Mobile Application for The Basic School: Reinforcing Land Navigation Outside the Classroom.

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ABSTRACT

The majority of incoming Marines are digital natives who learn and thrive with technology outside of The Basic School (TBS), but are hindered while attending TBS. The Land Navigation App will augment the classroom and practical application part of TBS's Land Navigation Course by providing its students with the opportunity to practice land navigation skills by identifying terrain features, working on a map, determining azimuth, and identifying compass parts. Students will also have access to the course material for reference to help them prepare for training events before and after the classroom instruction.

This application allows the students to use their issued map, see different areas of the base exactly as they look in the world, and work with their compass. This allows students to make mistakes without being judged by their peers or instructors. This mobile application gives them the chance to practice their skills, both written and kinematic, while learning the vital elements of land navigation.

The mobile app will propel TBS into the classroom of the future by closing part of the mobile learning capability gap. With this application TBS can begin to integrate mobile learning into their curriculum, fundamentally altering the previous instructional model by rapidly reducing the required classroom time and the number of instructors while improving the capabilities of the students and staff. Furthermore, mobile learning could make test taking secure and provide rapid in-hand feedback to students and instructors, ultimately reducing the amount of time required to train new officers.

ABOUT THE AUTHOR

Captain Carl "Marshall" Tucker is currently an Education Officer with the Marine Corps University's Vice President of Academic Affairs department where he specializes in instructional technology and design. As a twenty-two year veteran of the Marine Corps, Captain Tucker has experience in training design, development, curriculum and instruction at every level of officer and enlisted Professional Military Education and Training as well as training foreign nations' personnel. He holds a master's degree in Instructional Technology and Design from George Mason University's Graduate School of Education and a bachelor's degree in history with a teaching certificate from North Carolina State University.

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INTRODUCTION

The Basic School (TBS) at Quantico has been utilizing training manuals to train its newly commissioned officers from the Naval Academy and the United States Marine Corps in 30 different topics within a 26 week training period, without any supplementary aids to assist the officers when they are out of the classroom or in the field (Murry, 2013). TBS would like a mobile interactive application that provides manageable content with assessments to be accessed by students outside of the classroom.

The newly designed game will augment the practical part of the TBS's Land Navigation course by providing its students with the ability to practice land navigation skills. Students will be provided with reference material that they can utilize in their future endeavors to remain current with the basic skill set. This application will be made available through The Basic School and government purposed licensing. The game is called ORIENT (Objective Realistic Interaction for Exploring and Navigating Terrain); the idea behind ORIENT is it briefly and succinctly simulates the design for land navigation or orienting.

PURPOSE

The purpose of this application/game is to improve the student passing rates TBS has on all of the land navigation tests and exercises, reduce the burden of the extra hours of instruction time on the instructors, and improve the speed to mastery through digital accessible courses geared at the learners (Murray, 2013). This will be accomplished by allowing the students to practice land navigation during their down time allowing them the opportunity to make mistakes while no one is observing them. The application will give them the opportunity to see what portion they are doing incorrect (if any) before they go out and do their practical application or test. The game will provide them with scaffolding in the learning that applies to before, during, and after the courses by giving the students the opportunity to work on the reading, assignments, learning the material prior to the courses being taught then giving them opportunities to practice the material learned, share their experiences with others, and provide feedback to fellow students and staff.

GOALS

- Significantly improve speed to mastery through accelerated, active learning for digital learners
- Increase individually tailored learning feedback and point of need learning support
- Scaffold learning to stretch learning experience before, during, and after lessons
- Increase operational force digital demands by preparing students for future digital courses, Marine Online, E-Marines, and professional military schools
- Gain resource efficiencies, including student time, instructor time, stretching facilities limitations, higher student engagement, and reduce preparation/remediation requirements
- Extensively reduce passive learning lectures in favor of active learning experiences

DESIGNING THE MOBILE APPLICATION

We used the User Experience to build a user-centered design. Starting with the pre-design portion of the project, we conducted interviews with the stakeholders at TBS (leadership and academic department), the two instructors, and twenty students (half who had completed land navigation training). All data from the interviews,

checklists, script, questions, transcripts, videos, work activity affinity diagram, and demographic reports are available through TBS or the design team. They are not included in this paper due to their large size (Hartson, 2012).

From this contextual inquiry we developed the contextual analysis where we interpreted the data and made our conclusions, extracting the needs and requirements for the design. We conducted a sanity check with TBS leadership to confirm our process and ideas before moving forward with the prototype.

The process of ideation and sketching was a fast-paced and dynamic brainstorming session where we presented our ideas as they occurred to us while also keeping in mind the user and the interview data. In essence it was an applied design thinking process where we started our conceptual design. In our initial discussions regarding the scope of the Land Navigation App, our group had discussed the possibility of the app being broken up into two components: an instruction portion and a game. Upon entering the application, the student would select one of the two options. The instruction portion would contain activities to assist students in areas in which they were struggling, such as definitions, through the utilization of tools such as flashcards. The game would provide students with the opportunity to practice land navigation skills within a realistic scenario. However, upon reflection, we determined that having two separate components within the app would cause the scope of the project to become too large. Therefore we made some adjustments that still allowed us to maintain components of our original idea. The scope of our app will now be solely a game. However, the game will contain remediation components where students will have the opportunity to receive additional instruction in areas in which they are not performing well. For example, if a student is having difficulty with a particular task within the game, they can open the PowerPoint from class or contact the instructor on that topic. This route will allow us to still provide further opportunities for students to practice difficult tasks without having to create two separate components within the application.

Design Process

For the ORIENT game, a "T" prototype with medium fidelity was the best fit. The prototype will show the breadth of the game, though only features contained in the vertical portion will be expanded upon and contain clickable links. For our horizontal portion, we decided that we would show the courses that The Basic School offers as well as the various land navigation activities a student would be able to choose from, including orienting a map, lensatic compass, plotting points, shooting an azimuth, identifying terrain features, and more. We also displayed the buttons for additional activities the student would encounter within the game without going into depth and making them clickable. Additionally, a menu tab is located on every screen with various features (such as a toolbox, email the instructor, and technical help buttons) available throughout the game. However, only the features applicable to the activity will be clickable.

Vertical Build

For our vertical prototype we decided to drill down into one of the course activities that would be user interactive and useful for providing feedback on our prototype. Within the Land Navigation module, students learn about the magnetic azimuth, plotting points on maps, identifying land terrains, holding a protractor, and the proper way to hold a compass. The various land navigation courses are viewable on the prototype's main menu. Keeping in mind the interaction perspective or how the user operates the system, we decided that focusing on the student's ability to identify terrain features would be the most suitable activity for this purpose, as it is one of the most essential components of land navigation. The user is tested on his or her ability to identify terrain features (Figure 1), a necessity for reading military maps, and therefore an essential component of land navigation. The knowledge assessment tests the user and provides instruction in different terrain features (valley, hill, saddle, cliff, and draw) that are presented in three different ways using sketches, map and real world images, as well as map depictions.

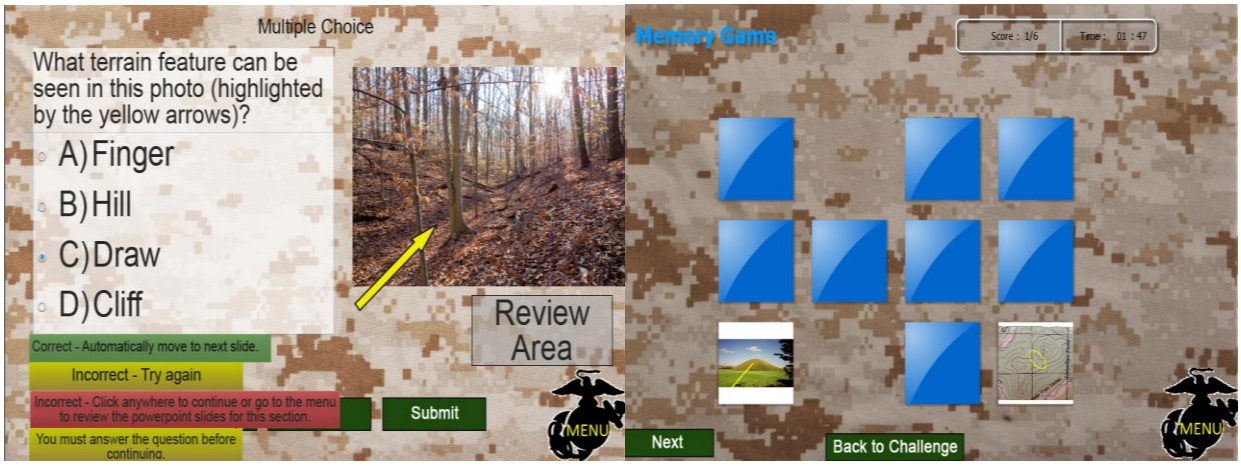


Figure 1. Identification of terrain.

It was important to show the different features that would be available in the module. The features we decided to highlight included challenging other students to games and images of different terrain features (terrain pictures from Quantico and surrounding areas, map images, and drawings) for students to identify. We included fifteen different terrain feature activities within the module in order to test the student's understanding of the material. The first eight activities require the student to view a terrain feature and identify it by choosing the correct written answer. The next activity requires the student to click on a terrain feature based on what the exercise is asking them to find. The following activity tests the knowledge of the student by asking the student to find and count the terrain feature in question. By including different activities, it allows us to test the same material (terrain features) in different ways. Students learn and process data differently; therefore we found it necessary to display the information in different formats, to maximize the experience.

It was important to show the different responses a student would receive based on whether he or she answered correctly or incorrectly. By including this in the prototype, it contributed to the true feel of the game and allowed the design of a route allowing students to go backwards or forwards, based on how they answered the question. The inclusion of the go back button was also added to enhance the playability of the game and to give the student freedom to navigate the module and the overall game freely.

Horizontal Build

For horizontal prototyping, based on client input, we decided to start from the actual image of the application for The Basic School to the Land Navigation course, the registration and log-in screen**.** From there, the student is presented with the entry into the 3D virtual learning environment that we envisioned with all the persistent buttons that will be available in this course. The main menu page also shows a general overview of the various land navigation courses which are offered. This would give the client a high-level overview at a shallow level (or the horizontal top of the "T" of the user experience) and chances to make high-level suggestions before more detailed features were incorporated into the design. This is why the prototype is not fully functional and is at a medium fidelity level to allow for more input and eventual changes in the design after pilot testing. We have prototyped this design for a handheld mobile device, keeping in mind the ecological perspective such as how the user will interact with the external environment. We have also received approval from the client on this design aspect.

INSTUCTIONAL TECHNOLOGY AND DESIGN

The Land Navigation course was designed as a constructivist learning environment that utilizes transformational play. Within the constructivist design part, the students will have the problem of having to navigate from point to point to make it to their final destination. They will have had some related courses prior to starting and they will have access to every course offered at TBS as well as instructional videos and practical application walk throughs. They will have the instructors there to coach them along the way and to model the proper techniques. The courses build upon each other and progressively challenge the students.

The Land Navigation Application utilizes transformational play.

> According to Barab et al (2010), Transformational Play "build(s) on a theory of learning that assumes that learners, content, and context are inextricably bound together...(and) position(s) learners as active decision makers who use their understandings to inquire into particular circumstances and change them...Playing transformationally involves (a) taking on the role of a protagonist (b) who must employ conceptual understandings (c) to make choices (d) that have the potential to transform (e) a problem-based fictional context and ultimately (f) the player's understanding of the content as well as of (g) herself as someone who has used academic content to address a socially significant problem" (p. 526).

The Land Navigation app will incorporate Transformational Play by allowing the learner to take on the role of the protagonist who must engage land navigation skills (such as plotting points on a map and using a compass) within a problem-based scenario.

An additional constructivist concept that relates to the Land Navigation app is Ausubel's Meaningful Learning Theory and anchored instruction. Through the Land Navigation app, learners will be transformed and partake in meaningful play which leads to meaningful learning. In Ausubel's Theory, there is an anchor and new ideas attach to that anchor accordingly (Ausubel, 2000). In the area of land navigation, the "anchor" will be the scenario in which learners will have to apply the land navigation skills (the new ideas) they have acquired through the course. Culture and prior knowledge anchor the ways in which learners think, and that plays into the way data is interpreted. Mental models and the way learners interpret situations are based on their perceptions, which are based on their culture and experiences. The Land Navigation game will ensure that learners will have the ability to participate in a common experience that will create meaningful learning, and be stored as long term memory.

Social Model

There are social applications involved in the use of the app. We decided to have a leaderboard where students can see how well they are performing against their peers, challenge their peers to games of knowledge, add flash cards to help each other study, and communicate with their instructors.

DESIGN

The land navigation game is designed to simulate and support the practice experience that marines are required to perform as part of their instruction at The Basic School. The Basis School's student body historically has varied skill levels, even within a single class. This fact was considered heavily in the design of the progression of skill level inside the game. The game simulates the practical application of the course because an instructor comes onto the screen and gives the user his or her objective and any important facts for obtaining that objective. The user then responds to the objective by using both the facts presented to him or her by the instructor and the tools offered to him or her inside the app. Pre-programmed parameters trigger suggestions to the user for utilizing help menus and instructional materials in the form of a pop-up window, acting as a learning scaffold. Additionally, the user can access these materials at any time in the menu bar. The user will assess his or her own knowledge on an on-going basis before deciding to utilize the suggestions or to explore the instructional materials on his own. The game does not allow the user to bypass the easier objectives, thus ensuring that all users are brought to an eventual level of unified knowledge before progressing to more difficult objectives; however, the user determines his or her own pace for what he or she considers to be "easy" objectives. The user continues to progress through all the objectives that the game's animated instructor gives him or her until all the objectives are completed. Additionally, the user can repeat sections if he or she wishes to review and solidify his or her knowledge. The end result is that all game users who complete all objectives now have the same knowledge level, regardless of how often they relied on its instructional suggestions or how often they practiced a single concept or task inside the game. If they finish all of the objectives, the user is considered competent.

The initial design was built using Microsoft PowerPoint (Figure 1) being built slide by slide, and integrating links and images in order to make it visually pleasing and usable. By using PowerPoint, it enabled us to alter and update the prototype when changes were necessary. The varying color scheme is intended to assist the user and serve as a visual clue when they are playing a new activity. The slides were purposely created in a simple

manner, in order to avoid over stimulating the user, visually. The language presented on the slides was also purposely kept simple, in order to avoid any confusion or misinterpretations. The buttons presented within the game were kept the same size and color in order to keep the design consistent, and to avoid negatively impacting the user experience. Once the prototype was built, each team member tested it and gave his or her input in regards to the design, aesthetics, and functionality of the links. The prototype was then ready for pilot testing. We simultaneously built a Wix site, utilizing the PowerPoint slides in the prototype. Due to the fact that many of us were unable to test it before the pilot testing, we initially felt that the Wix should not be included as a prototype. However, during the day of the pilot testing, we took the Wix prototype with us and decided to try it out with one of the testers. Two prototypes were tested: The PowerPoint version and the Wix version.

Figure 1. Initial PowerPoint prototype.

Ecological Conceptual Design

The instructor at The Basic School will introduce the game as a supplemental feature for learning land navigation and will provide the students with the web link from which to download the app. The game is downloadable to a mobile device. An internet connection is required for social aspects like asking an instructor a question in asynchronous timing and challenging other students to trivia and games. The app is a collection of instructional data combined with a game which allows users to practice their land navigation skills outside of the classroom in areas such as the barracks, library, and other areas outside of the classroom. We imagine the user being immersed in these environments to practice these skills, as the app is portable and challenging to the students.

Interactive Conceptual Design

The user will be presented with a home page screen that appears every time the user logs on (Figure 2).

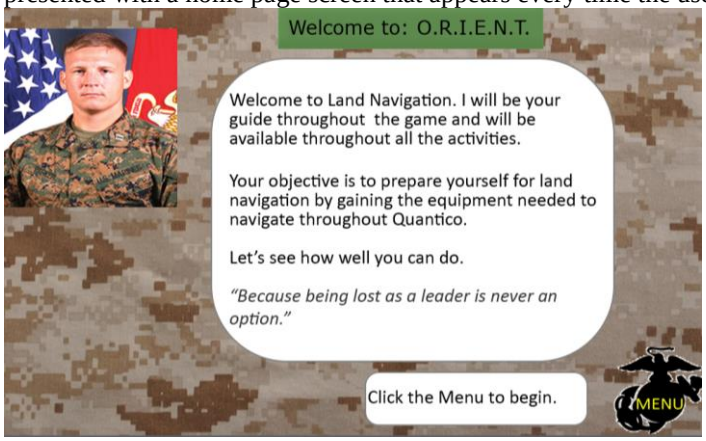


Figure 2. Open screen.

The screen will include a menu bar, which leads to the main menu (Figure 3) where the user can email the instructors or challenge other students. The objectives are land navigation tasks. The user proceeds to obtain the objective -- map, pen, string, etc., -- using the facts given by the instructor and tools available in the app via the menu bar that is always available. The user attains points by completing the objectives and challenging others to games. When the user is struggling (due to pre-programmed parameters such as time limits or obvious misjudgments), a pop up window will ask the user if he or she wishes to utilize a help menu for land navigation terms, how-to trainings, or other scaffolds regarding land navigation skillsets. Additionally, the user can repeat sections without penalty. The user must complete the levels sequentially, but he or she may proceed at a faster pace if he or she wishes and if his or her knowledge allows him or her to progress. Upon successful completion of the task/objective, the user will be awarded land navigation items and points and will be able to progress to more difficult objectives.

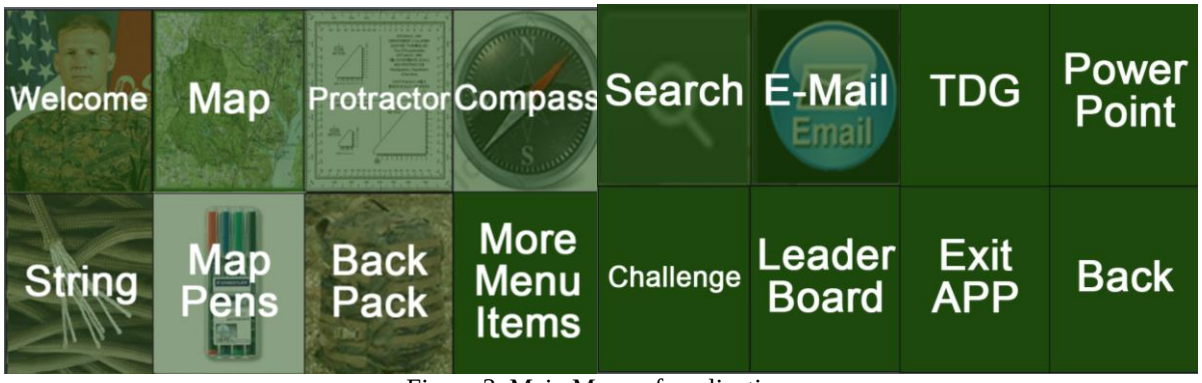


Figure 3. Main Menu of application.

Emotional Conceptual Design

The students at The Basic School have different backgrounds, skills and knowledge levels. The students have access to the bullpen, an area where instructors are available to aid students, but many have stated that the bullpen is intimidating. By allowing the students to have access to the land navigation game, students will be able to practice and sharpen their land navigation skills. The land navigation game will enable students to practice during their free time as frequently as they want, and it will allow them to make mistakes in private instead of in the presence of others. Additionally, the students can self-assess and take control of their learning environment and learning pace by utilizing the instructional content and help menus if they so desire.

User's Mental Model

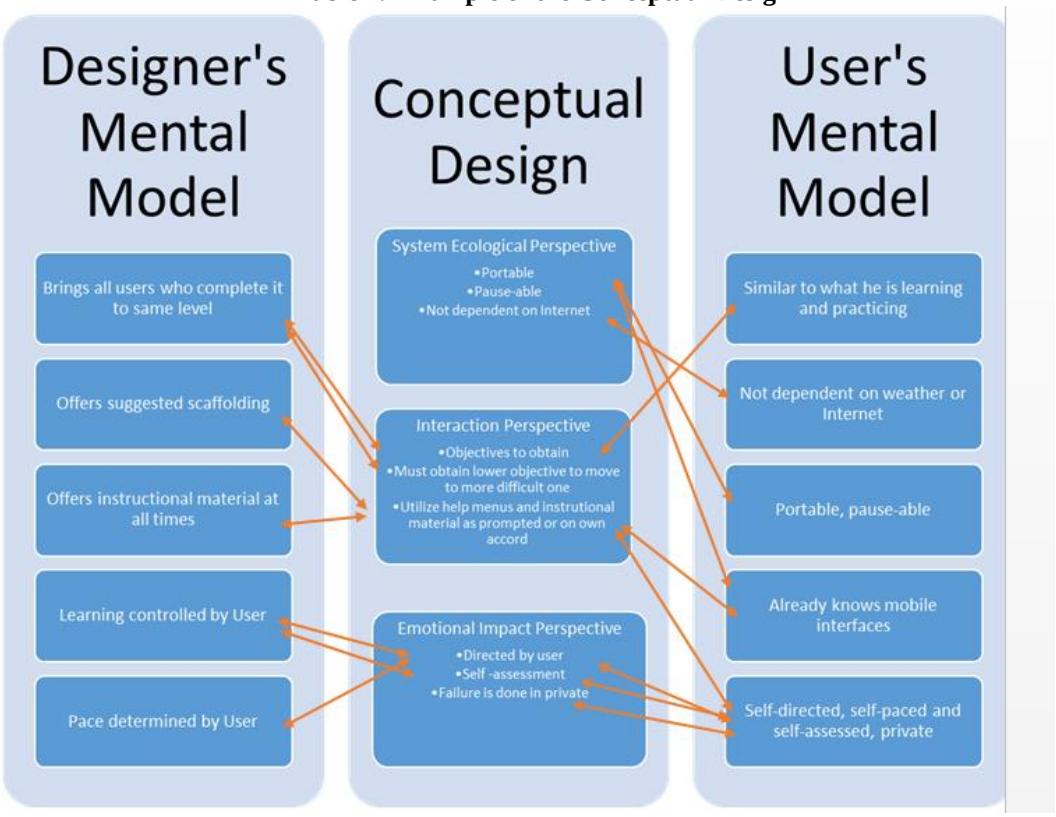
The user's mental model draws upon concepts the user is already familiar with and can build upon while using the game. The user probably expects a land navigation game to encompass similar concepts as those in the classroom and in the practical outdoor application that the students are required to attend. The game supports those concepts. Additionally, the student can practice land navigation skills in a weather independent environment using the same types of objectives that he or she will use (or have used) in the practical application. It is portable and can be more readily utilized during the user's free time. It contains pop-up windows, help menus, menu bars and other touch-screen features that the user is likely to have encountered in other apps that he or she have used on his or her mobile devices, and would expect to use across a majority of apps that are currently available. The game can be paused for learning, instructional review, or simply to return later. The learner will draw upon his or her current knowledge from the land navigation classes so he or she can practice his or her skills in a personal environment where he or she can learn at his own pace, self-assess, and control his or her own learning.

Mapping Designer and User Model via the Conceptual Design

The conceptual design incorporates the ideas from the designer's mental model and the user's mental model. The user is coming from a standpoint of a student who is taking or has taken the classroom and practical application portions of land navigation courses at The Basic School. He or she may have an idea of what concepts the game may entail but he or she doesn't know how to master the game until he or she uses it. The user also has his

or her own mobile device and is most likely familiar with mobile applications and their common interface features. The designer has information about the learners such as various knowledge levels, the perceived requirement for mobility, and knowledge about learners in general such as an adult learner's desire to control his or her own learning. The designer must incorporate instruction with the user's mental models of land navigation concepts, of operating a mobile device, and of any phenomenological aspects of mobile electronic instruction. The conceptual design considers both sides of these as valid concepts upon which to build the app's features.

Table 1. Example of the Conceptual Design



Prototyping for the emotional perspective, we decided to offer four different views of land terrain concepts so that the learner can see and identify with these concepts on the map as well as in the real and virtual worlds where they will be tested. We believe the user will derive value and meaning from such an interactive experience and the four different views that the activity provides. The prototype includes a log in screen and a navigation menu which allows the user, in this prototype, to select the "identify terrain feature" activity. Once the activity is activated, the user is asked to identify a variety of terrain features. The user advances through the prototype as he or she answer each question. The test allows users to learn by doing and it also allows them to learn from his or her mistakes by offering feedback to the user, depending on his or her selections in the form of right or wrong answers and a hint button feature. We also decided to design a help feature for the learner in the form of an email address that would allow the student to ask the instructor questions that our pre-programmed learning application cannot answer. This also adds a social dimension to our design so that the learner does not feel that he or she is all alone in this learning activity. These features should contribute to the aesthetics and the joy of use we hope our users will experience.

Prototype changes

Our design changed significantly in the beginning of this second semester of this course. These changes reflected input we received from users as well as from the instructors and stakeholders.

Based on the comments from the first testers, many prototype changes were suggested. As a result of the recommendations, prototype changes that were made after the testing include edits to the text and screen colors for better visibility, including arrows on every terrain feature, elaborating on the hints feature at the module's welcome

screen, enlarging the words in the toolbox menu, and changing the toolbox to a backpack. We also fixed the two links that were not working correctly. We decided to change these features because they are basic interface features that greatly affect the prototype's look and feel, and we believe they are easy changes to make now, that will not affect other improvements that we make later. We also believe these changes more closely support the user model and enhance the app's usability.

After the second round of testing we made some major changes where we decided to use Captivate rather than PowerPoint (as was used for last semester's prototype) because Captivate offers more features that will enable us to better create the type of learning environment we have envisioned (Figure 4).

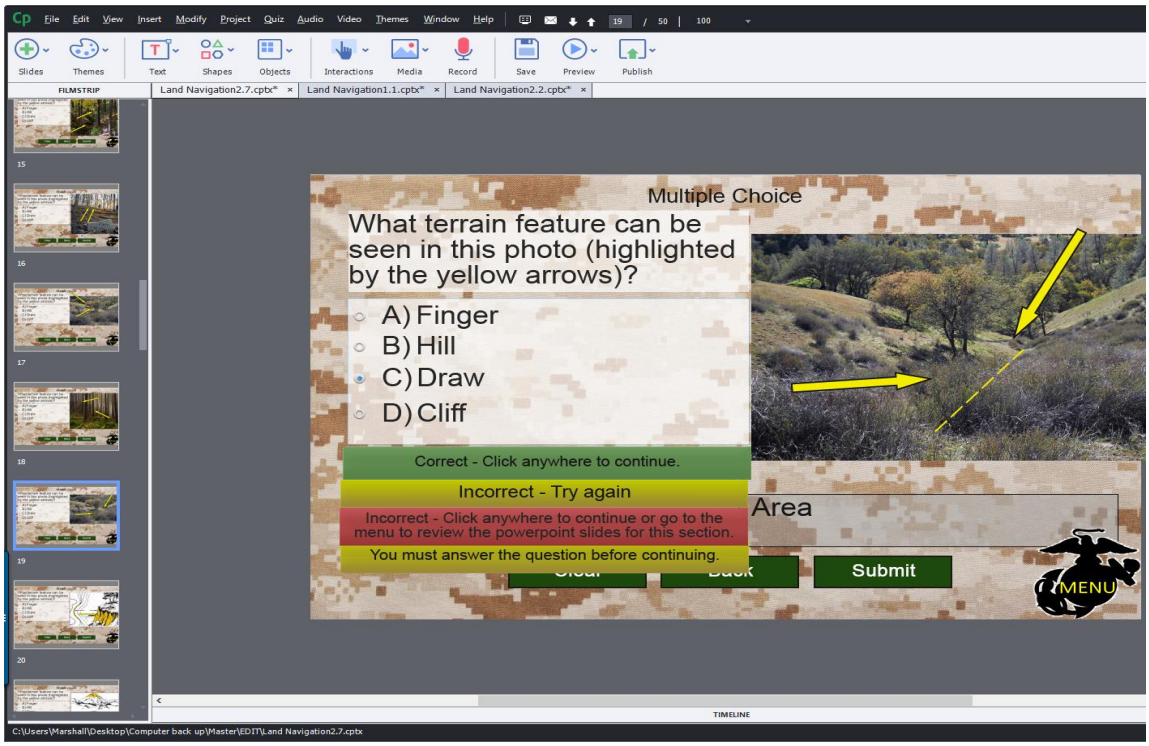


Figure 4. Captivate build.

Other changes we implemented were (Figure 5):

- Replaced the on screen menu with a menu tab
- Added 6 more photos of Quantico land terrain into the multiple choice testing
- Changed robotic voice to normal voice (voice recording)
- Removed Capt Smith from some of the pages
- Softened the color on the background
- Increased font size on pages
- Thickened background borders
- Added hints/wording to tell students where to go next
- Added the "Press Anywhere to Continue" option, replacing a "Y"
- Added place holder pages for Protractor, Compass, String, and Map pens
- Added "Millionaire" game
- Expanded "Memory" game

Figure 4. Prototype Changes.

Themes that emerged from Round Three came from comments that varied greatly between users. A few positive themes emerged that let the design team know it is on the right track with the prototype:

1. The app reinforces learning, and this reinforcement was a key requirement of TBS.
2. Most Marines would use it as a study aid. We are building this for the students to use to assist them in mastering land navigation. Their feedback, input, and suggestions have been incorporated into a working prototype that students would use from which to learn and challenge each other's knowledge.
3. The purpose of the app is clear. As students began testing the prototype, it was clear to them what their purpose, goals, and end state were as they worked though the app to accomplish their mission.
4. The tasks match user expectations. Students continually expressed they intuitively knew what was expected and could easily follow the tasks given while testing the prototype.
5. The text and buttons are large enough. During the first round of testing we had many issues with students struggling to read the text while on a cell phone; however since we increased the font, brightened the background for the words and lightened the screen background, students were able to read and see the phone portion of the prototype with ease.
6. The text is clear and the contrast is good. With the brightening of the background and changing its transparency, students were better able to see the text.
7. The buttons did not confuse users. Utilizing buttons similar to TBS, Marine Corps applications, and many gaming applications, users knew how to operate the prototype, they understood the content, and they rapidly picked up on new ideas.
8. The instructions are clear. While the majority of the students had very little to no training on the prototype, they were able to pick operate the prototype and follow on-screen instructions.

These themes are regarding the intent of the app in that it reinforces learning and that the app would be used as a study aid. These two ideas are in line with TBS's intent for a mobile learning tool for land navigation. The users understood the purpose of the app and it matched their expectations.

Themes that emerged around visual effectiveness are that for the majority of users, the text and buttons were large enough. Figure 5 presents the fact that users with smaller test devices had a more difficult time of reading or interpreting parts of the app. Users said that the text wa clear and the contrast was good. While the majority of users said the buttons did not confuse them, the Device and Usability Matrix states that they are easier to read on the larger device. Additionally the text in the instructions was easier to read on the larger device.

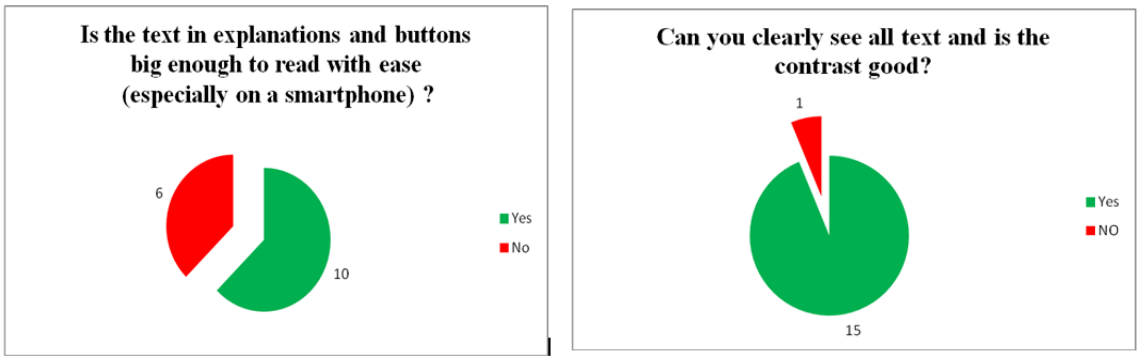


Figure 5. Sample questions.

We again heard comments on the content, such as a request for more photos and maps. Some users wanted to be more challenged by the app and some preferred to see the PowerPoint slide content from the classroom setting.

Way Forward

Based on these emerging themes and our findings from data analysis, we plan to improve the app in:

1. Visual Effectiveness
    a. We will update all the fonts to the optimal size that best fits each slide to improve visual affordances for future use of the application.
    b. For each of the question slides, the answer circle was difficult for many users to utilize on the phone; the final app will have an increased answer circle with an increased text font to create a larger clickable answer circle where the student can easily select the answer before moving on to the next question.
    c. We will add more space between each answer so the students would have an easier time selecting the correct ones.
2. Content
    a. As requested by several students, the final application will again increase the number of photos of land features in Quantico, instructional material from the PowerPoint slides, as well as topographical maps. By doing this, we can create a quiz bank so that each time the student enters the application he or she will not see the same questions and will be challenged by varying (random) types of questions he or she receives.
    b. For the final application we will add the instructors email link, and a group email that is connected to the instructor and chief instructor to ensure students have a direct link to them when they have questions concerning the content of the course.
3. Functionality
    a. We will remove the need to click anywhere once an answer is submitted. If the chosen answer is correct the student will automatically proceed to the next slide. If incorrect, he or she will re-attempt the question.

ACKNOWLEDGEMENTS

I owe a debt of gratitude to my fellow instructional design team members, Amy Ansong, Jenna Calautti, Nedium Ridjanovic, and Rebecca Roller; they were instrumental in the evolution of the TBS mobile application. Without a total team effort we would not had been able to create this mobile learning environment; a special thank you to each of you.

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