation tools.
- A system of organization that will help her deal with compounding subjects.
- Tools to help her focus in class.

Carolyn's Scenario: Carolyn has dreaded this semester ever since her first semester; she has put off taking her core science class! She was never very fond of science in high school, but she remembered at least being able to tolerate her chemistry class, so she has enrolled in Chemistry 101. They are currently studying chemical reaction types and she is having a tough time differentiating them.

Research

We began research by examining many educational theories. After some preliminary research three educational theories were chosen for further research: situated learning, cooperative learning, and anchored instruction.

Situated learning is the idea that learning takes place in the context in which it is applied [3]. Cooperative learning is a strategy that employs team dynamics to improve and facilitate understanding of the subject [1]. Finally, anchored instruction, is an educational theory that asserts that learning is easier when a concept is attached to an anchor (role-play scenario/ video/ etc.).

To briefly define anchored instruction: Principles of Anchored instruction (adapted from Bransford et al., 1990) include: realistic task or event, problem is anchored or focused; students take ownership (based on relevancy of scenario and relatedness to problems and goals seen everyday); deep development of knowledge structures, highly transferable to other situations; complex content, solved through interconnectedness of sub-problems, multiple scenarios presented, problem presented in a narrative format, a story with embedded data; learning context is generative, students identify with problem and become actively involved in generating solution. [5]

Having defined anchored instruction, we looked at how this would benefit our personas. Ryan and Carolynn are both students required to take a science course as part of their degree program. Ryan has traditionally used the cram-before-the-exam rote memorization strategy. For him, anchored instruction may lead to a deep understanding of the concepts, and allow them to be applied in other situations. Specifically since one of his goals is to adapt to the college environment. In college, as opposed to high school, he will be expected to apply concepts, rather than just commit them to memory.

Carolyn is in the last semester of her undergraduate career. She has neglected to take her science requirement because it is something in which she has little interest. Nearing graduation, she must take it and has decided on chemistry because she remembers it being vaguely tolerable in high school. She has a problem with compounding subjects, this will hurt her in chemistry because it is a subject that builds upon itself. Anchored instruction may help her succeed in chemistry because it helps associate

the processes and concepts in a way that facilitates actual learning in a way that is memorable.

We chose anchored instruction because it met our criteria for selection. Firstly, it benefits both of our personas. Secondly, the main advantage seems to solve the fundamental problems with textbooks. "students more likely to become independent thinkers, apply knowledge" [4]. Thirdly, it could be designed to utilize the features of the iPad. "Anchored modules can take the form of full-blown multimedia with branching or simple web pages with photos and text. In general, the presentation should be as realistic as possible" [1]. With the use of the iPad it is possible to create a highly immersive and interactive virtual world.

Finally, we found an article that specified an 8 step process for designing an anchored instruction unit which helped guide us. (See prototyping for further elaboration)

We conducted some primary research through interviews. The persons we interviewed were a doctoral candidate in chemistry, and a doctoral candidate in education. They both offered some interesting insights that reaffirmed our initial secondary research.

The doctoral candidate in chemistry elaborated that current chemistry textbooks are either too narrow, or too broadly focused. Furthermore, they often gloss over concepts, for example, steps in equations are routinely skipped. He also stated that current offerings do not provide feedback when working through problems. Lastly he mentioned that he has never used an included CD, because "I personally didn't need it". (See Appendix B1)

The doctoral candidate in education provided some insights to current offerings in digital textbooks. She mentioned some "had short readings, short quizes (sic) (self assessed), songs about key concepts and really hard tests (after almost no learning materials)" This reaffirmed our initial assumption that textbooks were a traditional form of learning, even most digital textbooks. Another important concept was articulated when one particularly good version of a digital textbook underwritten by National Geographic was mentioned. "Linked to animations, short clips from Nat Geo, articles from Nat Geo and puzzles and games over key terms (like

crossword puzzles they could fill out online like "hotpotato" website.)"
This reaffirmed our mantra that "More Immersive is More Better".
(See appendix B2)

Finally, the following statement both reaffirmed our research and helped
to shape our design.

*This would be especially helpful if it could link to animations of processes.
For example, an animation of gravity, inertia, normal faults, kinetic
theory, etc. Many of these animations exist online in a variety of formats.
And not to limit it to science, how about addition, subtraction (show
simple actual math equations being solved), voting, language terms like
they did in School House Rock (I know so many teachers who still use
these programs including me), verbs like "run", "walk", "sit",
"throw"(Appendix B2)*

Initial Sketching

During the initial stages of the sketching, we explored concepts based on
various ideas revolving around student needs when put in a setup of
anchored instruction classroom. The key was to achieve an animated
chemistry lab environment where Ryan & Carolynn feel safe to learn by
experimenting.
A few ideas which inspired the final prototype include:
● allowing students to research while they were experimenting, and
make sure that they return back
● allowing students to take their notes while experimenting, as they are
required to do a lot of research
● allowing students to collaborate with other students and be able to
share their notes seamlessly

The main reason of agreeing upon these ideas was that they encouraged
students to do things that they were afraid to do in real life.
During early brainstorming sessions, we also discussed ideas that had
huge potential, but somehow did not fit very well within the primary setup
requirements of an anchored instruction classroom. They include:
● provide features like language translation or transliteration, highlight,
text-resize, dictionary, etc.
● create a sequence view of all highlighted stuff, notes, marked areas,
etc. from the material read

- linking the existing material of a textbook chapter to available online resources like Wikipedia to encourage exploration
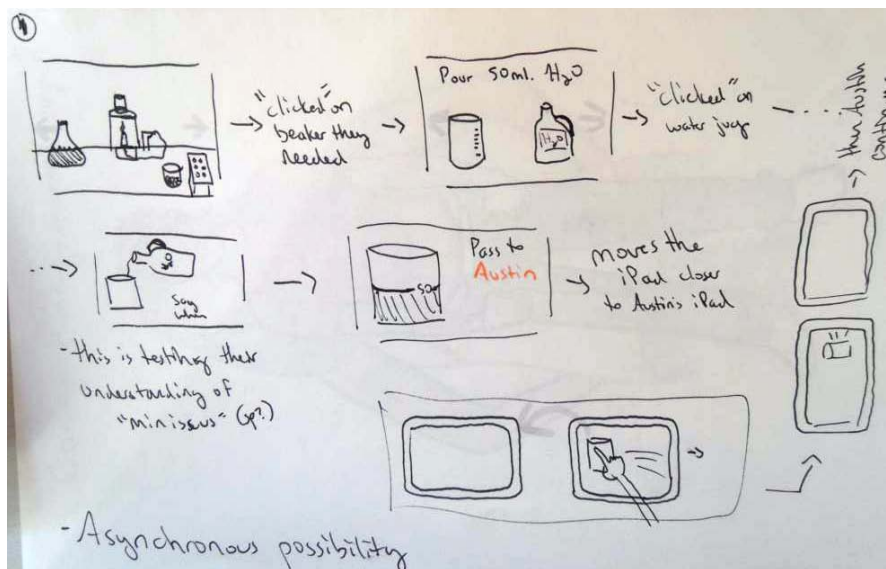- help teachers track progress of each student individually

Figure 1 Asynchronous sketch

After several discussions and much iteration, we came up with two very similar but contrasting design solutions. First concept focused on the asynchronous possibility of interactions among students while the other concept focused on synchronous possibilities. The asynchronous scenario (see Figure 1) would require every student to work on their own and then share their work with others. Where as in a synchronous scenario (see Figure 2) the environment is shared real-time and everyone is aware of what the other person is doing. We chose to move forward with the synchronous scenario as anchored instruction encourages a lot of collaboration.
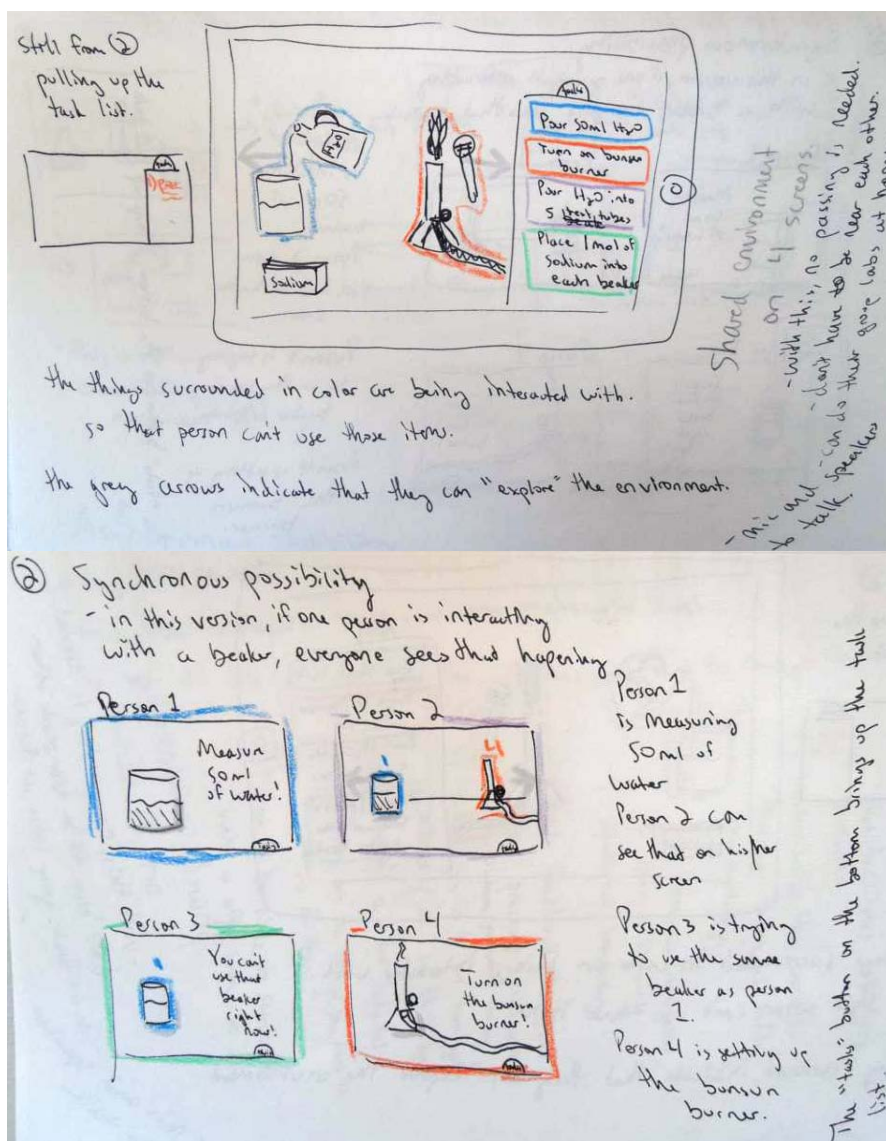
Figure 2 Synchronous sketches

Prototyping iLab

Due to the highly immersive nature of anchored instructions, we needed to focus on a very specific aspect of the instruction methodology to verify its effectiveness with respect to our design.

The list of 8 steps for creating an anchored instruction unit heavily influenced our prototype. The 8 steps are as follows:
1. Choosing a unit of study.
2. Identifying the anchor.
3. Presenting the anchor.
4. Discussing the anchor.

5. Generating research questions.
6. Organizing research communities.
7. Conducting research.
8. Presenting the research.
[2]. [A detailed explanation of these 8 steps are articulated and adapted for our purpose in **Appendix A**.]

After careful consideration of the aforementioned process, we decided that our prototyping scope would essentially revolve around steps two and three - Identifying the anchor & Presenting the anchor.

Step 2: Identifying an anchor. *The purpose of the anchor is to establish a core of knowledge for all class members. A well-crafted video or rich informational book is selected to serve as the anchor.*

Step 3: Presenting the anchor: *Students view the video or read the text. This step is facilitated by preparing an advanced organizer...to help students structure the information they are learning [2].*

With our scope sufficiently narrowed we began to develop the prototype (see Figure 3 below). Step 2 was adapted to utilize the capabilities of the iPad, such as touch,   gestures, portability, wireless connectivity, and accelerometer. With these features available we were able to create an environment much more interactive and immersive than a book or movie would be capable. We referred to our mantra "More Immersive is More Better" to guide us in the application and adaptation of these features into an anchored instruction environment.

Tactile interaction was applied to make the experience more hands on. By allowing the scenario to be more lifelike, the students would feel a stronger connection to the material. Gestures were considered, although ultimately omitted for the first iteration of the prototype (They were added later due to user observations during usability testing, see insights from usability tests). Portability allows the anchored instruction unit to be applied nearly anywhere, even more-so than a laptop. Wireless connectivity was used to allow for a shared environment for the iLab. The accelerometer was considered, although ultimately not used.

In summary, the prototype was designed to reflect the specific advantage the iPad has toward implementing anchored instruction. With particular attention paid to following the outline of anchored instruction and creating the most immersive virtual environment possible fulfilling step 3.

Figure 3 Prototyping process

Testing iLab with users

Tasks

To test the iLab, we chose to provide our users with a scenario based on a typical, introductory-level chemistry lesson: distinguishing between the types of chemical reactions. To present the anchor to the students we designed a scenario in which they are playing the roles of scientists who must synthesize a chemical for their company. To do this, the users had to synthesize the reaction, purify the chemicals, and verify their results. To synthesize the chemicals, the users had to pull out the correct chemicals

from the chemical closet, as well as the pertinent equipment. Then, they had to use the chemicals and equipment to mix the two chemicals together. To purify the reaction, they had to hand their beaker off to a non-playable character (NPC) lab assistant. When the lab assistant returned the purified chemical reaction, they had to verify their results by using the mass spectrometer. The chemical closet, the NPC lab assistant, and the mass spectrometer were all objects embedded in the shared environment. In order to receive the full instructions for the scenario, the users had to look at their task sheets. However, since outside research is an important aspect of anchored instruction, the tasks were purposefully vague. To get *full* instructions on what to do (e.g. finding out how the chemical ratio required), the users had to research the specific chemical they were asked to synthesize.

The iLab is a shared environment designed for lab-like work. To simulate this, we developed duplicate prototypes and tested three pairs of users. Each pair of users had to work together to complete the tasks.

Session 1 with Mathew Generic and Sam Public
These users found the "Tasks" and "Notes" tab immediately, but did not open the web browser tab until the very end, after they had made several mistakes. The tasks tab was purposefully vague to try to force the users to conduct external research. Unfortunately, these users took the vague tasks as a challenge, and decided to experiment with random proportions of chemicals until they guessed the right one. They were instructed to ask questions if they got stuck at any time, but they only asked questions after the third failed attempt at synthesizing the correct chemicals. When they did ask, Austin (playing the role of the instructor) was able to tell them that they had to conduct their own research to find the exact proportions of chemicals. Even after they learned the correct chemical proportions, they forgot to purify their chemicals, so they began to be extremely frustrated with the fact that they kept failing. It was not until they finally remembered to look over their tasks that they remembered to purify the reaction.

Sam and Mathew interacted with the iLab in a way we were not expecting: they both did the actual experimenting on Mathew's iPad and used Sam's iPad to look at the tasks, notes, and web information. Sam noted that he kept expecting various parts of the interface to be "just for flavor." For example, he never decided to click on the web browser tab or on the NPC

lab assistant because he thought they were just there for show. Mathew pointed out that he thought the iLab could be really helpful because it "would be better than blowing things up on you in real life."

Session 2 with Susan Bland and Nathan Boring
These users performed all of the tasks in the exact way we expected them to. They began by clicking on just about everything they thought would be interactive, just to see what sort of information it would give them. Because they had that context built up, they were able to breeze through the tasks; they knew exactly which part of the interface to use for each task assigned to them.

They also used the iPad cooperatively. If one of them had the web browser open, the other one would open something else, or would be conducting the experiment. Nathan kept trying to drag the notes away from the tab and have them appear permanently on the screen. They were really happy with the drag and drop qualities of the interface. Nathan had never used an iPad before, and he said his immediate response was to drag and click and move things around on the screen. Both users noted that this would be a nice way to keep from wasting chemicals in an actual lab environment. They also both expressed interest in exploring, experimenting and "playing" with the iLab.

Scenario 3 with Anthony and Cierra Everyperson
This group of users led to results that overlapped a little with the results from the other groups. The users wanted the notes, web browser, and tasks to be able to stay on the screen permanently. What was particularly interesting about this group was the way they worked together. In the other groups, both users worked on one user's iPad in a serial fashion. With this group, Anthony mixed chemicals on his iPad and issued instructions to Cierra so that she could mix chemicals on *her* iPad simultaneously. These users took advantage of the fact that this simulation took place in a shared environment.

Anthony happens to be a doctoral candidate in Organic Chemistry, so he was able to give us unique insights into how iLab could be helpful in a lab environment. He was really excited for the ability for students to be able to actually experiment with this application. He says that chemistry "is now classified as 'dangerous'" and that students aren't able to experiment because they could cause problems. This application provides a safe place

for students to fail while experimenting. He also noted that this would save money in the long run, because chemicals for chemistry labs can be really expensive!

Insights From Usability Tests

The results of the usability testing lead us to several insights, and a few possibilities for current features that we hadn't considered. Some of the insights gathered reaffirmed our research as to the enjoyment level of learning in an immersive environment, and also lead us to rationale that we hadn't previously considered.

Among the insights we adopted were: placing a door on the cabinet; adding an undo function; adding a way to keep track of action history; making it easier to take items off the screen; adding in the capabilities of gestural interaction; adding a "help" function (raise hand); watching a "replay" and pulling out multiple instances of items. The capabilities and rationale behind these adaptations will be described in the Iteration and Rationale section.

In speaking with user testers lead us to further rationale behind our prototype design. Our prototype would not only provide an immersive environment for learning, but would also save money on lab costs, allow for mistakes to be made without disastrous results and save time, allowing students to fail many times to receive a positive result. Several users made the comment on how, even as a paper prototype, the experience was still enjoying to them. Being able to play around with a variety of options without having to worry about negative consequences was useful. (See Appendix D) Several even pointed out the benefits of how when they went into an actual lab environment, this could help them to complete the lab correctly the first time through.

Iteration & Rationale

Usability testing led our team to discover several insights we had not previously considered. Some of these insights were adopted as we saw their merit, while others were either outside our scope, or were decided non-beneficial.

Changes Made

Undo button and logging activity: Anchored instruction embraces the idea that we learn through making mistakes, and encourages failing in a safe environment. That being said, we realize that sometimes unintentional mistakes happen. A friend can accidentally bump your arm and ruin your measurements, and in the real world this means you must scrap what you are doing and begin again. In a virtual environment, we do not want to encourage back stepping constantly, but understand the need to occasionally step back one action in the case of true accidents. Along with this thought, the ability to keep track of the previous actions was necessary so that the user is able to see what these were, whether to review, or to investigate as to where an experiment may have gone wrong. These two changes combined lead us to add a history menu item, and the ability to slide to undo the last change made by the user.

Help Button: This insight from testing became a discussion by team R, as we were unsure how to handle this idea. On one hand, we realized the need of a way to receive help for issues that may be outside the scenario. An error in the software, or unclear understanding of directions would be examples of such a need. However, help functions can often give too much insight in an environment where trial and error are instructional tools. After offering rationale behind a few different methods of handling this, team R eventually agreed that in the case where a student needs help, it should be up to the instructor who is overseeing the lab to decide how much to offer. The "raise hand" option signals the instructor's iPad that a student is in need of assistance, and queues them until the instructor has time to answer. Our rationale behind this was that if a student is in dire need of assistance they must ask. In this case they have already broken the immersion that our application relies on to facillitate learning.

Removing items is awkward, add an item interaction pane: Our rationale behind this addition was to offer an additional way in which excess or unused items could be removed from the workspace without having to reset the lab area. While some users during testing had asked for the availability of a trashcan, team R opted instead to offer the idea of reusing/recycling items. When an item is clicked on with no other interaction (dragging, moving, etc), an item menu appears with several choices including putting the item away. An idea for future iterations would be that users would be required to maintain their lab items by washing out used beakers and test tubes, else they'd be dirty when that user next accessed them.

Allowing notes to be persistent: The original prototype design would close out any of the side menu items if a user was to click outside their

area. A user tester noted that it would be more useful to them if there was a way to keep the note area open so that they would be able to refer to their notes without having to reopen them, and find where they were last reading. The change allows the user to drag the notes tab away from the "docking" area, and makes the notes free floating until they are returned to their home position. Our rationale was taken from real life experiences in which we, and others we observed, often do sit personal notes (or a place to take notes) off to the side of lab areas while working. In the real world, scientists keep detailed notes on hand so they may refer to or edit them.

Adding a door on the chemical closet: While testing, users would touch the cabinet and attempt to remove items from shelves. They seemed surprised when a zoomed in view of the cabinet with different items on the shelves appeared. Our users assumed that the shelves of the closet, since they were open, were available to interact with immediately. However, some of the items are very small, and the zoomed in view was easier to interact with these smaller objects – like the glass stirring rod. A suggestion was made by a user that doors on the cabinet would be an intuitive way to interact with the closet, and would allow the user to open it to interact, and close it to return to the main lab area. Team R debated this addition, and agreed that it was a reflection of realistic interactions with the object. We accepted the trade off of additional steps for more immersion.

Insights accounted for:

Some insights were interactions we had not previously considered in the lab area such as actually making a stirring motion on screen to use the glass stirring rod, and pulling out multiples of the same object type. Although we had not originally planned for either of these to be a part of the design, after watching the user interactions, we noticed that these were repeated among several users. Our rationale behind including these interaction allowances was that it actually increases the immersion when an item responds in a way you intuitively believe it should.

Another insight that was briefly discussed by team R was the availability of a "replay" or "Play back" option, which would allow the user to watch the last lab session they were involved in. Although the idea had been brought up during brainstorming, it was never expanded upon. Having users mention it during testing, however, brought our attention back to it, and we discussed where we would put this feature if we chose to include it. In the end, we decided to not include the playback function from the lab area, as it would not only take away from the immersion, but it was very

difficult to find a way to access it without making the screen distracting. Instead, we decided that if the playback option was included, it should be outside the lab area itself, likely on a previous menu.

Future Iterations:

One insight offered to us was something we discussed many times, and had actually planned on using. A function during the lab process which would allow a user to "pinch" the screen to zoom in like the iPad interactions, but would allow you to zoom in on a molecular level as well. In this case, however, it was outside of the scenario we had based our focus and research on. Our rationale behind wanting to include this feature is the unavailability to be able to see or interact with things on this level in real life. It would allow students to have a "hands on" experience with the bonds between elements, adding to their understanding. Our rationale behind waiting was that the actual interaction would be lessened with paper prototyping, and the reactions and results may be adversely affected, as well as our focus being on this introductory level lab which was to instruct students how to use the iLab.

iLab Final Design

The iLab interface allows multiple users to interact with each other in real time. It provides a shared environment where a teacher can create scenario based situations and make students do the role-play activities in groups. The idea is that the teacher would put students into real life scenarios and not guide them to the path. It is up to the students to collaborate with each other or perform some outside research and keep experimenting to figure out the correct solution.

The iLab application design includes five core features each serving a specific purpose and being integral to anchored instruction (see Figure 4 for full screen). The screens below list the screen designs along with a brief description of the core features – Tasks, Notes, Safari, History & Raise Hand.
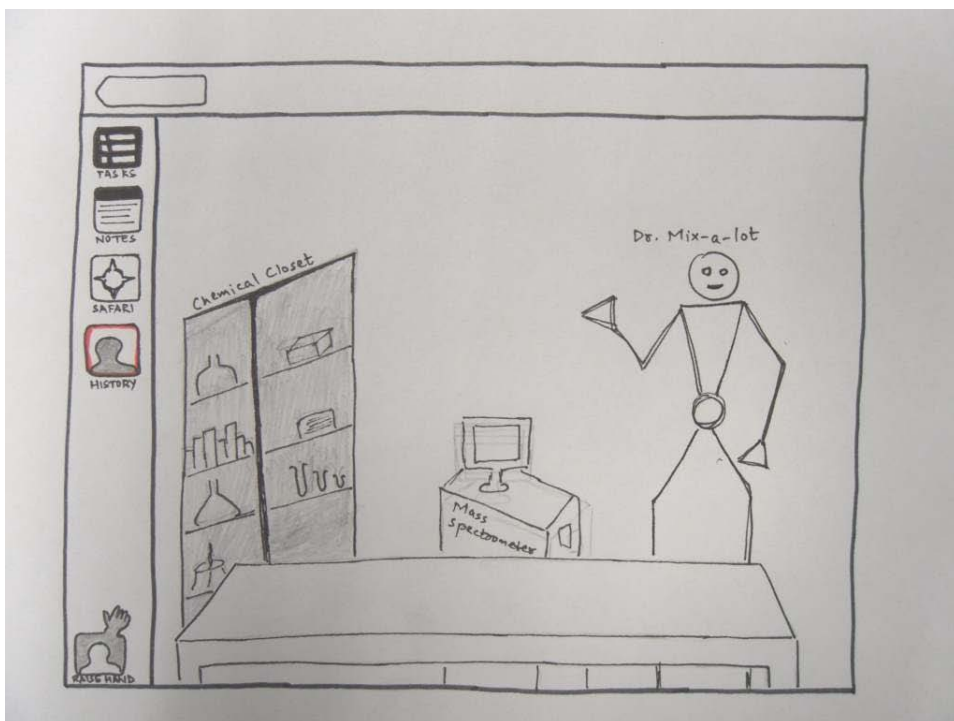
Figure 4 iLab application interface

Safari: The Apple browser is integrated into the application to encourage students to explore and perform research. The primary reason to include browser within the application was to allow students to be in context of what they were originally doing.
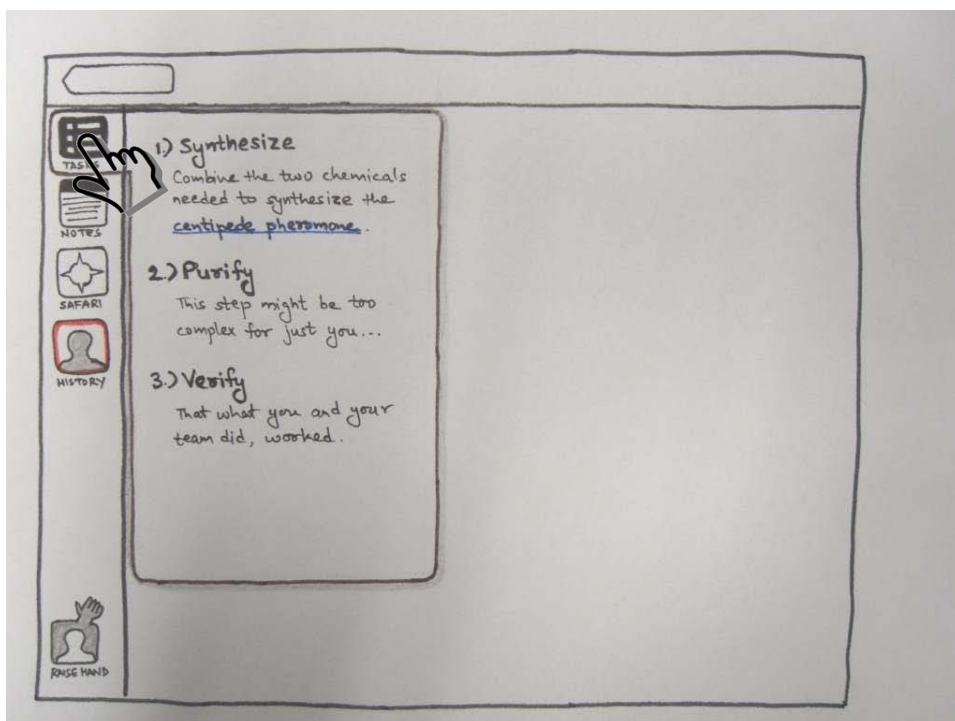

Tasks: Tasks are used by the anchor (teacher) to provide instructions and starting points for the situation. Every student would have access to the notes while they are doing the tasks. The 'tasks' have the flexibility for the anchor to link content to further class notes or web or any relevant content (Figure 5)

Figure 5 iLab task screen
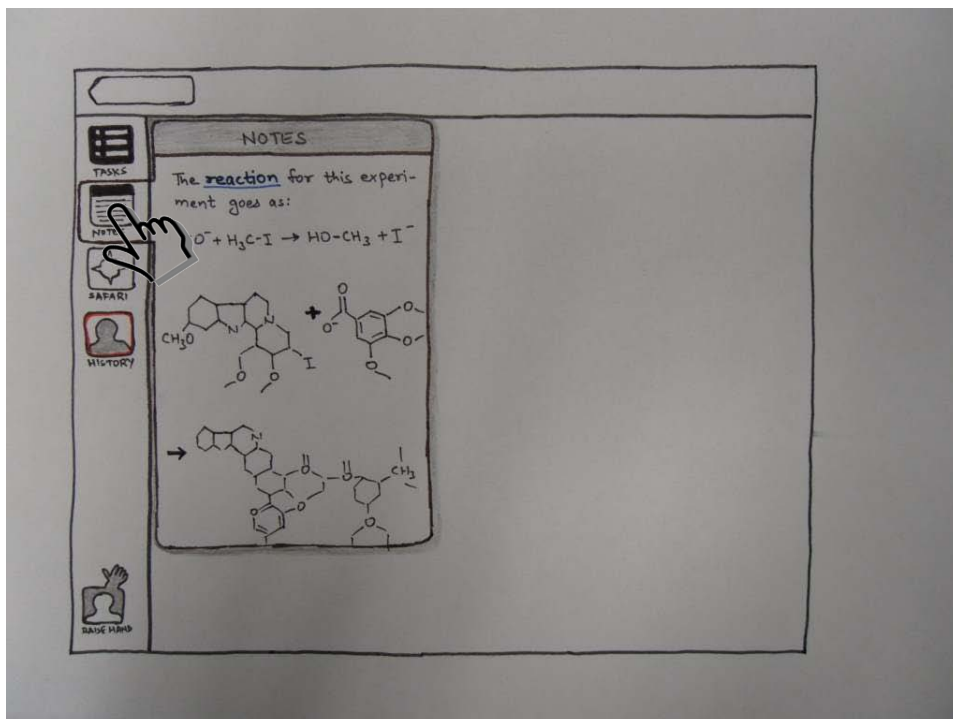
Figure 6 iLab notes screen

Notes: Notes would allow students to combine research from various sources and observations while performing the tasks. We thought of the possibility of students being able to share their notes with other students, but as this feature was really not an essential requirement of an anchored instruction environment, we dropped the idea of incorporating it within the application interface. We believe, notes can still be used by allowing sharing outside the application, or this feature could be added in a future iteration (Figure 6).
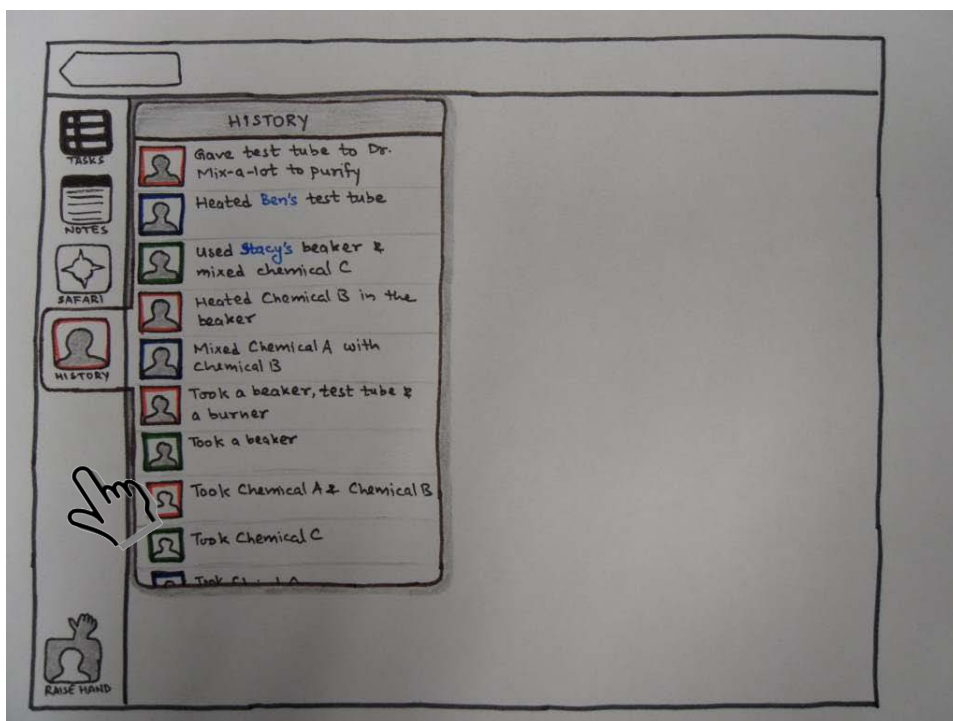
Figure 7 iLab history screen

History: History lists all actions performed by each group member in the order of the activity being completed. Each student would have a different color representation, to allow easy scan of the list and relating tasks to the group members (Figure 7)

The 'History' icon would be an avatar image of the person who executed the action shown. The icon would keep all group members engaged and informed of what others are doing on their own iPad.

An insight from our usability testing alerted us to the possible need of an undo function (see Iteration and Rationale). If the action that is being undone would revert other steps in the process, it must be voted on by . In such all team members before the change can take place. In the case where the action has no dependency, it will revert the state of items without need of a vote.

Raise hand: This was the last feature added to the application to allow people to collaborate when in need of help. The raise hand feature is a metaphorical adaptation of raising your hand when you need assistance . When activated, the hand icon in the bottom-left corner of the screen would show up image of the group member who raised the flag to draw the instructor's attention. More information can be found on this in the section on Iteration and Rationale.

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<http://www.ed.psu.edu/NASA/achrtxt.html>.

Appendix A: The 8 Steps of Anchored Instruction

These are the 8 steps of anchored instruction as defined by Cena and Mitchell and adapted for our purpose. [2]

Step 1: Choosing a unit of study.
The unit of study is Chemistry 101 in regard to reactions, specifically the substitution reaction.

Step 2: Identifying an anchor.
The anchor in this situation, is the iPad iLab we have created. It provides a safe place to conduct reactions, where failure can not result in personal injury. It also provides: a tool for research, collaboration, and an engrossing simulated reality. Furthermore, it allows students to perform tasks that are impossible, or far to expensive to complete. For example, students might be able to view animations of the reactions happening at the molecular level, which is either impossible or at best prohibitively expensive.

Step 3: Presenting the anchor.
Students will be exposed to the iLab, and given a "thinksheet" which is a mind map that has been started. This is to give the students a start, they are to fill in the "thinksheet" as the exercise is conducted. Also the students will be asked to complete 2 statements before the exercise. They are "What I know." and "What I want to know." After the exercise they will be asked to respond to "What I learned."

Step 4: Discussing the anchor.
After completion of the iLab, the professor and students will discuss what was learned. During this process the professor will aggregate the information for display. The collective information will be used to build a common core of understanding and be useful for reference in the future.

Step5: Generating research questions
After the completion of the group discussion, students will be broken in groups and will continue discussion. In this discussion they are tasked with identifying concepts with which they do not feel they have a firm understanding. These questions should be formulated as such that they require research to answer, rather than a simple answer.

Step 6: Organizing research communities:
When research questions have been generated they will be discussed as a class. The students will then be grouped based on interest. This stresses group collaboration and allows students to benefit from the resources of their fellow students. It is important for students to decide what research needs to be done and who will complete which parts.

Step 7: Conducing research.
Students will conduct research on their chosen topic inside their assigned group. This again stresses group collaboration. Since students are discovering knowledge on their own, rather than having it disseminated to them by a professor, it should be a more rewarding experience. Coupled with his, they are researching a topic they are interested in. Moreover, they also learn ancillary skills

such as how to utilize available resources, organization, time management, etc. The professor should prepare primers for these areas to help guide the students.

Step 8. Presenting the research.
Presentations will be made by each group after research is completed. Students will present their findings to other groups. Through this process students will be exposed to all areas of research conducted. The goal being, through investigation of the area they are most interested in or need the most help with, students will more firmly grasp concepts. When presentations are finished the professor will outline and discuss the next anchor.

Appendix B: Interview Data
B.1

- User 1: phd chemistry student (takes chem courses and also teaches chem courses)
- Uses textbook as a reference. Refers to it when he needs to find a specific idea.
- Thinks textbooks can be too complicated and can be too basic.
- Would like to be able to transition between complex and simple more easily (like less information and more information, going from a general overview of the info to more specifics)
- "nesting"
- Example Textbook:
- Organic Chemistry
- looking up important / basic reactions
- useful for finding general concepts and specific equations.
- naming conventions
- tables! "heck yeah tables"
- bond associations
- list of pks (acid association constants)
- tried to find one in his book to show us, but had a hard time
- "every once in a while you really need them, but you just go onilne cause it's easier"
- had to go to the index to find it
- "online you can find better tables"
- would an abridged version be better?
- the 1st 10 chapters are important. other toward the end are kinda optional.
- would it be helpful if you could reorganize the book?
- the chapters DO build on each other, so that could be difficult
- what if you could just move the concepts and fundamental ideas?
- that would be really helpful, as long as there was a "suggested order" somewhere
- was there an accompanying cd?
- yes, never looked at it.
- didn't think it was worth his time
- "I personally didn't need it. I didn't have the digital resources required…" to take advantage of it.
- online textbooks are easier to search (e.g. for specific chemical reactions and names)
- searching through textbook for those things is kinda useless
- good for general concepts but nothing else
- His quantum chemistry book was a "pain in the ass"
- he hates it when they skip steps in the equations

- which they probably do to save space and printing resources
- has a hard time finding all the equations that are referenced.
- integrating calculus and chemistry is really hard.
- suggestions
- videos of reactions might be easier to understand
- key examples would be nice
- especially when you're teaching

- more examples and visualizations
- instant feedback during a problem that tells you what you're doing wrong and why.
- User 2: undergrad (for the past 5-6 years)
- gripes about textbooks:
- they're too heavy and bulky
- they're too expensive
- publishers = the devil
- broken system
- example text book he used:
- Chinese textbook
- learning languages is difficult, and this book is antiquated.
- should be able to be reading a dialog, and point your finger at a particular character and it leads to options:
- show the pronunciation of the character
- speak the character for you (actual audio)
- give the definition or meaning of the character
- watch it get drawn with the correct stroke order
- maybe not show all of that all at once, but only when you ask for it, so you can review easily
- like flash cards
- he mentioned using flashcards at different "intervals" just like what marty showed us in class!
- reading paragraphs: highlighting and note taking in the book should be clean and seamless.
- should be able to add audio notes
- multiple methods of taking notes
- in their class, she breezes through grammar rules and asks them if they have any questions. everyone automatically says "no" but sometimes they really do and just haven't really had the time to realize they do.
- if everyone had an ipad, could determine if there were questions by having people press yes or no
- suggestions:

- "you could condense" so much of this
- so much flipping
- elegant menu could minimize this.
- flipping pages takes time AND mental energy
- built in dictionary for EVERYTHING (like oxford dictionary)
- internet: wikipedia should be maybe 3 or 4 taps away
- have a professional reader read the important parts of the textbook so you can listen as you read along.
- integrate it with skype and email. then for someone's office hours, they could just chat with their profs through their "textbook"
- User 3: was a culinary student and had culinary textbooks to show me
- textbooks are heavy!
- videos would be really useful, especially when discussing a method
- not just concepts but tasks etc..
- "I see you're using beets! Here are other ways you can use beets…"
- intelligent embedded assistant
- for her art history book:
- slide show!
- automatically show the art and info about it, and let her flip through it.
- click on things to learn more about them.
- "how did they make that garnish?"
- interrupt the video and ask the person watching: "what happens next?" and have them answer it.
- or have it ask "what did this person just do wrong?"

B.2

Responses to our questions from Dr. Dick Hines, science dept, Anderson High School
What are some effective strategies for explaining chemistry concepts?
I like the mole web for explaining conversions.
I emphasize factor label for all the problem solving
Labs tend to really improve understanding-if the instructor works to
develop a bridge between the topics covered in lecture/discussion and
the lab work.
What are the main problems you face teaching this subject?
Students tend to struggle with the math calculations.
A distinck lack of reading the material to get an additional supporting

coverage of the material.

The lack of a value placed upon "learning!"

What are the major resistances you run into while teaching these topics?

Lack on conceptual understanding-lack of logic-and truthfully lack of effort to improve.

Answers to these questions from my mom:

effective strategies: I try to use analogies to familiar substances, processes and to get students to visualize things

Main problems (other than being a geologist?): Students lack the mathematical analytic skills, students lack personal experiences to build on

Resistance: students do not want to do the work (mainly homework), students do not understand the links between the various concepts because they don't want to think, students struggle with the math because they don't understand what the numbers really MEAN

some of this is from personal experience, some of it is from conversations with other teachers in the past (some even from Mr. E at Madison-Grant - the chem teacher that Erin and I both had).

Information about digital text books from my mom (Tina A. Harris, Anderson School Corporation science teacher). It was spawned from a conversation we were having on the phone, so she basically just typed out everything we'd talked about (I was driving) and e-mailed it to me:

we were talking about what is currently available in "digital textbooks"

1) that had short readings, short quizes (self assessed), songs about key concepts and really hard tests (after almost no learning materials)

2) several that have interactive CD's that link to specific websites that may or may not have animations, worksheets (that look like real worksheets but are online), and will read the text word-for-word to students (my students don't really seem to like these)

3) one that came in a workbook format that was like a series of webquests to different sites (not all sponsored by the company so no guarentee they would all work the lifetime of the textbook) with pages for answers. Since it was a science book it had animated labs where students could control variables and

then after playing with the computer model for a while they could take what they learned to design their own physical lab.
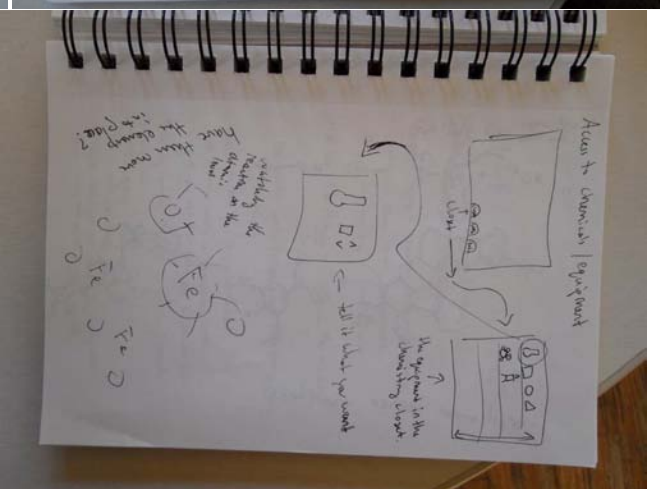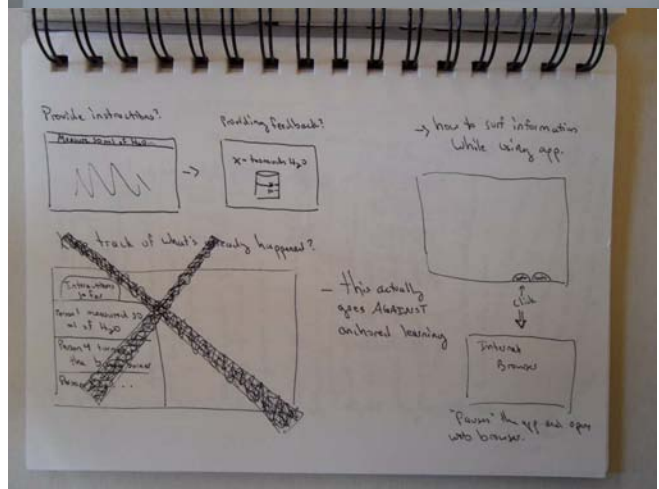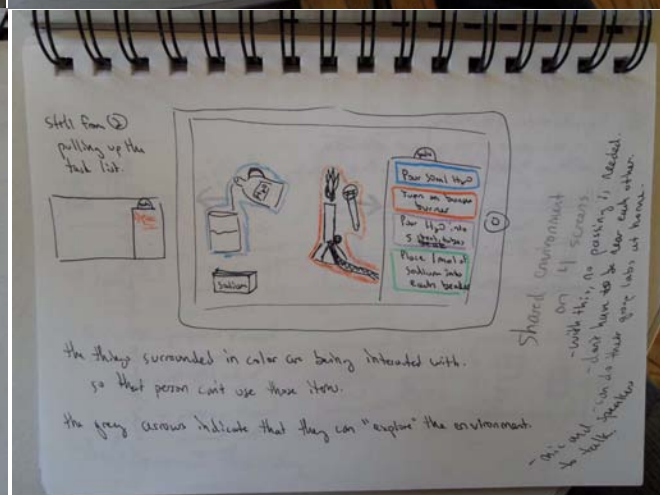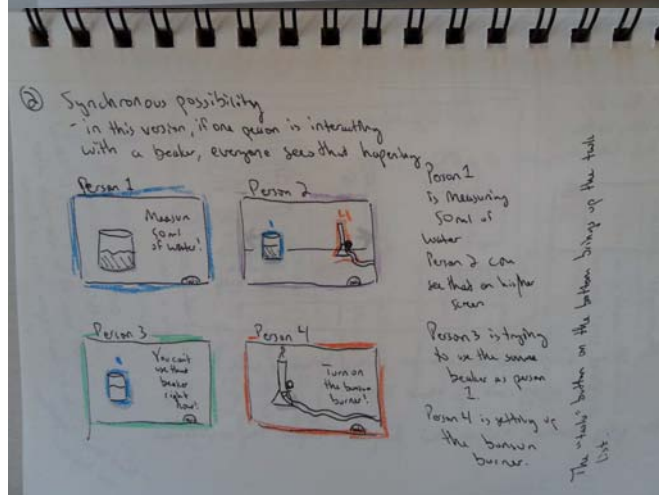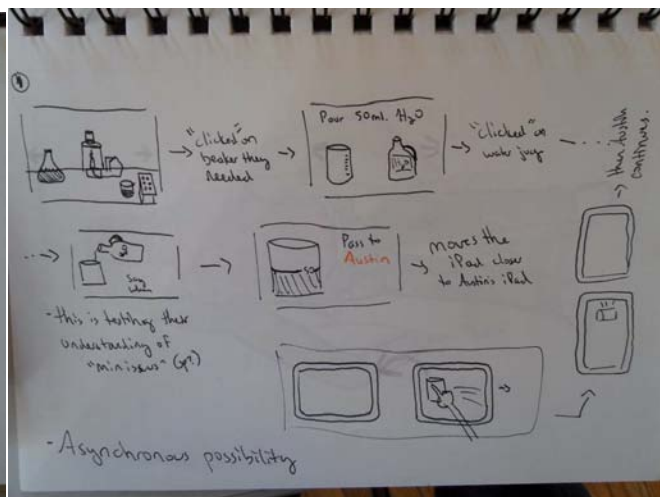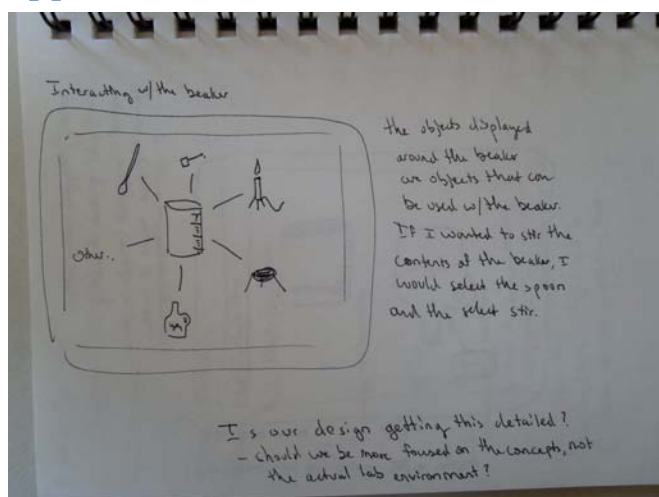
4) one partially underwritten by national geographic that linked to animations, short clips from Nat Geo, articles from Nat Geo and puzzles and games over key terms (like crossword puzzles they could fill out online like "hotpotato" website.)
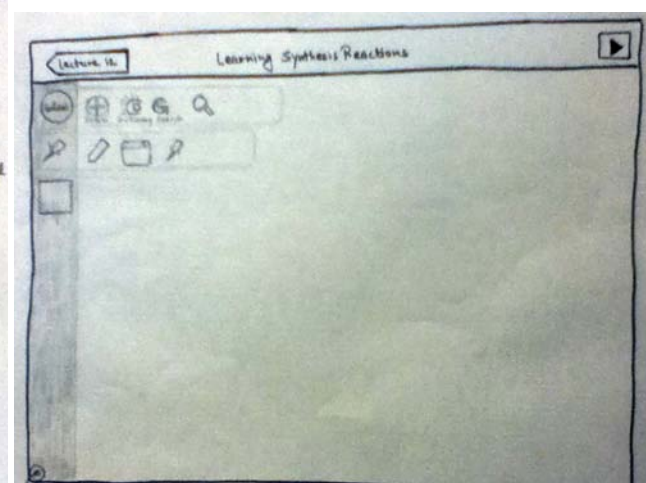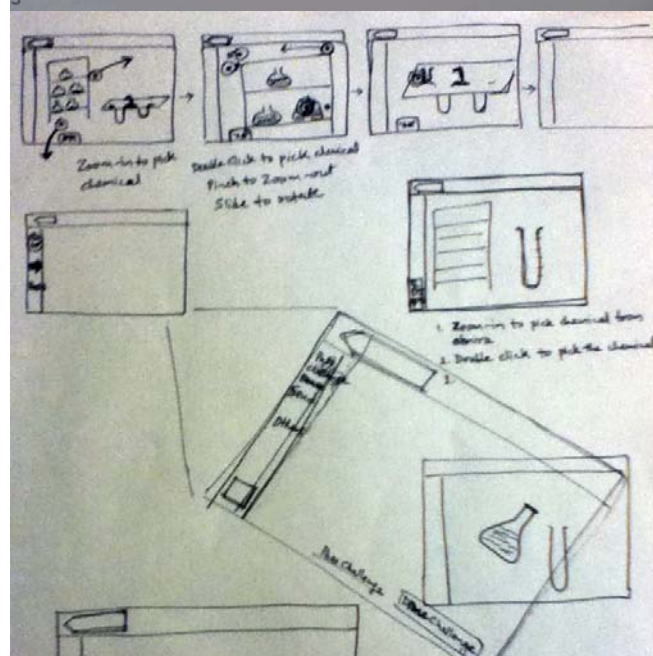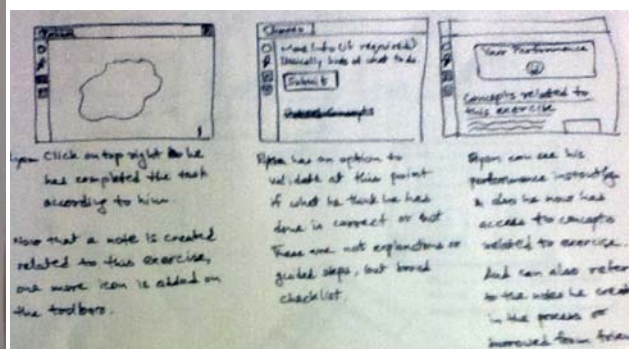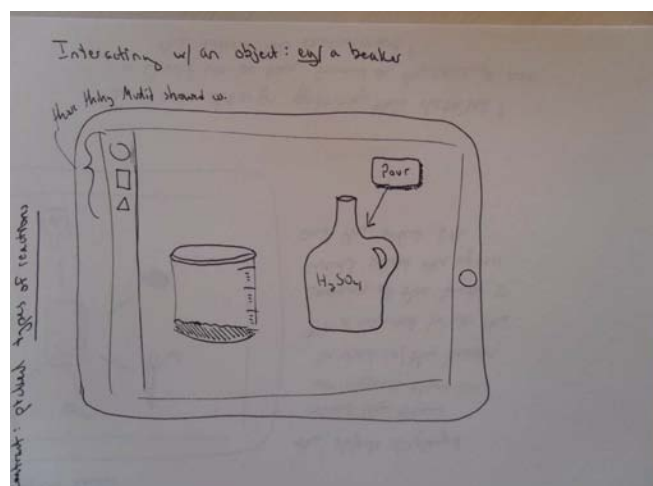
My suggestions: an app where when you locate a key term (or it is identified for you) it links to a diagram or animation directly. With the increase in ENL and ELL learners (English New Language - English Language Learners) and Special Needs students this would tie in with research on development of mental models to link language to mental images of previously learned objects and processes.
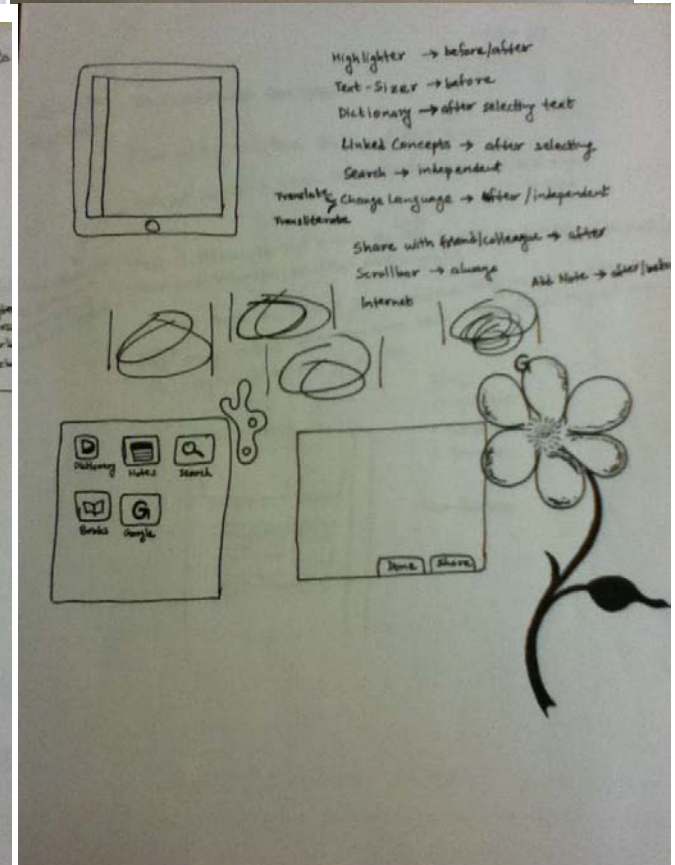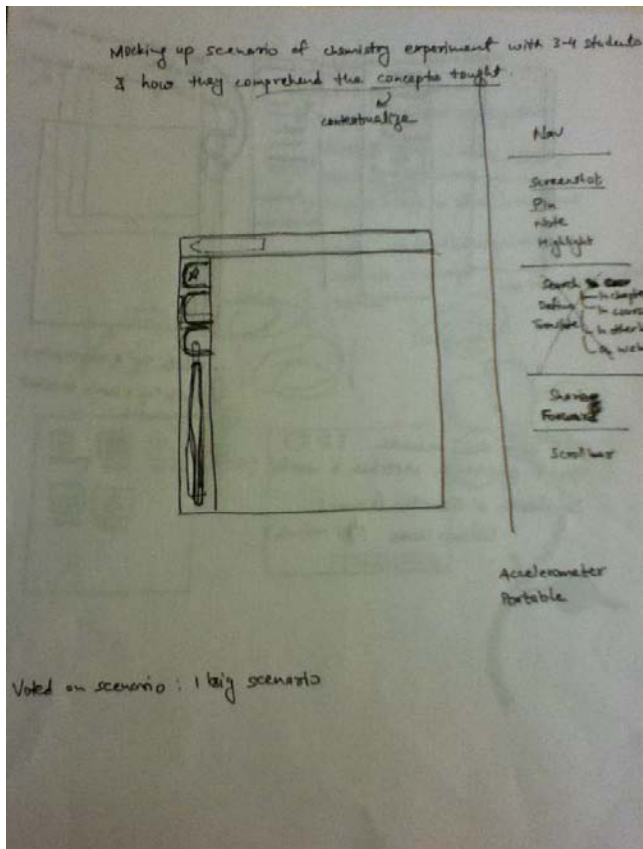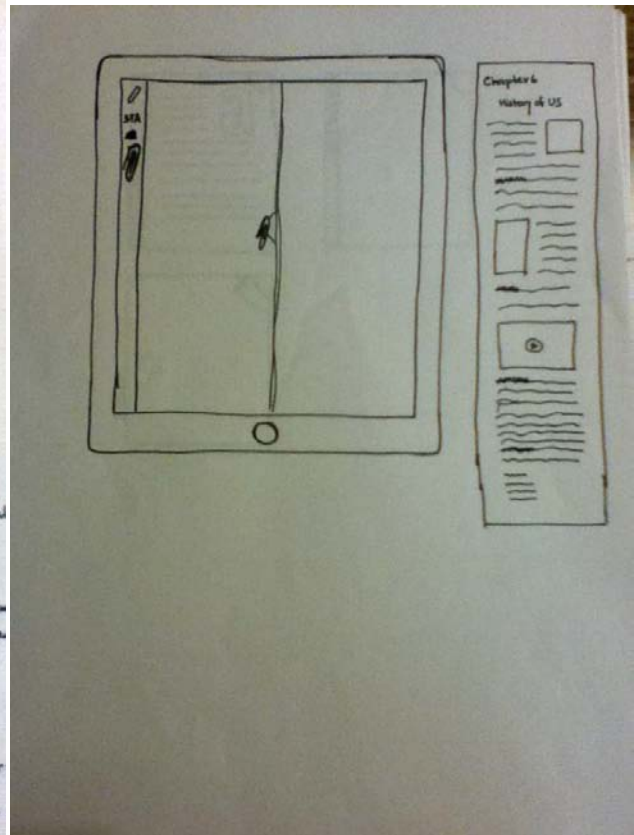
This would be especially helpful if it could link to animations of processes. For example, an animation of gravity, inertia, normal faults, kinetic theory, etc. Many of these animations exist online in a variety of formats. And not to limit it to science, how about addition, subtraction (show simple actual math equations being solved), voting, language terms like they did in School House Rock (I know so many teachers who still use these programs including me), verbs like "run", "walk", "sit", "throw"

By the use of images and animations it makes it a universal type of translater reguardless of original language and a teaching tool for any class. A visual dictionary.

Appendix C: Initial Sketches

CLASSROOM

Ability for teacher to allow students to follow individual pace.

↳ Gives different levels of assignments to students based on their ability.

Allows students to change their own notes

Allows to talk/chat

Allows users to navigate to deeper & broader levels.

Allows users to create their own

Chapter 6
History of US

Mocking up scenario of chemistry experiment with 3-4 students & how they comprehend the concepts taught.

contextualize

New

Screenshot
Pin
Note
Highlight

Search
Define
Translate

Sharing
Forward

Scrollbar

Accelerometer
Portable

Voted on scenario: 1 big scenario

Highlighter → before/after
Text-Sizer → before
Dictionary → after selecting text
Linked Concepts → after selecting
Search → independent
Translate Change Language → after/independent
Transliterate
Share with friend/colleague → after
Scrollbar → always   Add Note → after/before
Internet

Dictionary Notes Search

Books Google

Done Share

Student put into a situation
- Instructions
- Scenario (Elements + Interactions)
- Evaluation
  & Feedback (
- Learning Concepts

Ryan is supposed to complete the task

Navigate :
Recover : Reset
Explore : Internet Browser
Collect : Notes / Pins / Highlight
& Contextualize
Socialize : Others , Share
& Collaborate

Ryan clicks on browser to clarify few things

Ryan Drops a pin on video.
- Video is now bookmarked
  & you create an note is created automatically with the video, in it

New Interaction for Toolbar area.
Tools divided into 3 broad categories

Click to select the tool
Click & drag to see more
The last selected option remains visible.

1. Navigation options
2. Utility options that can be applied any...
3. Sharing options

Share with class

accelerometer
create a scenario

share

New
Layer Edits
Utility
Sharing
Actions
&
scroll

Class!

Utility

Double Tap

Summary of

Appendix D: Usability Results and Pictures

There were three testing sessions. I'm splitting this document into one section for each. Each section will have two subsections (one for Nick's notes and one for my notes). -Austin

the names of all of our test participants should be altered before they are included in the final version of the document

User_m and User_sc

Nick's Notes (directly from what he typed)
Explained scenario
User_m- "clearly tasks will tell us what the hell we need to do"
Notes- "where we put our notes"
Clicked tasks
Clicked notes
Clicked them both to go away
Clicked on chemical closet:
User_m- read items
Selected chem. A, chem. B, graduated, beaker
User_sc- hit tasks
Know we need 2 chems, know we need 2 chems
User_m- "assumed since touch pad can drag to mix"
Got to screen to mix
Filled beaker with 45% of the capacity of beaker with chem. A
20 ml
Beaker is 50 ml
Poured grad cyl in beaker with chem. A
Repeat with chem. B
20ml of each in the beaker
"perhaps we need a catalyst like heat" user_m
Chem. Closet get Bunsen burner
Get pipette
Get glass stirring rod
Drag beaker on top of Bunsen burner
Use the glass stirring rod on the beaker
Do we see any change? –user_m
Austin "changed color"
User_sc- "use pipette on beaker"
User_sc "use pipette on spectrometer"
Given feedback- wrong chemicals
User_m- "should we repeat the process with different chemicals or with different amounts of the chemicals we used"
User_sc- "know it is only 2, says so in the instructions"

User_m- "destroy it all and start again"
User_sc- "things that are ringed in purple, are they the only ones that are useable?"
Austin- "yes, those are the only ones with which you may interact."
User_sc- "if we only have those two chemicals we know that…"
User_m- "so professor, does the chemical we are trying to synthesize require a catalyst like heat"
User_m- "does the temperature matter"
Austin "no"
User_m- "so it has to be the amounts"
Austin- "on the chaulkboard is the name of the chemical you are trying to synthesize"
User_m- "do we have the right amount of chemicals"
Austin- "no you cannot see what the right amount is"
User_sc- "cant think of anything that could be wrong but the amounts"
User_sc- "retry with a new ration 3:1 ratio of a to b"
User_sc- "I click on safari"
User_sc- types in the name of the pheromone
User_m- "feel like this is cheating, but I guess this program wouldn't have safari if we weren't supposed to use it"
User_m- "let us do the reaction with 45ml of a and 63ml of b"
Start with b, pour a into b, heat and stir in beaker, then put it in the mass spectrometer.
Looked at notes, wrong still.
Looked at tasks
Looked what purify means
Austin "you are not capable of purifying"
User_sc: "forgot about dr mixalot, thought safari and dr were just for flavor"
Repeat with beaker heat, stir, hand to dr mixalot
User_sc: "seemed silly for us to both be doing something at the same time"
User_sc was doing research as user_m was experimenting
Gave to mix a lot, was purified
Gave to mass spectrometer-
Chemical is right.
Post questions:
Comments- slowed down things that were for flavor.
User_m "should have been a help tab, tells you what each of these things were"
Explain things more.
Austin: do you think this would be helpful
User_m: "yes, way better than have something blow up in your face"
"allows you to do things faster, don't have to actually wait for things to heat etc."
"cant flub something as readily on an ipad as you can in real life, can turn Bunsen burner to exactly what you need to, rather than just guessing"
User_sc: "didn't occur to me that when you clicked on a shaded item, would just get, not open a new window"
Thought of mix-a-lot as like the Microsoft paper clip guy
Thought that purify since it was too complicated, and as such couldn't do
User_m thought it might require teamwork. Reword this.

User_sc- "had drawn shelf with closed doors, I would have thought to click this and retrieve items from it"
Better undo button.
User_m- "good to see that you can do things in this app that you cannot do in real life, like see bonds forming, which would be important for a chemistry student"
User_sc- "like the idea that you pick up items and put them on the table, because it mimics real life, I would not just hold chemicals in the air and mix them"
User_sc- "I intuitively thought that by clicking on things I would be given a menu, and then options on how to use them." "Repeating the processes as close to possible as you would in real life"

Austin's Notes (transcribed from written notes)
m: "clearly, tasks will tell us"
s: "notes has chem. stuff"
M is reading tasks
S - reading notes off of M's iPad

--tapped tasks / notes to get it out of the way
(we told them they know the name of the centipede pheromone and that they need to use a synthesis reaction)

M- chemical closet
--looking through stuff
- if we click on the beaker, does it go back?
clicked through things
we'll try just combining chemicals

they're both working on user_m's iPad, but user_sc pulled up the tasks on his so user_m didn't need to leave chemical closet screen.

don't know the combination we need, so we'll just try a 50/50 ratio.

clicked and dragged chem a to graduated cylinder.
(told them that it showed them the graduated cylinder and chem. a and would let them choose how much of it they measure out.)

chose 45% of capacity of beaker (but we asked them to give us a real measurement so they chose 20ml)
poured by clicking graduated cylinder over to beaker.
repeated with chemical b (20 ml)
-back to chemical closet
got out the bunsen burner, pipette and stirring rod.

they're still just working on user_m's and reading tasks on user_scs
drag beaker to bunsen burner
stirred beaker
(told them is changes color)
used pipette on beaker, carried it to spectrometer.
(gave them the verification screen)
they checked notes, and saw it didn't match.

"should we just mess with amount of chemicals?"
they haven't asked for help yet
"destroy it all and begin again"

purple = highlighted for use
directly asked me: does it need a catalys?
yes
specific heat?
doesn't matter
"ah, so it must be the amounts"
we can see the structure of what we made, what is there too much of?
-told them they wouldn't be able to tell from what they saw

clicked on pipette to empty it (should make easier to empty)
repeat process 30:1
told them it was wrong.
s: looks at safari
"ah, handy browser"
M: "Ifeel like this is cheating"
-I guess it wouldn't have safari if we couldn't use it.
S: "I thought it was just for flavor"
M- lets do it with 45 ml of chem a and 63 of B.
going through process. they skipped mixalot this time tho.
frustrated that they got it wrong again.
S: I want to click on tasks again
M: oh. forgot to purify. we purify it then
me: this is too complicated
m: prof will you help?
me: dr. mixalot is there to help you

repeating, giving to mixalot
they don't care whose iPad they're on.
chem. magic and he gives it back to you.
pipette on spectrometer
finally came out right.

comments:

s slowed me down because i thought a lot of things were there just for flavor.

m not chemistry students. should have been a help tab to tell you what things were.

m if the doors to the cabinets were drawn shut, it would have made it look more like something they click on to interact with.

helpful?

as chem student? yes. better than having things blow up on you.

can do things faster (don't actually have to wait)

-can't "flub" something as readily.

just thought pretty colors. knew they were usable though. thought could pull things off of chemical closet.

thought dr. mixalot was like the paper clip.

purify: it said "too complicated for just you." m thought it meant they had to work together. s thought they could just skip it if it was too complicated.

once you clicked on the cupboard, you know highlighted things are interactive.

would be good cause you can watch how bonds break and reform

**we need a better undo button

assumed GUI for graduated cylinder would have numbers you could use to measure.

lots of click and drag.

User_sa and User_na

Nick's Notes (directly from what he typed)

User_na and user_sa

User_na clicked dr mixalot

User_sa clicked notes- to see what chemical structure you are going for.

User_na clicks tasks- "I will click tasks to see if there is a specific list"

"that explains dr. mixalot"

User_sa also clicked on tasks

User_na clicked on safari

"what does safari do?"

User_na: "is there any way I can take this note and move it to keep it on screen when I am doing other things?" "seems that it would be really useful to use later"

User_sa- closed safari and went to chem. Closet

User_sa- clicked on chem. A, chem. B, Bunsen burner, pipette, beaker, clicked close, now items are on the table of both things

User_na- opened safari user_sa said me too, user_na said no because it is here

User_na- read requirements 45 mils of chem. A, 63 mils of chem. B

User_sa- clicked on pipette- dragged it over to chem. A,

How much chemical a would you like

User_sa- "can I see how much the pipette will hold"

User_sa took out 45 mils of chem. A in the pipette

User_sa drug pipette to the beaker, emptied the pipette into the beaker

User_na closed safari, said "it is 63 of chem. B" opened chem. Closet

Took out a glass rod- user_na then closed chem. Closet

User_sa- "I guess we should do the same thing for chem. B as we did of chem. A"

Put in the beaker.

"stir first" User_na said "I will stir"

User_na "did it say how long to stir"

User_sa opened safari and said "heat and stir at the same time"

User_na stop stirring put the beaker on the heat and start stirring again.

The chemical changes colors what do you do

User_sa: "we have to purify it, so I will click on mix a lot'

User_sa clicked yes, mixalot purifies

"mass spectrometer is what we use to verify"

User_sa dragged the beaker to the mass spectrometer

Spectrometer shows the results

User_sa clicked notes because of the arrow, compared the chemical structure on both the notes and the results, noticed it was the same.

Comments-

User_sa- "safari tab name isn't completely clear"

User_na: "did not know that in this context that safari was the web browser, even though he is aware of the web browser."

User_na" really wanted to have these things to be persistent" (these things= tabs)

User_sa- "not so bad because one person can have notes open and the other can have other things open"

User_sa "not familiar with chemistry familiar with ipads"

User_na- "familiar with chemistry"

User_na- "has an iphone, has never used an ipad"

User_sa- "I think because I have used an ipad, that my first impulse was to drag things, rather than just click them"

User_na- "I realized after clicking on dr mixalot that the other objects were clickable"

User_sa- "I realized that in a lab I would have carried the beaker to the mass spectrometer, so I did the same in the real environment."

User_na- "weirdest silliest thing I thought, when you drag the pipette to the chemical, that you would be able to interact with the pipette"

User_sa- "wanted to actually use the stirring rod to stir" (swirled finger in a circular motion)

Once read all the stuff on the left, everything seemed easier to use.

User_na- "my first instinct was to click on everything, like dr mixalot, maybe he would give me advice"

User_na- "I wanted to open the chem. Closet and mix random stuff to see if I could make anything blow up"

User_sa- "not being able to interact with things you cant use, made it slightly easier"

How do you feel about ebing able to mix chemicals in a safe environment.

User_sa- "I think it is exciting, you do not get to do that in chemistry class. It may be cool to do things you don't get to do"

User_na- "I thought that it was cool that I could play with chemicals and see what happened"

User_na- "explosions are cool, I would have liked to have seen one"

Hadn't thought about less chemicals being used

"would be a good argument toward doing this, especially if you are mixing things that are hard to get rid of"

User_sa- "also a good way to teach students to work with dangerous chemicals without actually hurting themselves"

User_na- "possibly some kind of help button"

Austin's Notes (transcribed from written notes)

N clicked mixalot right off the bat.

"oh, nevermind" after reading it

s- notes (to see if we have chemical structure aiming for) (and she was right!)

- closed by clicking again.

n- tasks.

s- reading off of it. then opened her own cause reading his screen is annoying

n- safari

s- reading off of his

N: can I keep this open all the time?

S: chem closet. chem A, chem B, bunsen burner.

N: I'm going to open safari

S: me too

N: no you should keep it closed.

-showed her numbers from safari

s: pipette dragged to chem A "how much does it hold?"

I will take out 45 ml.

-> to beaker

-> bunsen burner

n: glass rod from chemical closet. after closing safari.

s: repeats what she did with chem. A

n: stirring 1st. how much stirring?

s: I'll open safari

-heat and stir

N: oh I'll stop stirring

beaker -> heat -> stirring

s: now we have to purify
-> dr. mixalot -> yes.
->mass spectrometer
->notes
they got it right!

s: I don't think safari is clear. should just say "internet"
N- really wanted little screens to be persistent
s- with 2 people its not too bad.

s- not familiar with chemistry. is with iPad though.
n- chemistry in high school. no interaction with iPad.
s- my first imulse was to drag things.
n- I wouldn't have dragged the beaker onto the mass spectrometer. I would have just clicked. b/w the objects makes sense. but with background things not so much.
s- i would.
n- pipette to beaker. imagined screen come up where you'd have to interact.
s- wanted to actually "stir" with stirring rod
-like a really easy minigame
-once we read the stuff it seemed easy.
n- click random stuff to see what happens.
n- wanted to start mixing random stuff. wanted to make something blow up.
s- makes it easier that usable stuff is highlighted.
**should we make it harder?
exciting that you can do dangerous experiments.
environmentally conscious?
doesn't waste chemicals
s- makes sense. good way to teach students to work with dangerous chemicals.
n- kinda
n: help button ***
-tells you what to do.

User_ca and User_an

Nick's Notes (directly from what he typed)
User_an and user_ca
Explained that it is a shared environment
Both clicked on tasks simultaneously
User_ca tried to click synthesized it is not clickable, it probably should be
User_an clicked on safari, found the chemical formula
User_ca hit notes again and it went away
User_an tried to move search but couldn't, it should be moveable
Chemical closet
User_an measured out chem. B with grad cyl

User_ca measured out chem. A with a grad cyl

User_an "A round bottom flask would be nice"

Both combined everything into a beaker

User_an "a hot plate would be nice"

User_an and user_ca put the chemicals away in the cabinet

Click and drag the stuff to the back

"Dr mixalot is not wearing goggles or a lab coat" User_an

User_ca "I forgot what we did can I watch a replay?"

User_ca moved it to the mass spectrometer.

(did not match)

Clicked dr mixalot after, saw that it should be clarified

User_an doesn't like that dr mixalot had to purify

"there is nothing on here that tells me how to purify" – User_an

User_ca-

"Good program, same kind of lab could be used in different situations, the format is easy enough to use, it would be interesting to see how it would work on something more compliuser_caed"

User_an- "it shortens some of the time, you can go through the procedure, there are sometimes where the order of procedure matters, if you mess that up, you will not get product. Order can be very important, a lot of times what I see people doing when I teach labs, they get so far and they wont know what to do, im doing the step and I don't know what happened. I just spent 2 hours doing this, and I do not want to mess up" "aw crap I messed up, if you could go back and do it again that would be helpful"

"lap classes are 15 students, one large scale reaction 100ml of solvent, 150 students each using 100ml of solvent, not expensive but it would add up." 450 dollars for solvent, alone, 100-200 dollars for compounds. Could save money, large lab fee for ochem. Stuff they use is expensive, if they break it they have to pay for it.

"chemistry is now dangerous, all chemicals are now dangerous, hard to get your hands on anything but the most rudimentary chemical kits, which sucks because they are next to useless, you cannot teach anything from them."

Cost, safety is a secondary concern, "biggest problem I found with chemistry labs is they are not allowed to experiment, they are there to learn the technique, they are not learning the science, they are learning the steps which is god-awful. If there was a way to do the reactions, one reaction would take the full 5 hour lab period, if you could cut that down to 50 minutes you could do 4 more reactions. You could actually experiment and see what is best."

Austin's Notes (transcribed from written notes)

they both immediately say "lets look at tasks!"

user_ca: wanted to click "synthesize"

a- i'll click on safari, you click notes

c- okay.

c- "hit notes and it goes away"

a- wanted to move around the safari window.

SYNCHRONOUS! they're doing this synchronously! sweet.

c- i'm clicking pipette -> chem A. w/pipette
a- graduated cylinder and chem B.

mixed them.
**user_ca used "her" graduated cylinder w/ chem A and user_an used "his" w/chem b.
I have too much stuff out
--need to be able to put things away.
c- stirred it.
can I watch a replay?*
can I undo?

beaker -> mass spectrometer
they did it wrong. forgot mixalot. got it back.
didn't clearly explain mixalot would do it for them

did it over and got it right.
comments?
good: same lab could be used multiple ways: eg. sandwich. format could be reused. would it work for something more complicated?
a- order of addition of chemicals can be important. so undo would be really nice.
less afraid to make mistakes

environmental aspect: absolutely helpful.
explained some money stuff.
saves on equipment too.
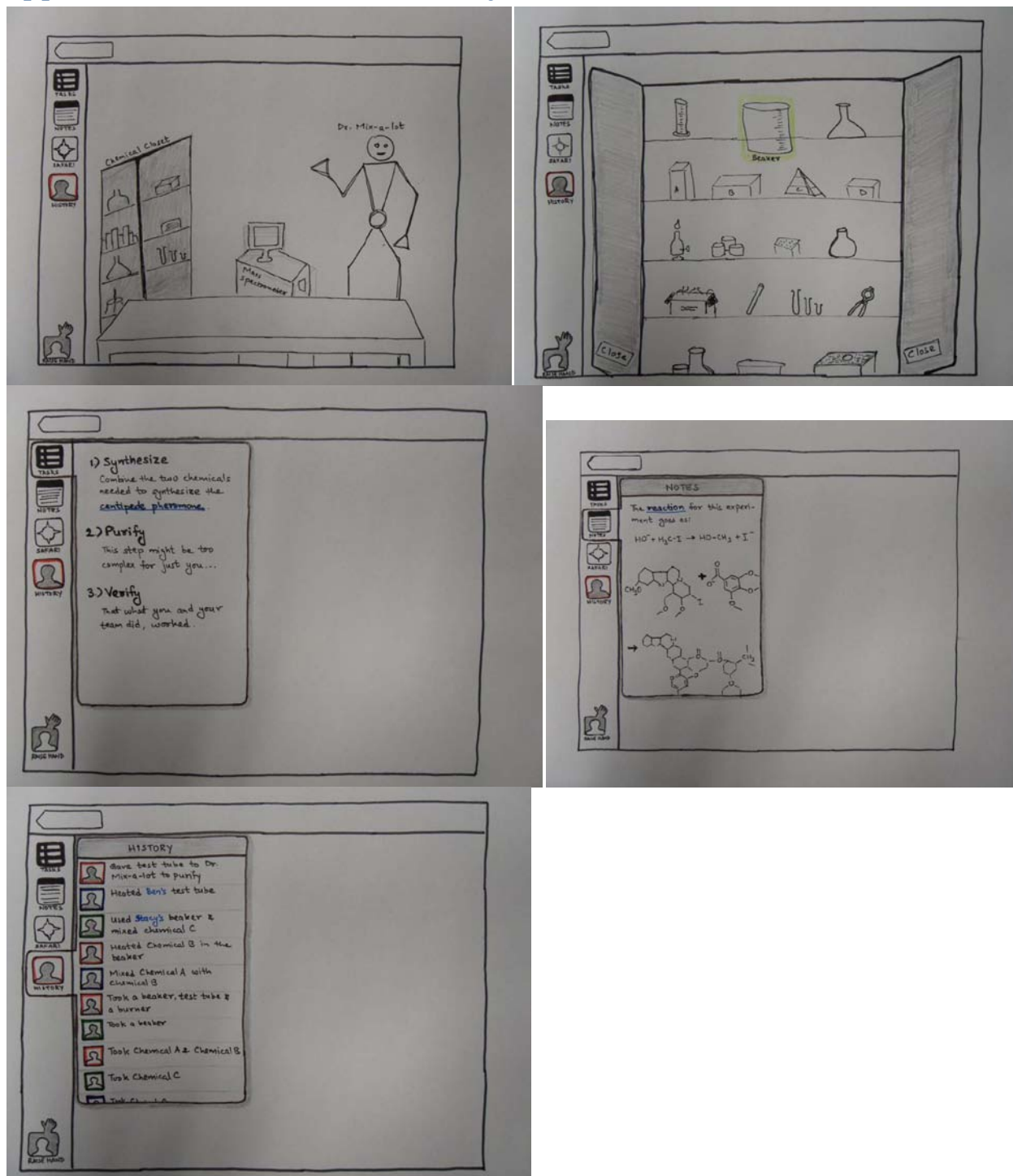a- chemistry is now "dangerous"
safety nice too.
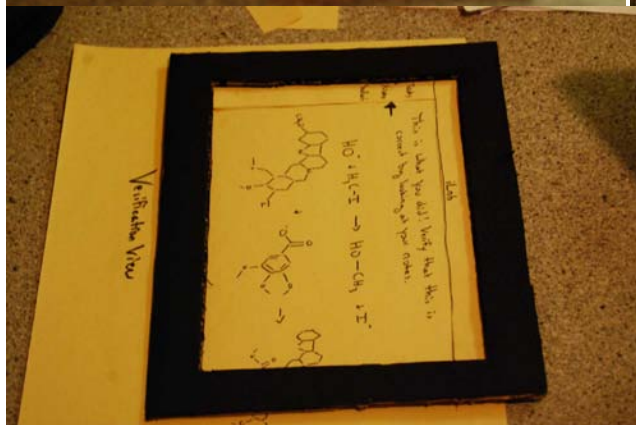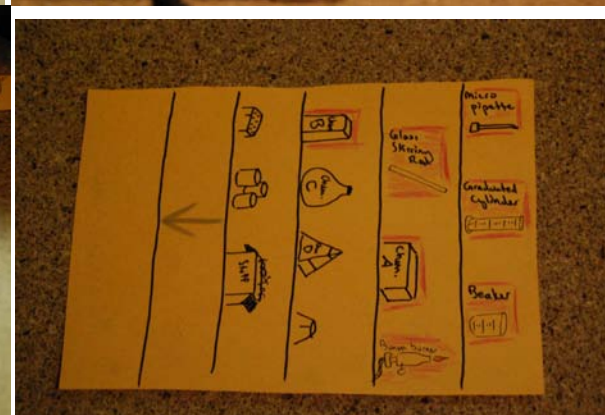chemistry lab problems: not allowed to experiment

user_an likes the experiment part of it

Appendix E: Sketches after Usability

Appendix F: Prototype Process

Checked in hats ☺