MySchool: An Educational iPhone Application for Children
Ashley Kayler, Sunny Lee, Laura Paajanen, Connor Riley
Thursday, May 6, 2010

Abstract

MySchool is an iPhone application that promotes learning among children ages 9 to 11. Based on childrens' love of "playing school", MySchool places the user in the shoes of an elementary school teacher who must teach lessons to virtual students. In addition to teaching lessons, the child also grades their students' homework, and teaches their students respectful behavior by handling classic elementary school behavioral issues. Educational content is delivered through multimedia 'learning modules' which increase in difficulty as the user progresses through the game. Once the child has earned enough 'teaching points' they can move on to the next module. In order to facilitate scalability and submission of content by third parties, all MySchool content is formatted in a standardized xml schema. As an iPhone application, MySchool takes advantage of the inherent flexibility and ubiquity of mobile devices; this is a game which can be played anywhere and which delivers an enriching experience through just a few minutes of play.

Educational software games for kids are often limited to math drills, spelling drills or trivia memorization. MySchool aims to expand the learning experience to include a deeper understanding of subjects and concepts while engaging children through gameplay that is fun and immersive.

Problem & Goal

MySchool is an interactive mobile application for the iPhone that promotes learning among children ages 9-11. We chose to explore this space after finding that there were scarce educational resources that were engaging and interactive in a meaningful way on the mobile platform. Most educational applications available that we found were targeting the preschool/kindergarten demographic who are just learning to read and write. These applications often were fancier versions of traditional flash cards with stimulating graphics and animation. However, content was limited to learning the alphabet and spelling simple words, or basic math concepts such as addition and subtraction. As older children have limited options for games with sophisticated educational content on either mobile or computing platforms, we decided to position our game for the 9-11 age range in order to fill this perceived need.

Choosing to create a game for a mobile platform was motivated by both current technology trends and the unique opportunity to reach both children and parents. Smart phones on average are still cheaper than a personal computer, and in 2009 it was predicted that the smart phone market would surpass laptops in unit sales that year [1]. The continuous growth and ubiquity made developing on the smartphone platform an appealing option for us. Most children do not have their own smartphones, but many parents do; children mainly see smartphones as handheld gaming platforms. Given that parents already allow their children to use their phones for games (on car trips, at restaurants, as an after-
homework treat), we guessed that a game which was both educational and fun would appeal both to the parents who control the device and the kids who would benefit from a more engaging game experience.

Our choice to develop for the iPhone was finally cemented by its variety of unique features which would allow us to build a more engaging interaction. Mobile devices enable use in any location, which is good for families on the go, but also allows users to better understand the world around them through the device. Tactile interaction through touching and shaking the phone would enable us to build stronger interaction metaphors. Finally, the mobile platform lends itself best to shorter periods of gameplay, making educational content easier to digest.

Thus, our choice of platform, target user, and game type were highly synergistic. One of our goals was to address a lack of educational games in general, but we realized that we would need participation from two key stakeholders: parents and children. As parents generally control their childrens’ access to mobile devices, we saw a unique opportunity to engage both parties; MySchool would be fun and engaging for kids, and would involve their parents in helping them learn.

The Idea/Research

Before beginning to brainstorm any of our own interactions, we carefully researched work by educational theorists which would help us better understand methods of promoting effective learning. We researched Vygotsky's Psychology of Play and Zone of Proximal Development as well as Papert's Constructionist theory, an evolution of Piaget's Constructivism. We also investigated the teaching method "Lernen durch Lehren (learning by teaching)", established by Jean-Pol Martin and commonly practiced in Germany, in which students learn by teaching their peers. The fundamental concepts underlining these theories and methods for learning helped us determine the initial interaction designs of MySchool.

According to Vygotsky, it is through play that the child develops abstract meaning separate from concrete objects in the world, which is critical to the development of higher mental functions [2]. The 'zone of proximal development', often associated with scaffolding, signifies the gap between what a learner has already mastered, i.e. the actual level of development, and what he or she can achieve when provided with educational support, i.e. potential development [3]. Vygotsky stated that play can create this zone of proximal development a child. In play, specifically role play, the child often mimics the behavior of someone beyond his or her own age, and by doing so, it is as if the child tries to jump ahead of his or her usual level.

In our initial interaction design, we decided to have the user play the role of a teacher in a classroom. This role allows our users, who are students in real life, to take on the role of a caretaker and authority figure, essentially creating the zone of proximal development. In the game, the user takes on the clearly defined role of the teacher, and must uphold the responsibilities of the role. In order to be a good teacher, the user has to learn the material...
thoroughly and do a good job teaching, all the while managing the behavior of the students in the classroom. We think this will lead to a greater degree of self-regulation, as users' actions are influenced rather than constrained by the rules of the game. Vygotsky explains that when involved in such play, childrens’ concentration and application to the task will be much greater than when they participate in an actual classroom setting [4].

In Martin’s learning by teaching method, students become responsible for their own learning and teaching after intensive preparation by the teacher [5]. Implementation of this method is structured, multi-staged and very specific. The idea is that students are able to better satisfy their social needs, self-esteem needs, and self-actualization needs through the process. We did not design MySchool to follow the detailed, specific requirements of this learning method, but instead took inspiration from the fundamental idea of learning through teaching as its core game concept.

The Constructionist theory, according to Papert's proposal, Constructionism: A New Opportunity for Elementary Science Education [6], takes the view of learning as a reconstruction rather than as a transmission of knowledge. Learning becomes most effective when an activity the learner experiences, comes from constructing a meaningful product.

Rather than having the user learn through rote memorization, our game design allows the user to reconstruct obtained knowledge by reapplying it in the space of a virtual classroom. After the user learns the material by going to the “library”, the flow of the game takes the user into the classroom where he or she must effectively teach students the material that the user has just learned. Not only is the user assessed based on his teaching capabilities, he also needs to juggle the students questions and manage their behavior. The goal of the game is to have the user be invested not just in the academic accomplishments of the students but also in their overall well-being. The user ought to be interested in his or her students becoming good citizens as well as good students. Tying the well-being of the students in the virtual classroom to the performance of the user playing the game is intended to encourage the construction of a more compelling experience for the user, thereby creating a more meaningful end product.

**Technologies Used & Programming Design Philosophy**

**Agile Development Method**
We used agile software development in the design and implementation of the game and tested products with incomplete interaction designs. The feedback often corroborated our misgivings and helped us swiftly rectify the interaction designs that did not work.

**XML**
We made extensive use of XML resources to store data in an easy-to-process, human-readable format. Currently all data which is not changed by player interaction is stored as XML; educational module content, help content, and content describing student behavior are notable examples.
Objective C
The program is written entirely in Apple's object oriented Objective-C programming language. The app runs natively on the iPhone, iPad and iPod Touch.

Core Data and SQLite
In order to manage dynamically created, in-memory player data we are using Xcode's Core Data framework to manage a persistent data store which contains everything from the player's name and avatar to their students' scores for behavior and performance. The Core Data framework allows us to store the game state so players can come back to a game in progress, as well as allowing multiple user account creation, which may be important for families where more than one child is playing the game. Core data runs on an SQLite database.

SVN
The code base was housed in an SVN repository on code.google.com to allow for concurrent code development and milestone code release.

PHP
One key element of MySchool is parent-child interaction; parents are able to enter their email address in the game, and the game will periodically send updates on their child's progress via http requests to an external server running a php email script. Right now, this component is the only piece of MySchool which is handled by an external server as sending email in the background of a process is explicitly disallowed on the iPhone platform. We do envision that running an external MySchool server could be useful for handling certain future functionality which was outside of the scope of the project.

Design philosophies

Code Consistency
Camel case used throughout to facilitate ease of reading code
Use of 'category' classes to allow for simple modification of core data object classes
Use of a designed color palette to ensure color consistency
Use of sub classes to maintain consistent navigation functionality across game sections

Modular design
Normalized relational database structure
Reusable model objects

MVC (Model, View, Controller)
We used the MVC design principal to maintain separation of data, user interface elements, and game logic

Graphics and Visual Design

We planned for a simple, consistent look and feel for the game visuals. Due to limitations in screen real estate and time, and our focus on interesting content rather than innovative 3D graphics, this approach was useful in creating graphics that we hoped would appeal to our
intended audience without being distracting from the gameplay. Our color scheme was a combination of bright primary colors and some consistent neutrals. The student graphics were designed for easy recognition of facial expressions, since that was our primary planned feedback for the user on the correctness of their teaching.

Alpha Interaction Designs for User Testing I

0. Avatar Design
While we intended for the avatars to eventually be customizable, in the alpha the users could only choose between a male and female avatar.

1. Parental Notification
Before the user started the game, a pop-up encouraged the user to input his parent’s email address. From our research we noticed that many games, whether educational or not, did not invite parents into the conversation; they are usually one-on-one experiences between the user and the game. We thought it would be useful to send notifications to parents after the user successfully completed a module. This gives parents an opportunity to engage their children and play a more active role in the child’s experience of the game. If the user enters his or her parent’s email into the system, the system sends the parent an email with information on what their child learned from the module and some questions parents could ask to confirm what the child learned.

2. Library/Learn
From the main menu, when the user tapped the library button, he saw a bookshelf lined with books, positioned such that the user was looking at the front book covers. These were the content modules which were designed for scalability. The user would tap on a book of his choice, which would take him to the learning section. The learning portion was heavily text based. To make this seemingly dull section more interactive and engaging, we planted easter eggs into key words in the text. When the user discovered these "secrets" through
tapping, a popup window showed pictures and further informational tidbits that were helpful in the teaching section.

Figure 3. Library bookshelf screen

Figure 4. Secrets discovery screens

3. Classroom/Teach
After the user finished learning the subject matter, he or she proceeded to the teaching section. There the user was required to teach and manage the students while keeping track of time. Lecture text appeared in a window which scrolled automatically, revealing red-highlighted, incorrect words which the user had to correct. While correcting these words and phrases, the user also had to call on the students who raise their hands and answer their questions for additional points. The students’ questions are related to the content the user just learned in the library.

Figure 5. Classroom/Teach screen for female and male avatars
The user was able to recognize when his or her answers to the questions on the blackboard were correct by the feedback he received from his actions. If the user correctly changed the red-highlighted words on the blackboard, they changed to green, if not, they remained red. The student's expressions additionally changed to smiling or frowning faces. We were unsure of how best to provide feedback for the answers to students' questions and so did not provide any in the alpha version.

4. My Office/Homework & Reports
In My Office, the user would encounter a stack of papers indicating the number of outstanding worksheets he needed to grade. The user would tap on the worksheets to start grading the papers one at a time. Each worksheet presented a number of questions and answers to the user. The user could grade each answer by either tapping on the green check mark to indicate that the student answer was correct, or the red x mark to indicate that the student answer was incorrect. While we intended to have clear feedback provided for the user on whether he was grading correctly or not, we were unsure how to do this in the best way and did not include this in the alpha version.

5. School Store/Get activities
The system kept track of the user's total accrued points which the user was allowed to use to purchase items such as a class pet, art supplies, etc. at the school store. While we liked the school store concept, we were unsure of how to implement some of the program structure around how student could display or interact with their purchases. For alpha, we decided to keep the store very simple and looked forward to user feedback from testing.

User Testing & Findings
We ran three rounds of user tests: one group of weeklong in situ tests on the alpha version, and two groups of 30-minute usability and retention tests on the alpha-2 and beta versions, respectively. We wanted to investigate not only the usability of the game, but also whether
kids found it fun and engaging, and how learning from gameplay compared to a paper-and-text-based control version of the same content.

1. **Weeklong In Situ Tests on alpha**

Our first round of user tests was a weeklong in situ test with 9 participants, 5 female and 4 male, from 6 different families. They ranged in age from 8 to 13. The participants were families, friends, and colleagues of students and faculty at the UC Berkeley School of Information.

We helped each of the parents install the alpha version of the game, outlined above, on their phones, and instructed them to let their children play the game as they saw fit throughout the pre-determined week. We explained that the alpha was a work in progress and that we intended to use the feedback from testers to help guide us in our next round of interaction designs. We checked in periodically to remind parents to allow their children to play the game, and at the end of the test period we visited each of the 6 families and conducted interviews with both the children and the parents.

We received a great deal of feedback, some expected and some surprising. One of the biggest surprises was regarding the Easter egg "secrets". Only one of the users was able to discover any "secrets" in the learning section and he did so by accident; the majority of the kids noticed the hints as to how many secrets remained in red, but were unable to contextualize it within the learning section. They had no idea of how it related to the text above. There were no instructions as to what the secrets meant and what the user needed to do in order to uncover them. Tapping around randomly for unmarked words in the text was not a very intuitive action for users, especially without any instruction to do so. The user who discovered the secrets by accident, S(11) remarked, "It seems the secrets pop up whenever you tap on fancy or difficult words." Since the users didn't notice the secrets which were intended to make the learning of the material more interactive and fun, some users found this text-dense section rather long and boring.

Once we showed them what the secrets feature was intended for, all 9 users responded favorably. Based on this consistent feedback, we knew that we needed to make the secret discovery more clear to the user. We also needed to provide the user with stronger incentive to go through and learn the material other than the unraveling of more content in the form of Easter eggs.

Prior to alpha, in our initial interaction designs, we had decided to include a behavioral component in order to allow the user to have a more meaningful experience beyond just learning and teaching. We were unable to incorporate this in time for our alpha user testing but feedback provided validated our decision to include such an aspect to the game. Several users commented that they'd like the students in the classroom to have some personality. Some mentioned that they’d like to be able to discipline unruly students if necessary and give out rewards for good behavior.
Feedback in the form of student expressions for the user’s performance as a teacher within the classroom was still unclear to the majority of the users. When users corrected the incorrect red-highlighted words on the scrolling blackboard, not only did the red highlight turn green but the student expressions changed to smiling faces. The problem was that students with their hands up have a default expression of confusion. Therefore, as can be seen in Figure 8, even if the user provided the correct answer and the students responded with smiling faces, if there were any students with their hands raised, the confused expression would dilute the feedback expressions, rendering the feedback expressions less noticeable to the user.

![Figure 8. Feedback is provided to the user through change in highlight color and student expressions. Notice the student expression feedback mixed with default confused expressions by students with raised hands.](image)

Additionally we realized that when the user was taken to the one-on-one screen for calling on a student, as can be seen in Figure 9, upon answering the question the feedback was provided in the next screen back in the classroom rather than occurring in the one-on-one screen. This was disconnecting to the user. Additionally if the user answered the question correctly but the student was queued up for a question already in the next classroom screen, the confused default expression would be on her face rather than the feedback expression as can be seen in the second screen of Figure 9.

7 out of the 9 users did note the changes in student expressions but didn’t know that they necessarily correlated to their actions as a teacher. We needed to make them clearer and more natural for the user to make the connection between teaching performance and student happiness.
Users found the worksheet grading somewhat uninteresting, especially without receiving feedback on whether they were grading correctly or not. One user, R (13) commented, "I would like to know whether I graded it incorrectly. If you graded all [the answers] correctly, maybe have that give you points?" This user wanted both feedback for their grading performance and incentive to grade correctly. It was evident that feedback here as with the feedback provided in the form of student expressions above needed to be made clear for our users.

As anticipated, users - especially girls - wanted the ability to customize their avatars. Requests were made to be able to customize hair, eye, skin tone and clothes on a basic level and even to accessorize their avatars. One participant wanted to be able to customize the students and name them too. Male users weren’t as vocal as their female counterparts when it came to avatar customization but had grown accustomed to a base level of customization from playing other video games and found the male/female dual selection on MySchool alpha limiting.

All 9 users liked the store and wanted to see more from it. For alpha, we hadn’t quite thought out exactly how we wanted to develop the school supply store or what role it would play in the overall game, nor where users could go to place items purchased in the store. We had a lot of missing pieces that needed to be thought out and were curious to know how the users felt with the limited interactions the store provided. We were surprised at the uniform enthusiasm for the store and learned how much the students looked forward to earning points to consume them. 5 users independently pointed out that they either purchased the hamster or really wanted to but didn’t have sufficient points to do so. As expected, users wanted to know how to access items purchased in the store or be able to place them in the classroom for decoration. The tested implementation, which did not allow users to access purchased items, was not satisfactory. One user suggested that MySchool should provide points after sign up or avatar design so she could purchase an
item in the store right away, even without earning points through the learning and teaching module!

All 9 users expressed disappointment regarding the limited number of modules available for play (we only had two). A few recalled playing the same module over and over. This feedback reminded us of the importance of content in our game and of making content generation as automated and simple as possible.

All parents interviewed from the 6 families expressed enthusiasm for the "email updates" feature, which automatically sends parents an email about the modules their child had completed including a few things the child should have learned through the gameplay and some suggested questions the parent could ask. One parent commented, "I like knowing what she's up to. I would like that a lot. The whole thing about her online or her computer experience is I have no idea what's going on and I don't want to be looking over her shoulder." Parents seemed to agree that this was an unobtrusive way to know what their child is doing on their mobile devices.

Based on the above, we conducted a simple qualitative analysis of the information we gathered and created a list of must-have items for our next round of tests:
1) Add unambiguous feedback for the user's performance as a teacher. This is key to the user's learning. Feedback needed to be especially clear in the classroom teaching section as well as in the office grading section.
2) Make the learning section less dense and have the secrets seem more 'clickable'. Better integration of the multi-media popups would allow the learning section to be more interactive and engaging for the user.
3) From the unanimous request for avatar customization, we needed to add more customizable components to the avatar design.
4) Based on the request for student personalities from several users, we wanted to implement a behavioral component of classroom management as we had discussed in our initial interaction designs.
5) Figure out what to do with the store. All the users reacted very favorably to being able to spend accrued points so we needed to allow users to be able to check their inventory of purchased items and figure out how they could use the purchased items.
6) Evaluate our point system and see how we can use points to further incentivize users for gameplay stickiness and promotion of learning.

2. Half Hour Sessions, Take One on alpha-2

We conducted our alpha-2 test one week after the alpha test, and so had not yet implemented many of the above modifications. One key change we made was giving feedback in the office/grading section, in the form of the principal's approving face in a green bubble for correctly graded answers and the principal's disapproving face in a red bubble for incorrectly graded answers, as can be seen in Figure 10. We also laid the framework for the behavioral component adding a student book in the teacher's office from which the user could navigate and see each student's performance in the classroom (Figure 11).
Lastly, we came up with a new interaction design for the school store. Selling decorative items for the classroom was limiting considering the tiny screen space we had to work with. We needed to have something that did not take up screen real estate but would be worthwhile for the users. All users from alpha wanted to know where to go to "check up on" items purchased. What we finally added were purchasable mini-games called "activities" which replaced virtual decorative items (Figure 12). The users could visit these items through an added menu option on the main screen (Figure 13).
The second round of user testing consisted of half-hour sessions combining both usability testing and comparative learning tests with six children from four different families. They ranged in age from 11 to 14. We presented users with our iPhones with the game installed and had them conduct a range of tasks, encouraging them to think out loud while trying to complete them. The idea was not only to observe the usability of the game but also to take note of initial impressions. In this alpha-2 test, we wanted to observe the users' interactions with the game in real time rather than having them recollect their impressions through an interview as we did with the in situ testing.

In addition, we wanted to see how the user's retention of new information increased or decreased compared to traditional text-based learning. In order to do this, we planned to have kids read a piece of text, take a quiz on this text, then play a lesson in the game and take a test on that lesson. We realized that we had a tall task ahead with the comparative testing, as we were not accustomed to conducting scientific surveys. In addition, the small sample test size we were working with combined with time constraints with each user made it challenging for us to generate an unbiased set of data. Regardless, we thought it would be a learning opportunity for us.

For the comparative learning tests, we took the exact same content from the learning sections of chapters 1 and 2 from the Dinosaur module and printed it out as plain text. We printed sample questions for both chapters as well. Each child took one paper-based learning quiz and one game-based learning quiz. Half of the users completed chapter 1 paper-based then chapter 2 game-based while the other half did the reverse. The content of each chapter was independent so the user did not need to know information in chapter 1 to do well in chapter 2.

We made several interesting findings. It became quickly evident that there was a learning curve to figure out how to play the game. This was not an issue during alpha interviews.
since the kids had plenty of time -- a week -- to figure out and play the game. However, during our alpha-2 testing, almost all users did not initially know to click on the red highlighted words on the scrolling blackboard nor to click on the students to call on them when they raised their hands. After seeing the interactions unfold, they would start tapping around to figure things out. If the users figured out one of the two, they often ignored the other; i.e. they would either just continue fixing the red highlights without regard to the students raising their hands or continue calling on students with their hands raised while ignoring the red highlights on the blackboard.

Many seemed overwhelmed with all the things happening on the screen. Some users thought the students in the classroom asked questions too frequently. One of our users, S (12) commented, "There's a little too much going on." We realized that we needed a set of simple instructions before each type of gameplay for new users. It was apparent that users expected some direction when they started the game and encountered initial difficulty figuring out tasks without it.

In the homework grading section, users understood that the principal's approving look in a green bubble indicated that they had graded the homework correctly, and the principal's disapproving look in red indicated they had graded incorrectly. But they had no context for who this person was. None of the users recognized the face to be that of the principal character. In the alpha-2 design, the principal is part of the MySchool introduction page (Figure 14) before going to avatar design but other than that she does not play a noticeable role throughout the game. Considering the minimal role the principal played in the game, we needed to figure out whether having her head popup in green or red was the best way to provide feedback to the user. We had to consider either ways in which we could expand her role in the game to contextualize her presence in the grading section or find another way to provide feedback.

Users reacted favorably to the purchasable mini games in the store but found the term "activities" unnatural. We had thought to make the purchased activities accessible through the classroom/teaching section after asking users from alpha where they thought they should go to be able to retrieve items purchased from the store. Most users answered "the classroom" thinking that's where they would place the various virtual goods. But as previously mentioned, this wasn’t a feasible option for us considering the limited real estate on the classroom screen. As a solution we created a list of "activities" purchased that were accessible when the user tapped on the classroom/teaching section from the main menu. The popup would prompt the user to select either to teach or engage activity. We weren't very happy with this solution and the users didn't find it intuitive either.
From the testing we were able to detect several UI issues. When the user clicked on library/learn section from the main menu, he was taken to a chapter menu as seen in Figure 15. Next to each chapter the user could choose between selecting 2 icons: a stack of books for learn and a blackboard for teach. This was confusing to the users. They didn’t know why they had to select between the two. 5 out of 6 users tapped the title of the chapter rather than the learn or teach icons, which was not a clickable area; this often led to a few seconds of frustration.

When correcting the red-highlighted words in the teaching section of the game, several users said they encountered difficulty because the whole sentence often was not made visible. They needed more context in order to be able to correct the incorrect word or phrase, but the rest of the sentence was often cut off in the blackboard window. Proposals to improve this were to increase the amount of visible lecture text, or to include the full sentence in the pop-up correction screen.

None of the users seemed to notice the time ticking down or the +/- buttons on top of the blackboard provided to enable the users to control the speed of the scroll (Figure 16). We pointed these features out for each user after which the users noted the utility.

Users found it odd that the students would immediately start raising their hands and asking questions related to the scrolling blackboard when the lecture began. They asked how the students would know what to ask without sitting through some of the lecture at first. We thought this was a
valid point and decided to let the blackboard scroll with content for a few seconds before having the students start asking questions.

The more visible "secrets" had not yet been implemented for this round of testing, and our users reinforced that without the visual guidance or instructions, it was unlikely that they would be found.

Enjoyability and engagement seemed fairly high despite the testers being slightly older (11 - 14) than our planned age range of 9 - 11. We conducted the tests from the dining room of the home of one of our participants and all the kids were roaming around either in the front yard or the living room area awaiting their turn. The kids were excited for it to be their turn to participate, asked to repeat levels when they had mastered the gameplay, and were not often distracted despite half a dozen of their friends playing outside the window or the living room. Some of the older kids said that it seemed more appropriate for slightly younger kids, reinforcing our earlier impressions, but said they enjoyed it themselves nonetheless.

While conducting the comparison between game learning and control (text-based) learning, the children scored slightly higher on the paper-based texts. We hypothesize that this is mostly due to the learning curve of the gameplay and combining tests; we were conducting the usability interview during gameplay so the users were likely distracted from learning the content. Additionally our lack of experience in designing appropriate comparison tests and the small sample size make it unlikely that our results were statistically significant in favor of text-based learning.

The analysis of our alpha-2 testing aligned well with the results of our alpha testing. What was most glaring was probably the need for an instructions screen that could help provide users with directions on how to play their first time through.

3. Half Hour Sessions, Take Two, Beta Version

In anticipation of the next round of user testing, we were able to implement the following features based on the cumulative testing results from alpha and alpha-2:

1) We made several UI adjustments within the classroom/teaching section. We made the teacher smaller to be able to accommodate more text within the scrolling blackboard so that users would see more context when correcting the red highlighted words/phrases. We made the students’ faces bigger to help users see the student expressions more clearly. We changed the +/- buttons for scroll speed on top of the blackboard to a progress bar with a tortoise and hare theme that took up less real estate and unambiguously communicated manipulation of speed.

2) We made the "secrets" in the learning section stand out by adding a pulsating animation to the words; we hoped to make them seem more visually interesting and clickable. We didn’t want the easter eggs to be giveaways and wanted the users to work a little to discover them and came up with this subtle yet slightly more obvious solution.
3) We included instructions at the beginning of the game along with some help buttons featured throughout game screens so that users may be able to clarify any confusions or remember what to do.

4) We further developed the behavioral component of the game to complement the learning and teaching aspect of the game. Each student in the virtual classroom is assigned a "smarts" score and a "behavioral" score. The user's goal as the teacher is to improve both measures. When the user teaches well in the classroom, the students' smart scores improve. When the user handles personal questions ("Can I go to the bathroom?") in the classroom, how he or she handles them will influence the students' behavioral score.
The user has an additional opportunity to help shape student behavior. The user may check student performance through the student book available in the My Office section of the main menu. In this section, the user may check if there are any outstanding behavioral reports that need to be addressed and handled. In handling the behavioral report the user is confronted with two choices for discipline or praise, as appropriate. The user must select the most appropriate way to handle a situation in order to improve the student's behavior measure. We think this behavioral component is an important part of the MySchool game that differentiates it from other educational games. It is not only promoting academic performance, but also the importance of appropriate behavior and good citizenship.

5) In order to make the store interactions more organic, we added a "Fun Zone" to the main menu (Figure 21). This is where the user must go in order to play the mini-games purchased from the school store. We took out the unnatural selection between teaching and doing an activity that popped up when the user tapped on the classroom/teaching section of the main menu. As seen in Figure 22, Fun Zone is constructed in such a way that we can add an unlimited number of minigames without crowding the screen. This gave us a way to mitigate the problem of not having space for placing items in the limited confines of the classroom.

![Figure 21. Main Menu screen](image1)

![Figure 22. Fun Zone Activities retrieval screen](image2)

6) Principal's Role
We decided to make the Principal's role more prominent in order to use her as a tool for providing feedback. The user moves onto the next level of teaching after accruing a certain amount of points through teaching AND by achieving a certain principal approval rating. Principal ratings are achieved primarily by grading the homeworks accurately. We may add more metrics in the future to this rating.
7) Avatar

We added many of the desired customizable items requested by users for the avatar design. Users may change gender, eye, hair, skin tone, clothes and whether their character has glasses.

Our third round of Beta-version user tests was similar in format to Alpha-2. We conducted both usability and comparative tests with a paper-based control. Due to time constraints with our subjects, we were unable to completely solve the previous issues we had with combining usability and comparative learning; however, we alternated the order in which we gave the game and the control to the users. The testing process was the same as for the Alpha-2 version, we had half of the students do paper-based learning and quiz first then game-based learning and quiz while the other half of the students did the reverse. We wanted to take note if there were any emergent patterns that came from the order in which the users did the learning.

Beta testing took place in a third grade classroom in Berkeley, California with thirteen 8-9 year olds. While the classroom lessons went on as usual in the background, students were excused by the teacher two at a time to come sit with us in the back of the classroom to participate in the testing sessions.

Unlike the alpha-2 group that skewed older, this age group skewed younger than our target but we were optimistic that we would find new insight nonetheless. Noticeable amongst this group was that many of the children, who were excited to come sit with us, thinking they were being excused from class to play with an iPhone were visibly disappointed and some even alarmed when they encountered the quizzes and the paper-based content presented in front of them. But many quickly changed gears when they were presented with the iPhone application and displayed enthusiasm at the opportunity to "play" as opposed to sit and read off of a piece of paper.
Also evident was the difference in maturity and self-assurance between the 11 to 14 year old age group that we tested in alpha-2 compared to the 8 to 9 age group we tested for beta. Unlike the alpha-2 test group, beta participants often struggled to express themselves and many of the answers generated were through laborious questioning. Beta users were much more bashful and had difficulty expressing what they liked or disliked about the application which proved challenging for us. We had to take a lot of cues from facial expressions, time it took to complete tasks and frequency in distractions.

The users all seemed to navigate through the avatar design swiftly and intuitively. Most seemed to enjoy customizing their avatar to their liking and creating names (interestingly, most students created their avatars to look like themselves).

In the library/learning section, users still seemed to have difficulty figuring out how to uncover the secrets. When asked whether they saw the intermittently blinking text, all of them said yes. This may be related to the fact that not many of the children had used an iPhone before; they were unused to scrolling and clicking on the phone screen. However, few were able to figure out that they needed to tap on the blinking text in order to discover a hidden easter egg. It wasn't until we prompted most users, that they were able to figure it out and uncover the secrets. Once they did though, most seemed excited. With the exception of several users who went on to the teaching section without unraveling all the secrets, most stuck around the learning section poking around through the texts to find them all.

In the teaching section we observed a vast improvement in the kids taking initiative and tapping on the scrolling blackboard and calling on the students with their hands raised, unprompted. We believe the introduction of the instructions played a big role in facilitating this. However, several students expressed having difficulty with understanding the vocabulary in the module and reading through the scrolling blackboard in the allotted time. Many students also seemed flustered with the demand of having to both correct incorrect words on the scrolling blackboard and call on students. Most students were unable to do both successfully. No student utilized the speed control bar on their own volition but noticed it and made sense of it upon prompt.

Many students also didn’t seem to notice the facial expression changes by the students in the classroom and took notice only once prompted.

Most users did not seem to have much difficulty with the grading section and understood the changing looks of the principal in red or green bubbles to mean that they either graded incorrectly or correctly.

It was difficult to get a read on what many of the users thought about the behavioral reports. As mentioned previously, when prompted to let us know what they thought, users often shrugged, and would say an ambiguous comment like, "I think it’s ok." These users, much like alpha and alpha-2 testers seemed to like the school store concept of purchasing items from points accrued.
Overall the users seemed to enjoy the game but noticeably struggled more than users from alpha and alpha-2 with the demand of the interactions. The small age difference between the beta and alpha-2 testers amounted to a huge difference in confidence and verbal expression. This helped us understand that 8 year olds may be a little young for the game and our previously estimated target age range of 9-11 was more appropriate.

Many of the users were bored or dismayed by the quizzes we had them take. To take any pressure off, we told them they didn't have to put their names on the quizzes and that this would not count towards their grades. Despite that, 5 students refused to answer some questions. When we calibrated the results of the quizzes, text-based learning beat out game-based learning by a slight percentage at 6%. Interestingly, for both text-based and game-based, the users did better on the 2nd quiz than the 1st one. Similar to alpha-2, the sample size for beta (13 testers), still was not a large enough pool, nor were the settings of the comparative test done precisely enough to draw any conclusive results. What was notable however was the enthusiasm the majority of users displayed at the opportunity to play with the application as opposed to having to read from the paper, text-based content.

![Figure 25](#) Comparison of material retention between paper test and game learning.

**Conclusion & Future Work**

We are pleased with the results of this project and the overall positive feedback received in user testing, and we plan to release the MySchool game for sale in Apple’s App Store over the summer. However, there are additional components we would like to continue to work on.
Expanded selection of modules
The most common complaint from our week-long in situ testers was that there was not enough content. We have already expanded from two to four modules as well as adding the three mini-game activities (calendar, music & fractions, and color theory), but there is huge potential to expand the content and to sell further content as add-ons to the game. We have developed a content scraper that creates a first-draft of module content pulled from sources such as Wikipedia, but this content must be cleaned up and edited to be ready for the game.

Another option to increase available modules may be to partner with a third party content provider; deals could be made with educational organizations or companies who wish to focus on content creation and work with our existing game learning platform. This expanded content can be made available after earlier levels are completed, similar to unlocking song catalogs or levels in video games like Rock Band. There is also the ability to offer in-app purchases to provide a consistent and uninterrupted experience, rather than requiring users to exit the game and go to the App Store to purchase additional game modules.

Student introductions & increased personality
User interviews indicated that adding complexity to the virtual students' personalities would increase engagement with the game. On creating a new game, we envision a section that introduces each of the four automatically generated students to the user, giving their name, notes on their personality, and what sort of schoolwork and behavior should be initially expected of them, based on the randomly generated initial smarts and behavioral scores. The smarts and behavioral scores, and how the teacher can improve them, can be made a more prominent part of the game.

Connect to friends
Ideally, we would like to allow multiple users to connect in-game, so that kids can visit each others' classrooms as students and participate by asking questions and doing homework sheets. This could be similar to helping friends by visiting their farms in Farmville.

Location-based information & learning
Location-aware mobile devices have great potential to offer relevant information about the user's surroundings. If the phone knows that it is near a historical landmark or in a forest with interesting plants and wildlife, it could serve related information or activities and provide an immediate learning opportunity relevant to the user's setting. However, implementing this would require a large database of locations and appropriate learning interactions, so development of location-based learning was not in the scope of this project.

Principal playing a role in the help
Our proposed update to the help function of the game would increase the principal's presence as a guide figure. When help functions are activated, a pop-up would appear so as to minimize the interruption of relocating the user away from their place in the game. The pop-up window would contain the principal and a text box with instructions. Instructions
may be similar in appearance to the instructions for the teaching section: example in-game images with arrows and explanatory text.

**Point System**

Users earn two kinds of points in the game: points to buy activities and move onto the next level, and the students' points (smarts and behavior). Currently we do not have the students' points directly tied to the user's points. Increasing students' smarts scores and behavioral scores is purely driven by the user's intrinsic motivation. We think there might potentially be more motivation for the user to be mindful of the students' overall well-being if student points are somehow linked to user points. Providing users with additional extrinsic motivation by increasing user points when students' smarts and behavioral points increase may be something to consider.
References:


Appendix I
Detailed Interaction Design Description (MySchool Beta as of May 14, 2010)

0. New Game and Introduction
In a new game, the principal welcomes the user to the school, and instructs him to design an avatar. Avatar customization options include gender and choices of hairstyle, skin color, eye color, clothing, and glasses.

1. Library - Prepare to teach the lecture by reading about the material
After the user successfully designs his custom avatar, he is taken to the main menu page. The user should first go to the library to learn the material.

When the user taps the library button, he sees a book shelf lined with books, positioned such that the user is looking at the front covers and titles. These each represent content modules. The user may tap on a book of his choice, e.g., All About Dinosaurs, which takes him to the list of chapters. When a chapter is selected, the user sees a text window containing the chapter content. To make this text-heavy section more interactive and engaging, we planted easter eggs into words that flash intermittently. When the user discovers these "secrets" through tapping on them, a popup window delivers further informational tidbits accompanied by images that are helpful in the teaching section. The discovery of these "secrets" is tied to points to incentivize users to look for them and in the process read through the text and learn the material thoroughly.

2. Classroom - Teach
After the user finishes learning the subject matter, he goes to the teaching section. There the user is required to teach and manage his students while keeping track of time. The user must correct the incorrect red-highlighted word or phrase on the scrolling blackboard, as well as call on the students with their hands raised and answer their questions for additional points.

The students in the classroom will ask a mix of content-related questions and behavioral questions. How the user answers content-related questions will help increase/decrease the student's smartness score as well as affect the user's own points. How the user answers behavioral questions will help increase/decrease the student's behavioral score, but will not affect the user's points. We intend to modify this so that the user will receive points for responding to behavioral questions properly, to provide motivation for the user to help improve student behavior.

The user receives feedback from his actions during teaching. When he correctly changes the red-highlighted words on the blackboard, the highlight changes to green; if not it remains red. Additionally, the students' expressions change to smiling or confused expressions depending on the correctness of each answer.

Students provide feedback in the same way as above when user answers their questions one-on-one. When the user answers the students' questions, student provides smiley face for correct answers and confused face for incorrect ones. When the user successfully
completes teaching the lesson within the allotted time, the user is prompted to go to his office to grade his student worksheets.

3. My Office - Meet the Students, Grade Homework & Handle Reports
In My Office, the main screen elements are a stack of papers and a book entitled "Students". The stack of papers represents ungraded student worksheets with a number indicating how many homework papers the user must grade, and the student book is where the user can check the progress of his students' academic and behavioral performance.

When the user taps the stack of papers, he is taken to the homework page and may grade the student homework one at a time. When the user grades correctly, the principal's approving face shows up in a green bubble to indicate that the user graded correctly, if not, the principal's disapproving face in a red bubble pops up. The user grades by either tapping on the green check to indicate that the student answer is correct or the red x mark to indicate that the student answer is incorrect. How well the user grades the homework affects the principal's approval rating of the user's performance. It is a combination of the total points the user earns along with the principal's approval rating that allows the user to advance to the next grade level.

When the user taps on the student book, the user sees the list of students in his class. He may tap on any of them to see what the student's smartness and behavior scores are. The screen also shows the student's grades and if there are any outstanding behavior reports the user must handle. How the user handles the behavior reports affects the student's behavior score. The user is provided feedback on how he handled the behavior reports form the behavior score bar that flashes and ticks to the right towards the green if the user answers "correctly" and to the left towards the red if the user answers "incorrectly". As mentioned previously, the behavior points are not yet tied to the user's points like the student smartness score is.

4. Principal's Office - Check progress in the game
In the Principal's office the user can check on their overall progress in the game. This includes checking their 'Principal's Approval Rating', their current 'Teaching Points' total, and their 'Grade Level'.

5. School Store - Get fun activities
The system keeps track of the user's total accrued points which together with the principal's approval rating determines when the user is eligible to advance to the next grade level. The user may spend these points to purchase "activities" at the student store. Note that while the system only allows points to be spend once, the spent points are still part of the running total of points the user has accrued over time that enables him to advance to the next level.

Once the user purchases the item, he may collect it at the place designated as "Fun Zone", also a part of the main menu.
Currently there are three activities in the school store: the music game which allows the user to learn fractions while composing music, the paint game, which allows the user to mix paint or light in different combinations in order to match generated colors, and the calendar game which provides the user with interesting events or facts associated with a calendar date.

6. Fun Zone
This is an "activity inventory" space where the user can play with all purchased items.
Appendix II

Screen Evolutions

0. Avatar Design

1. Main Menu Screen
2. Library
3. Chapter Menu

What is a dinosaur?
Dinosaur origins
All about fossils
The Triassic period
The Jurassic period
The Cretaceous Period

4. Secrets in Learning Section

The dinosaurs are a group of prehistoric reptiles which lived many millions of years ago. There were many kinds of dinosaurs; scientists have discovered more than 1,000 species of dinosaur, and more are found every year!

All of the dinosaurs were reptiles, like the lizards and crocodiles we know today. There were both meat-eating dinosaurs and plant-eating dinosaurs. Some, like Compsognathus, were as small as a pigeon, and some, like Brachiosaurus, were over three stories tall! In fact, dinosaurs were the largest land-dwelling animals ever (the blue whale is still the largest animal to ever exist on land or sea).
5. Classroom

6. My Office