Evaluation
CS 352 - Team 18

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1. INTRODUCTION

Group 18 is designing an interactive cue sports coaching application for mobile and tablet devices. The group has conducted four cognitive walkthroughs for analytical evaluations of the poolShark prototype, and one empirical analysis with a potential user that belongs to the target audience. The target audience of the poolShark app is novice users interested in practicing to improve their skill at cue sports.

The four cognitive walkthroughs, ie. the analytical evaluations, have been completed individually by the four members of group 18. The data acquired from each member is reported in appendix A. The single empirical analysis has been completed by one member, Ehmar Khan, of group 18 and the results were discussed among the group for further insight. The data acquired from the empirical study is reported in appendix B.

2. ANALYTICAL EVALUATION

A. Research Goals

The goal of our analytical research is to test the poolShark prototype's usability by asking fundamental questions about the user experience at each step of the cognitive walkthrough. The usability of the prototype includes elements such as how easy and intuitive navigation of the app is, how errors in using the app may occur, how easy it is to fix those errors, how effective the app is at relating the virtual coaching to the physical world, and how well the app incorporates social features that entice the user to engage in them. In order to achieve this research goal, each member of group 18 will keep the aforementioned usability elements specific to the poolShark app in mind when answering the fundamental usability questions at each step of the cognitive walkthrough.

Conducting each of the four cognitive walkthroughs separately and by different group members will help ensure the incorporation of different perspectives on the usability of the prototype.

B. Reasons for Choosing Cognitive Walkthroughs

Cognitive walkthroughs were chosen for the analytical evaluation of the PoolShark prototype. Group 18 decided to choose this method over heuristic analysis because the cognitive walkthroughs place more of a research emphasis on task completion, rather than more detailed points of research such as specific screen content. As poolShark app is still early in the develop process, the group felt that it would be most beneficial for development to ensure that tasks that would be commonly performed using the poolShark app could be done so with ease.

Group 18 chose cognitive walkthroughs over GOMS/KLM analysis mainly because the group did not have the available resources to complete a GOMS/KLM analysis. Another indication for the use of the cognitive walkthrough approach over GOMS/KLM was that the target audience of the poolShark app are novice cue sport players that may not be using the application often enough to be considered skilled users.

C. Research Plan

Since group 18 is using a cognitive walkthrough approach, each one of the group members used the prototype to step through the process of completing a specific task while playing the role of a hypothetical user.

Before each member began the cognitive walkthrough, each member specifically characterized a hypothetical user to role play as during the cognitive walkthrough. Each member then created a task that the poolShark app would be commonly used for. This task served as the main goal of the hypothetical user during the cognitive walkthrough, and is the point at which the cognitive walkthrough ended when reached.

After any given member created their hypothetical user and user task, that member posted their hypothetical user and user task to the group Canvas discussion as well as the group Google Hangout for review. This ensured that even though each hypothetical user belonged to the target audience, each hypothetical user and user task was unique.

Since group 18 did not use a planned order of sequence in which to complete the user task, each member recorded the sequence they took. This yielded insight into how different users may navigate the app. As each member is recording their sequence, they will answer the following questions at each step

- Will the user know what to do?
- Will the user know how to do it?
- Will the user understand from feedback whether their action was correct?

The answers to these fundamental usability questions are recorded in Appendix A, along with notes about possible issues and possible solutions to these issues.

D. Research Material

We used the following to complete and record the data for each cognitive walkthrough.

- pen/pencil and paper
- a sketch prototype of the poolShark application

D. Results and Insights

Many insights and suggested changes related to the usability of the poolShark prototype resulted from the cognitive walkthroughs that each member of group 18 conducted. These insights occurred throughout the length of the cognitive walkthroughs. The following is a discussion of these insights and suggested changes ordered temporally from the beginning to the end of the cognitive walkthroughs. The group 18 members that conducted the walkthroughs will be referred to as "researchers".

The first element that two out of the four researchers noticed may frustrate some users is the lack of feedback letting the user know that the application is working. These researchers noted that due to loading time, some users may think the app has stopped working when it is loading. The researchers decided that the addition of a loading screen between screens that take additional time to load would sufficiently solve this problem.

Another element regarding app feedback that was noted was the lack of icon highlighting, which would let the user know that a selection has been made, and that so that the user can be certain it was the selection they intended to make. The addition of a highlighting feature that does this should solve this problem.

The next element that was unanimously noted by the researchers was the lack of a sign-up feature on the sign-in screen. This oversight would make it impossible for those who do not have a Google or Facebook account to create an account for the app. As such, a sign-up feature will be added to the sign-in screen, under the "password" text box.

One researcher made a suggestion that a message be displayed on the sign-in screen welcoming the user after successful login. After discussion, the researchers felt that this feature would help facilitate interactivity between the user and the application and have decided to add it to the prototype.

On the main menu screen (main 3 in the prototype) that is displayed after the sign-in screen, the researchers noted screen display element modifications and feature additions should be made.

One of the researchers noted that in order to facilitate memory and recall regarding the functions of icons, icons that execute similar functions should be colored the same. Another researcher noted that the addition of a simple tutorial video would help first time users understand how to operate the app. After deliberation, the researchers decided that both of these modifications should be added to the prototype.

Each of the researchers noted deficiencies on the photo input screen (play 1 of the prototype). Each of these deficiencies was directly related to how the app provided feedback that a sufficient picture was taken for the application to work with. To solve this issue, the researchers suggested adding either a small output (like a flash) and a screen pause or adding a feature that automatically takes the photograph for the user when the image feed is lined up correctly. The researchers decided that it would be best for the application to automatically take the picture, but as the researchers are unsure of the technical requirements of this feature, it will have to be further investigated.

Another feature that one of the researchers noted was lacking from the photo input screen was an error message that notified the user when the picture they took was not correctly aligned or otherwise could not be used by the application for the purpose of virtually placing the playing balls. As all researchers agreed that there will certainly be times when a user takes a bad picture, it was decided that this feature will be added to the prototype.

The insights regarding the next set of in game screens (play 2, play 3, and play 4 of the prototype) were regarding the layout of the screen elements, missing navigational functionality, and icon function clarity.

The layout of these screens was noted by one of the researchers as appearing cluttered. It was suggested that a title above the shot options appear on the screen and that the "shot 1" and any other subsequent "shot" icon can be changed to "1". All the researchers agreed that this would make the screen appear more organized as well as allow more room for additional shot options, and this screen layout change was decided to be added to the prototype.

In order to further de-clutter the in game screens, another researcher suggested that the labels on the schematic only be visible the first time the user uses the app per day. The researcher also suggested that the labels not appear on

the schematics of any subsequent shot screen after the first, as the user will have already seen these labels at that point. While the research group as a whole agreed with the notion of limiting the display of the labels in some way, it was decided that instead of only displaying the labels once per day, the app would display them once per instance of the user opening the app.

Regarding navigating the application, each researcher noted the ambiguity of the perceived function of the "< Back" icon. Some users may think that this icon returns the user to the most previous screen, while other users may think that it brings them back to the main menu (this is the current functionality of the prototype). To resolve this, one researcher suggested that the "<Back" icon be changed to the "Main Menu" icon so that it is clear that it brings the user back to the main menu. After group deliberation, It was decided that the "<Back" icon should remain, but instead return the user to the most previous page. It was also decided that a main menu or home icon be added to the select pages to easily go back to the main menu.

One of the researchers noted that, in order to further reduce the ambiguity of the icon function, the meter in the schematic should be labeled upon first use (like the other labels appear) and the name of the "overview" icon be changed to "top-down view". The reason for the change of name being that "overview" may lead some users to believe that this presents a summary of the displayed shot, which is not the case. The researchers as a whole agreed and it was decided to change the name of "overview" as well as add a label to the meter.

Two out of the four researchers noted lacking functionality in the in game screens. One researcher stated that the addition of a "shot checking" feature that allows the user to take an aligned picture of their shot results so the app can show them what they did wrong. Another researcher noted the lack of a feature that allows the user to re-load the previous shot, in case they accidentally tapped the "next shot" icon. All researchers agreed that both features should be added to the prototype.

E. Results and Insights Summary List

The results and insights of the analytical evaluations (cognitive walkthroughs) are displayed in the following list:
1. Highlight icons when selected (to give user feedback)
2. Add sign-up feature (to allow new users to make an account)
3. Add "welcome back" after successful sign-in (to give users positive feedback)
4. Color icons with similar functions the same color (to facilitate memory and recall of icon functions)
5. Add tutorial video (to instruct new users on how to use the app)
6. Add automatic photo capture feature (to allow give user feedback on whether the video feed is lined up correctly)
7. Add message popup when a bad photo is taken (to give user feedback as to what to do next, ie. retake photo)
8. Change layout of in game screens (to make screen more organized)
9. Change "<Back" icon to bring user to most previous screen (to reduce icon function ambiguity)
10. Add "main menu" icon to some screens (to facilitate simple navigation of the app)
11. Make schematic labels only visible the first time used per app opening (to simplify interface)
12. Change "Overview" icon name to "Top-down View" (to reduce icon function ambiguity)
13. Add "shot checker" feature (to facilitate a more interactive coaching experience with the app)
14. Add "previous shot" navigation function (to allow user to navigate back to the previous shot in case they mistakenly tap the "Next Shot" icon

3. EMPIRICAL EVALUATION

A. Research Goals

The goal of the empirical research plan is to evaluate how an actual user reacts while using the prototype. Group 18 will be using a usability study format with the user being instructed to think aloud. Because the poolShark prototype is still a paper prototype and not yet a working prototype, the usability study will be conducted without a physical pool table and with the group member conducting the study verbalizing some of the functionality of the app. This will give feedback on how quickly they are able to access the options of the application. Factors that group 18 observed and evaluated during the study are:

- Is the user going straight to the main function or are they checking the social features first?
- How long does it take to get to and use the main function?
- Impact of environment? People, social activities, etc.
- Obtain information from user's expectation of the app versus the actual functionality of it

B. User Details

Group 18 selected a 24 year old Biology student from Oregon State University for our evaluation. She identifies as a target user for our project as she likes to play pool in the MU basement from time to time and also falls in a demographic range that is appropriate for our project. She has used smartphone applications before although she's not very experienced with technology and is relatively more likely than other users to help us derive data that will represent a wide audience. The subject has shown interest in the group's project and is willing to take part in the empirical evaluation process.

C. Research Plan

Since the purpose of this study was to determine usability issues, getting feedback from the user was crucial. One group member guided the user through the application as a means to meet our research plans.

The user was encouraged to "think aloud" with the group member recording this information that was shared with the rest of the group at a later time. Although the group member guided the user, the group member minimized extra explanations and help to get a more accurate reaction from the user.

Group 18 decided to simulate a common use of the app by presenting the user with the following scenario: "You are in the MU basement practicing pool. You are in the middle of a practice game and you are not sure what shot to make next, so you decide to use the poolShark app for help." The group member then walked the user through each of the processes of the app until the goal of finding the next shot to make was reached. The group member also noted the following observations:

- What are the user's reaction to each part of the app?
- What reaction is there about the shot they took? Was it helpful?
- Are they using the options like advanced techniques or taking the simplest shot?
- How relevant are the multiple views and shot options?
- All facial expressions, body gestures, user voice tone, video recordings should be noted.

D. Follow-up Questions

After the user reached the goal, the group member asked the user the following questions:

- How easy was it to navigate through the application?
- Are the screens clear and easy to understand?
- Was taking the photo easy to achieve or did it take a long time to get the right angle?
- Did the application contain all the functions that were expected to have?
- Was the main function easy to understand along with the options?
- Did the results simulate what was expected? How difficult was it to replicate the shot?
- How satisfied are you with the app?

E. Research Material

We used the following to capture our observation.

- A sketch prototype of the poolShark application.
- Pen and paper.

F. Collected Data

The walkthrough of the prototype with a prospective user is recorded in Appendix B, along with a follow up interview.

G. Results and Insights

Similar to the cognitive walkthroughs, the prospective user commented on the lack of ability to sign up for a new account within the application. The user did not appear to have any concerns with signing in using Facebook. The ability to sign up for a new account will be added to the main login page.

The user seemed confused about what to do after taking their shot, unsure if the application would have the ability to determine if the shot was made correctly. This feature was not considered during our initial design of the prototype, but does seem like something that some users would request. It appears to be a feature that would be especially useful when using the coaching features. The researchers determined that this would be an additional feature to be considered because it was not immediately clear from the initial test whether the feature was necessary.

The user also appeared to have some confusion on where the 'Back' button would take them. As discussed in the analysis of the cognitive walkthroughs, there will be more clarity added to better explain where the different back buttons will take the user.

The user seemed to appreciate the clearly marked, color-coded navigation buttons. Having a consistent and well-marked layout throughout the application will help to keep the application easy to use and make navigation easy for the user.

Overall, the prospective user seemed happy with the ability of the application to fulfill the main function of taking a picture of the pool table and providing a suggested next shot. They seemed to especially appreciate the availability of several views from which to see the suggested shot (point-of-view, overview and a simple animation). The user noted some of the additional social and statistics features but did not take the time to explore them during this initial test.

Appendix A.1.   Cognitive Walkthrough Questions

The answers marked a, b and c after each step will correspond to the following questions:
   a.   Will the user know what to do?
   b.   Will the user see how to do it?
   c.   Will the user understand from the feedback whether the action was correct?

Additionally, notes regarding the following topics may be listed after any given step:
   ·   Assumptions about what would cause any encountered problems and why
   ·   Side issues encountered
   ·   Possible solutions to any encountered problems or side issues

Appendix A.2.   Cognitive Walkthrough 1

Researcher: David Ramirez

Hypothetical User: A 23 year old male college student, who plays pool recreationally about once a week, just finished a big test and has nothing to do for the day. He wants to relax by doing something fun, so he decides to go to his favorite pool hall. While waiting on friends to arrive, he decides to try out a new app he got for practicing pool.

Assigned Task: This task will simulate a new user opening the app and trying it out for the first time. They will use the app to get coaching for 2 moves of a pool game and then return to the main menu.

1. **Tap on the "Start" icon to start the app**
    a.   I knew what to do because it looked like there was only one selection on the screen to choose.
    b.   The fact that the graphical design around the text stating "start" looked like a button let me know how to use this functionality (by pressing or tapping it).
    c.   I knew that this action was correct because a new screen prompting me to log in came up.

Notes:
        If the loading time from the opening screen to the sign in screen is long, I can see some users possibly exiting the app because they think it may have frozen. To avoid this, we should highlight the start icon after being successfully tapped. This will immediately let the user know that the app received their input so that they will be more likely to wait for the result.

2. **Tap on the "Quick Play!" icon to play without logging in**
    a.   I knew what to do because I am familiar with this common "sign in or quick play" kind of menu screen. I assume that I will enter my email or sign in with a google or facebook account, or press "Quick Play!" to use the app right now, but likely with no save option. I tap the "Quick Play!" icon because the friends that I am waiting on might be here soon and I want to try the app before they get here. I notice that there is no sign up option for those who would like to create a profile.
    b.   I knew how to do it because the icon resembled the previous "start" icon, which I tapped.
    c.   I knew that this action was correct because a new screen that showed a main app menu came up.

Notes:
        Like with the previous step, if the loading time between screens is long, I would understand if some users would get frustrated by not knowing if the app had received their input or not. As this seems to be a reoccurring theme, I suggest that all selectable icons be highlighted after they are successfully tapped (from this point on, I will assume that this functionality has been added to the prototype).
        I noticed that there is no sign up feature on the sign in screen for users who would like to create a profile. Even though I was going to select the "Quick Play!" option anyway, this confused me about how I was going to create an account if I liked my experience with the app. I suggest that a sign up feature be added to the sign in screen.

3. **Tap on the "Play" icon to start the main functionality of the app**
    a.   I knew what to do because I could see brightly colored options on the screen and the word "play" is usually used to signify starting the main functionality of an

entertainment related program.

    b.   I knew how to do it because the icon resembled the previous icons that I tapped.

    c.   I knew this action was correct because the button I tapped was highlighted and a a new screen that corresponded with my selection came up.

4.   Align the pool table with the photo template using the camera and take photo to input the ball locations from the physical table to the virtual table in the app

    a.   I knew what to do because the of the instructions near the top of the screen, the the view of the camera feed has a template in the shape of a pool table on it, and there is a brightly colored button labeled "Take Photo" under the camera feed.

    b.   I knew how to do it because the instruction near the top of the screen state how. It was also obvious to me by the template on the video feed. I knew how to physically instruct the device to take the picture because the icon labeled "Take Photo" resembled the previous icons that I tapped.

    c.   I knew this action was correct because a new screen that displayed a virtual representation of the physical playing table came up.

Notes:

    There could be frustration among users that are not sure if the app took a good picture. I suggest that some output (like a flash on the screen resembling a camera flash) and then a short pause on the screen to see the template over the photo taken be added. This would reinsure the user that a good photo was taken. I suggest as well that the pause on the photo be only for a very short amount of time, because this is a process that will happen often in the app and it may become cumbersome if the pause is too long.

5.   Observe virtual move schematic to help find best next move

    a.   I knew what to do it because the schematic is clearly displayed in the center of the screen.

    b.   I knew how to do it because it is visually obvious that the schematic is displaying a move in pool.

    c.   I knew this action was correct because it is central to the purpose of the app.

Notes:

    While the labels on the schematic are helpful the first time using the app, I feel that they could get in the way and be a nuisance when the user already knows what the schematic represents. I suggest that these labels only appear in either the first ever use of the app, or the first use of the app in any given day. The latter is the best option, in my opinion, because it provides reinforcement to the user without becoming a nuisance.

    I also noticed that the meter that displays the strength of the shot (bottom left of the play 2 and play 3 screens) does not have a label. I suggest that a label that appears only for the first use of the app per day be applied to this meter.

6.   Tap on the "Animation" icon to watch the schematic in motion

    a.   I knew what to do because there are only 3 options that look like they relate to the Schematic on the screen. It is obvious that the "Animation" option will show some sort of the schematic displayed on the screen.

    b.   I knew how to do it because the "Animation" icon resembled the previous icons that I tapped.

    c.   I knew this action was correct because the schematic images started moving, showing the ball going into the pocket. (this feature is not in the prototype, but will be

In the final product)

7.   Tap on the "Overview" icon to change the view of the schematic
a.   I knew what to do because there are only 3 options that look like they relate to the schematic on the screen. However I could confuse the "Overview" icon with presenting a summary of the shot, rather than presenting a top view of the schematic.
b.   I knew how to do it because the "Overview" icon resembled the previous icons that I tapped.
c.   I knew this action was correct because the display of the schematic changed to a top down view and the "Overview" icon was highlighted momentarily after I tapped it.

Notes:
The naming of the "Overview" icon can lead to confusion about what the icon is supposed to do. On one hand, "Overview" could mean "a view from over the table", while on the other hand it could mean "a summary of the move shown". I suggest that this icon be renamed "Top-down View" to eliminate the possibility of confusion.

At this point in the walkthrough, the user should have enough information to take the shot on the physical playing table. The next step assumes that this was done before it.

8.   Tap on the "Next Shot" icon to get recommendations for the next shot
a.   I knew what to do because I have exhausted the other two options (Overview and Animation) and have decided that I have exhausted all my options for gaining for information about the shot displayed and took the shot. The next logical thing to do Would be to load the next shot into the app.
b.   I knew how to do it because the "Next Shot" icon resembled the previous icons that I tapped.
c.   I knew this action was correct because the "Next Shot" icon was momentarily highlighted after I tapped it and a new screen came up that prompted me to input another image for the next shot.

Notes:
I feel that there should be some way of returning to the previous shot, in case the user accidentally taps the "Next Shot" icon. I feel the best way to implement this functionality would be to have the app save the most previous shot displayed and add a "Previous Shot" icon the "Play" series of screens. Another way to implement a sort of "check" on accidentally tapping "Next Shot" would be to add a popup screen that asks the user if they are sure of the choice to load the next shot. However, I feel that this would be too disruptive to the flow of the app.

9.   Align the pool table with the photo template using the camera and take photo to input the ball locations from the physical table to the virtual table in the app
a.   I knew what to do because the of the instructions near the top of the screen, the the view of the camera feed has a template in the shape of a pool table on it, and there is a brightly colored button labeled "Take Photo" under the camera feed. I also remember seeing this screen just a few screens previously.
b.   I knew how to do it because the instruction near the top of the screen state how. It was also obvious to me by the template on the video feed. I knew how to physically instruct the device to take the picture because the icon labeled "Take Photo" resembled the previous icons that I tapped. I also remember what I did when I saw this screen previously.
c.   I knew this action was correct because a new screen that displayed a virtual

representation of the physical playing table came up. I also remember the results of the last time i encountered this screen.

Notes:

As with the notes accompanying step 4, I suggest that some output (like a flash on the screen resembling a camera flash) and then a short pause on the screen to see the template over the photo taken be added.

10.   Observe virtual move schematic to help find best next move
a.   I knew what to do it because the schematic is clearly displayed in the center of the screen. I also remember seeing this screen just a few screens previously.
b.   I knew how to do it because it is visually obvious that the schematic is displaying a move in pool. I also remember what I did when I saw this screen previously.
c.   I knew this action was correct because it is central to the purpose of the app.

Notes:

As with the notes accompanying step 5, I suggest that the schematic labels only be shown the first time the app is used that day and that the shot strength meter have a label as well.

11.   Tap the "Shot 2" icon to change the suggested shot (simulates the user not liking the first shot the app suggested)
a.   I knew what to do because the options "Shot 1" and "Shot 2" appear in a short list at the top of the screen, with only 1 icon highlighted. This implies that what I am currently viewing is shot 1, and that the "Shot 2" icon will lead me to a screen displaying shot 2.
b.   I knew how to do it because the "Shot 2" icon resembled the previous icons that I tapped
c.   I knew this action was correct because a new screen showing a different shot came up.

Notes:

To avoid cluttering the screen with unnecessary text, I suggest that the labels be removed from the shot 2 screen. The user would have already seen the labels in the previous shot 1 screen, and re-introducing will not help the user, as they already know what the schematic details.

12.   Tap on the "Animation" icon to watch the schematic in action
a.   I knew what to do because there are only 3 options that look like they relate to the schematic on the screen. It is obvious that the "Animation" option will show some sort of the schematic displayed on the screen. I also remember seeing this screen just a few screens previously.
b.   I knew how to do it because the "Animation" icon resembled the previous icons that I tapped. I also remember what I did when I saw this screen previously.
c.   I knew this action was correct because the schematic images started moving, showing the ball going into the pocket. (this feature is not in the prototype, but will be In the final product) I also remember the results of the last time I encountered this screen.

13.   Tap on the "Overview" icon to change the view of the schematic
a.   I knew what to do because there are only 3 options that look like they relate to the schematic on the screen. I also remember seeing this screen just a few screens previously. However I could confuse the "Overview" icon with presenting a summary of the shot, rather than presenting a top view of the schematic.
b.   I knew how to do it because the "Overview" icon resembled the previous icons that I Tapped. I also remember what I did when I previously encountered this screen.
c.   I knew this action was correct because the display of the schematic changed to

a top down view and the "Overview" icon was highlighted momentarily after I tapped it.

I also remember the results of the last time I encountered this screen.

Notes:

As with step 7, I suggest changing the name of the "Overview" icon to "Top-down View".At this point in the walkthrough, the user should have enough information to take the shot on the physical playing table. The next step assumes that this was done before it.

14. Tap on the "< Back" icon to return to the main menu

a. I knew what to do because it is obvious that an icon labeled "back" would bring the user back to a previously encountered screen.

b. I knew how to do it because at this point in use of the app, I know that I should tap on icons to execute the functions that they represent.

c. I knew this was the correct action because the "< Back" icon was briefly highlighted after I tapped it, and the main menu screen came up.

Notes:

There may be some confusion about the results of the "< Back" button as to whether it brings the user back to the most previous screen or brings the user back to the part of the app they were at before the current part. I suggest that the "< Back " icon be renamed "Main Menu". There should be no need for a "< Back" icon that brings the user to the most previous screen because every screen is accessible directly by it's own icon.

Appendix A.3   Cognitive Walkthrough 2

Researcher: Khoa Phan
Hypothetical User: 25-year-old male, professional who visits a local bar next to his workplace, typically playing pool to relax after a long day. Novice player, who plays with friends while drinking beer on occasion. He practices alone some nights to improve his skill level at the game.
Assigned Task: This task will simulate a new user opening the app and trying it out for the first time. They will use the app to get coaching for a move and check to see his statistics history.

1. **Tap on the "Start" icon**
   a. The start icon was clearly visible amongst the rest of the starting screen.
   b. It was easily accessible as it is on the lower part of the screen, typically near the thumb. It helps identify itself as something I should press.
   c. This opened up the next screen which is what I expected to see in some form.

Notes:
A loading bar would help the user know it is starting. Layout wise, it is expected to see the design/artwork with the name on top, so this was familiar.

2. **Tap on the "Facebook" icon**
   a. This is a common screen with most apps that have sign-in options. Integration with other applications is common, especially with Facebook and Google. It is clear what the intentions of this screen are.
   b. It was clear what I needed to do to sign in due to the familiarity and icon. It asked if I wanted to use this option.
   c. I am to believe it redirects me to Facebook to allow access and connect with friends, just like many other applications.

Notes:
   There is no option to sign-up or "new user" icon I would expect to have. There is no indication on how to do this. A "remember me" checkbox would be nice, as well as a "keep me signed in" checkbox so I don't have to re-enter my information every time. The quick play icon is similar to the "Start" icon, located in the easiest place to access so this is a positive.

3. **Tap on the "Play" icon**
   a. This was clear in what this button did, as it was at the top of the list and colors were distinct from the other options.
   b. I knew how to do it because the icon distinctly says "Play", as if I were playing the game.
   c. I knew this action was correct because the button took me to the correct screen that I was expecting.

Notes:
   The "Play" button should be the same color as "quick play" from the previous screen as they are related to one another. It would globalize that function for the app.

4. **Align the pool table with the photo template using the camera and take photo**
   a. I knew what to do because the layout was like a set of instructions and sequences.

b.   I knew how to do it because the top has a description, then the photo box with the highlighting, static red lines to show me how I need to take the photo and take photo button at the bottom. From top to bottom it was clear.

c.   I knew this action was correct because the photo was taken and proceeded to load into the next screen.

Notes:

Adding in a flash option would help. Another would be a live, object highlighting real-time feature on the camera to show that it is picking up the pool balls in the photo. This would help the user understand that their photo is working and is correct. I could also see adding different camera angles, for some tables that may have overhead lighting that may obstruct the photo.

5.   Selecting between shots options

a.   I knew what to do because it was at the top, like a title.

b.   I knew how to do it because the two options had a red box around it, showing me that this was the selected shot option.

c.   I knew this action was correct because displayed the shot in the center of the screen with instructions on how to play the shot, with projections of how it plays out.

Notes:

The layout could be adjusted slightly as the bottom of the screen seems congested. A description above the two options like a title would help identify what it is and change the "shot 1" to just be a number, in case the app wants to add options up to 5.

6.   Selecting overhead view

a.   I knew what to do because the was at the bottom where I could easily access it and was identified clearly.

b.   I knew how to do it because it was colored again, like many of the buttons in this app.

c.   I knew this action was correct because it took me to an overhead view of the virtual table.

7.   Selecting the back to go back to main menu

a.   I knew what to do because there was a "back" option at the top left of the screen.

b.   I knew how to do this because the button had an arrow that typically signifies that it is going back to a previous screen.

c.   I knew this action was correct because me back to the main menu.

Notes:

It could be clearer on what the back button does as it takes you back to the main menu. This could be confusing as it can also be the previous screen. If a user is expecting it to back to the previous screen, they will be frustrated if they have to start the process all over again. The option to go back to the main screen can be within the setting options in the bottom right corner.

8.   Selecting the statistics option

a.   I knew what to do because it was, again, like all the other buttons in the app.

b.   I knew how to do it because it is highlighted with a color and descripted.

c.   I knew this action was correct because it took me to the statistics screen. This screen had all the information I was expecting to see.

Appendix A.4   Cognitive Walkthrough 3

Researcher: Ehmar Khan
Hypothetical User: Cade, a 22-year-old male engineering student at Oregon State University. Novice pool player, enjoys recreational games with friends roughly once a week. Cade visits McMenamins with his friends for dinner, and decides to play a pool game using poolShark for assistance as they wait for their food.
Assigned Task: This task will simulate a user, Cade, who has interacted with the application before to login with his social media account and check out its features but has not used it during an actual game. He will use poolShark to get coaching for a move and check out the 'friends' option.

1.   Tap on 'Start' icon
a. I knew I had to press the 'start' icon, not only because I have done this before but there is only one option to select at the home page.
b. The option is clearly highlighted with a blue button. I can focus on selecting this option as there are no other options or major distractions demanding my attention.
c. Selecting the start option takes me to a login page, which represents successful transition to the next step.

2.   Tap on 'Google' icon for sign in option
a.   I can tell the purpose of this screen is to log me into an account so that my statistics get recorded.
b.   The sign in options are clearly visible with text fields and distinct icons.
c.   Pressing on Google icon redirects me to a page which prompts me to select a preferred Google account to link with this application. Selecting the account brings me to a new screen with main menu including user data at the top which hints that the login was successful.
Notes:
        A sign-up option is missing which needs to be added so I can consider signing in with app credentials. For better response feedback on signing in, a message could be presented that hints at successful transition, such as 'Welcome/Welcome back, Adam'. Also, I don't have a clear idea on how I'd log out once I'm in the main menu screen (Do I select 'Options'?) A log-out button could simply be added at the bottom of this screen.

3.   Tap on 'Play' icon
a.   The color-coded icons grouped in the main menu hint at selecting one of these options to proceed to my desired task.
b.   The 'Play' option is at the top so it grabs my attention before any other icon, which lets me jump straight into my main objective of using the application.
c.   Selecting the option brings me to a new screen with instructions, from which I can tell the coaching has started.
Notes:
        A 'tutorial' or 'about' option could be included in the main menu which explains how the application works, so that the user knows what to expect on hitting the 'Play' icon.

4.   Align the pool table with the photo template using the camera and take photo
a.   I can tell from the highlighted instruction that I'm supposed to take a photo of the pool table.

b.   I am instructed to align the pool bed within the provided red lines along with the option of taking a photo which is convenient, but the sequence of the instructions is not obvious. The instructions could be rephrased to something like, 'Align table within red lines and then take photo.'

c.   Taking the photo takes me to a new screen that shows multiple shot simulations, hinting I have taken the photo correctly.

Notes:
        The application could support taking the photo automatically once the pool bed is aligned properly. This helps with minimal attention investment for the user and could also address the issue stated in 4b.

5.   Using shot simulations

a.   From the resulting simulation, I know I'm supposed to follow the provided guideline to make my move. The shot simulations are numbered at the top and the selected simulation is highlighted with a red border so I know which one I'm currently using and that I can switch between them.

b.   The simulated animation along with the shot power indicator, hit spot, projected paths and an overhead view make it clear how I'll be making the shot.

c.   I get the option to proceed to 'next shot' but no feedback on if I made my current move correctly.

Notes:
        The application could include an option in this screen which takes a photo to check how accurately I followed the suggested move.

6.   Selecting the back icon to go back to main menu

        a.   I can tell I'll need to tap the '<- Back' icon at the top if I wanted to go back.

b.   The back button is clearly visible at the top-left, isolated from other elements of the screen as it is not involved with in any functionality of the current screen but with a transition between screens.

c.   Tapping the icon brought me back to main menu which is what I expected to happen.

Notes:
        On my attempt to switch back to 'Shot 1' from 'Shot 2', I accidentally tapped on the 'Back' icon. Since it's hard to isolate this icon any further, a pop-up can be added that warns the user of losing the current simulation information if they go back.

7.   Selecting the 'Friends' icon

a.   I know I'll need to select the 'friends' option if I wanted to check statistics among friends who use the application.

b.   The 'friends' option is color coded and clearly visible in the main menu just like the other options.

c.   As expected, selecting 'Friends' brings me to a new screen state with a list of friends from my Google contacts. I can view their skill levels, add or remove friends and broadcast my current location to them.

Appendix A.5   Cognitive Walkthrough 4

Researcher: Richard Maxwell
Hypothetical User: A 27-year-old female engineering professional visits her boyfriend's house over the weekend and they decide to play a couple rounds of pool at his place. She and her friends have been really getting into pool as a hobby lately and she normally plays a few times a week. She has used the poolShark app a few times before but has not used much of the social or statistics parts of the application before.
Assigned Task: This task will simulate a user who has used the application during playing a couple games and when practicing, but has not used the social and statistics parts. She will use the app to play a quick game, then compare her game with her friends using the Friends and Statistics pages.

1. **Tap on 'Start' icon**
        a.   I have used the application before and know what to do to open the app. Tapping the start icon is easy enough.
        b.   The Start button is highlighted and easy to see.
        c.   I understood that pressing the button was correct when the next screen loaded up.
Note: It's important that either the next screen load fast or the button has some visual feedback to represent the successful interaction.

2. **Tap on 'Facebook' icon to login**
a.   I have used the application before and have a good idea what to do to login. Logging in with a Facebook account has become pretty common and it normally works pretty easily.
b.   The Facebook logo is prominently displayed as an option for signing in.
c.   I understood that pressing the button was correct when the Facebook login page displays, allowing the app to log me in.
Note: missing link to sign up a new account through the application

3. **Tap on 'Play' icon**
a.   I have used the application to play a game before. Pressing the large play button to start a new game makes sense.
b.   The Start button is highlighted and easy to see, making it easy for me to know what to do.
c.   I understood that pressing the button was correct when play screen loaded.

4. **Align table and tap 'Take a Photo'**
a.   I have used the application to play a game before. I know to follow the on-screen instructions to align the table and then take a photo.
b.   I can see on the camera screen when the table is aligned with the redlines and it's clear that I need to press the take photo button.
c.   I know that it worked when the next screen loads showing me the suggested shot.
Note: Something not covered with the current prototype is what happens if the app fails to read the table and needs a new photo. We will need to add some error handling.

5. **Tap 'Overview'**
a.   I can see the suggest shot and that I have options for an "overview", an "animation" or "next shot". Wanting to see an overview to better understand the suggested shot, I know that I need to press that button.

b.   The buttons are clear and brightly lit. It's clear that I have three options.

c.   I know that it worked when the overview screen pops up.

<u>Note</u>: Overview and animation screens should probably have titles added to the top so it's clear what page loaded.

6.   Tap 'Friends' button from within play screen

a.   Having taken my shot, I now want to see what my friends are doing. It was not initially clear to me what the friends button was in the bottom left. With some investigating I found this would take me to the friends page.

b.   It wasn't entirely clear where the friends button was on this page.

c.   I know that it worked when the friends page loads.

<u>Note</u>: This is mostly due to the limitations of an initial prototype, but it's important for the friends and settings buttons to represent their meanings clearly.

7.   Scroll through 'Friends' page and tap on a Friends page

a.   On this page, I can see a list of my friends and assume based on the colored links that I can click on their names.

b.   This is a pretty simple list of friends with other basic options (add or share location).

c.   I know that I clicked on a friend's page when their profile page loaded.

8.   View 'Friends Profile Page' then tap 'back'

a.   On this page, I can see my friend's basic information, see if they're currently playing and their current location (if it's being shared). The only option I have from this page is to go back.

b.   I can see the profile information and the back button.

c.   I know that the back button worked when I return to the 'Friends page'.

9.   Tap 'back' on the Friends page

a.   On this page, I know that I can go back, but I'm not entirely sure where it will take me.

b.   I can clearly see the back button.

c.   I know that the back button worked when I return to the main screen.

<u>Note</u>: We'll need to be careful about using the back button when the user has entered the friends page while playing a game (this could either take them back to a game in progress or the main screen).

10.   Tap 'Statistics' on the Main page

a.   Back on the main screen I know that I have a few options, and decide I want to see my statistics.

b.   I can clearly see there is a button for statistics that should take me there.

c.   I know that the button worked when the statistics show up.

11.   Tap 'Back on the Statistics page

a.   From this page I can see my statistics and only have an option to go back.

b.   I can see the important information I want to see and know how to go back.

c.   I know that the button worked when I'm returned to the main screen.

12.   Tap 'Play' on the Main page to return to game

a.   It's my turn to shoot again, and from back on the main screen I know that I have a few options, and know I need to press play to get back to the shot suggestion part of the application.

b.   I know the play button will take me where I need to go.

c.   I know that the button worked when the table screens loads.

Appendix B   Empirical Evaluation

User

24-year-old Biology student at Oregon State University, occasionally plays pool with friends in the MU basement. She's not very tech-savvy but has used plenty of smartphone applications before.

Observer

Ehmar Khan

Introduction

I gave an overview of our project to the user when we selected her during the planning phase of the evaluation. The scenario is that she isn't sure about her next move during a practice game and decides to use the poolShark app for assistance. I met her in the MU basement for the evaluation at a time when there weren't many people around, or any major distraction that could affect the evaluation process. I instructed her to start with the home screen and follow the instructions on our paper prototype to move towards her goal of finding suggested moves. She was asked to think aloud on her actions while pretending to be alone and trying a new application.

Transcript

Home Screen:

"Okay, I have tapped on the start button"

(User switches to 'Main 2' after following the instructions)

Sign-In page:

"I'm signing in through Facebook. Can I sign in with those text fields? How do I even sign up?"

(User switches to 'Main 3')

Main Menu Screen:

"I've pressed the 'play' button."

(User seems confident about using the prototype at this stage. She selects 'Play' right away, ignoring other options)

Play 1 screen:

"I'm aligning the red lines on the app with the boundary of the pool table and taking the picture. It's not mentioned where I'm supposed to go after this but by looking at screen named 'Play 2', I assume that's my next screen."

(User looks slightly confused as she switches to 'Play 2')

Play 2 screen:

"The app suggested my next move. I'm not making the move yet but checking other features so I press the yellow 'next shot' button. It says it loops back to 'Play 1' so I'll take a picture and start over."

(User switches to 'Play 1')

Play 1 screen:

"I'm selecting the 'Overview' option. I'm assuming this goes to 'Play 4'. What happens if I select 'Animation'?"

(User looks curious. She's explained it will give a simulated animation of the suggested move, but we couldn't include it here since it's a paper prototype)

"Okay, I have made the move as instructed. Did I do it correctly?"

(Looks confused about what to do next. I asked her to assume the move was made correctly and to return to main menu screen)

 "How do I return to the main menu?"

(User is asked what she thinks she'll need to do from the prototype)

"Okay, I have pressed the back button. It says it'll take me to 'Main 3'."

(User switches to 'Main 3')

Post observation interview

Q: How easy was it to navigate through the application?

A: It went more smoothly than I expected as I haven't navigated using a paper prototype before. Once or twice I didn't know which screen to switch to, but I guess I figured it out.

Q: Are the screens clear and easy to understand?

A: Yeah, all the options are laid out very neatly and are color coded and I had a clear idea of what I was doing. Mostly.

Q: Was taking the photo easy to achieve?

A: I assumed from the prototype that I'll need to align the pool within the red lines and then take the photo, but how will I know that I have correctly aligned it? I can't comment on how difficult this stage is until I use it with a working prototype.

Q: Did the application contain all the functions that were expected to have?

A: It contains most basic functions. I'd like if it could confirm that I made the move as it was suggested.

Q: Was the main function easy to understand along with the options?

A: Yes, it was easy to understand, and it seems it gives me a detailed description of the suggested moves.

Q: Did the results simulate what was expected? How difficult do you think it'll be to replicate the shot?

A: I didn't have any expectation on how the moves are going to be suggested, but now I have clear idea of how it'll work and the process makes sense to me. It shouldn't be very difficult to replicate the shot as I can check the overhead view and an animation and overall feels efficient to use. But like I said, how do I know if I did it right?

Q: How satisfied are you with the app?

A: The application includes other options and a social layer beyond the main functionality which was cool. Overall, I'm satisfied enough as I could reach my main goal of getting a move suggestion.
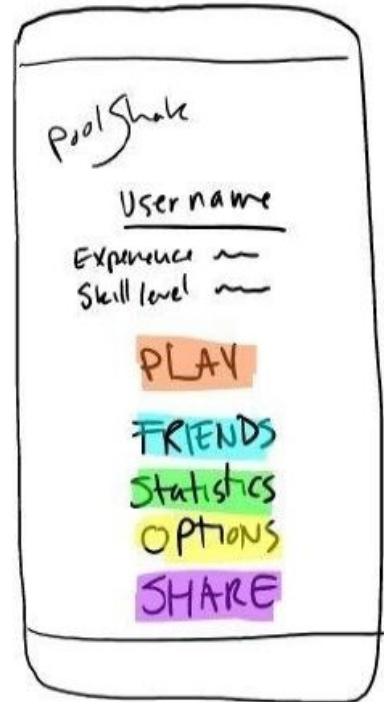
Appendix C   **Sketch poolShark Prototype**
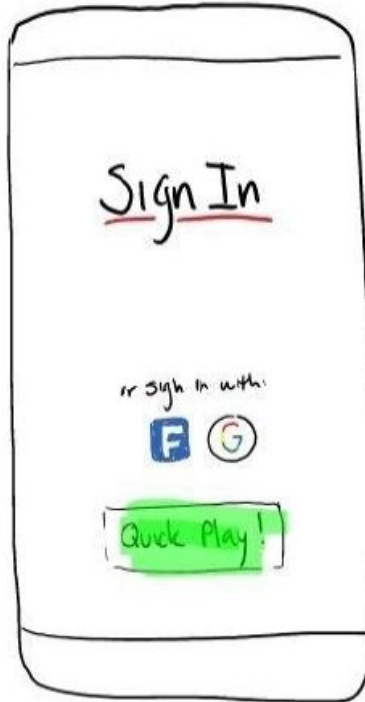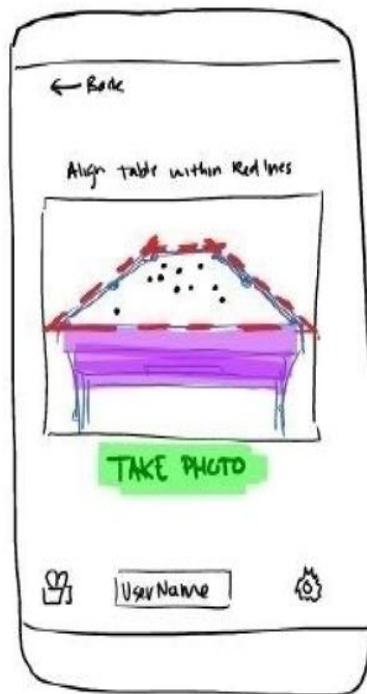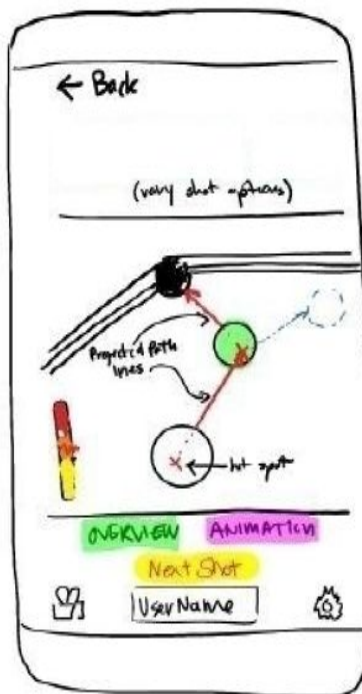

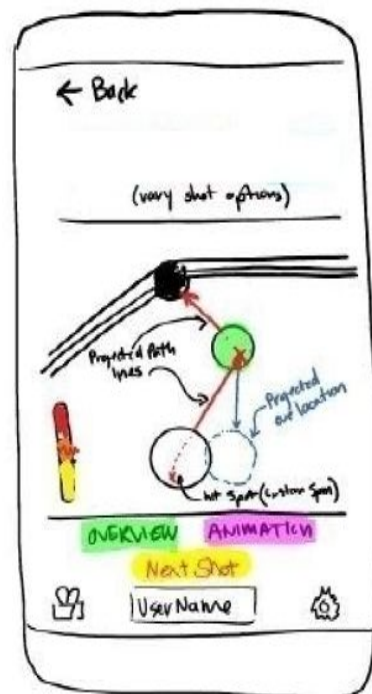MAIN 1   MAIN 2   MAIN 3

*END OF MAIN SKETCHES

- initiates "play" sketches when corresponding button tapped.
- initiates "friends" sketches when corresponding button tapped.
- initiates "statistics" sketches when corresponding button tapped.
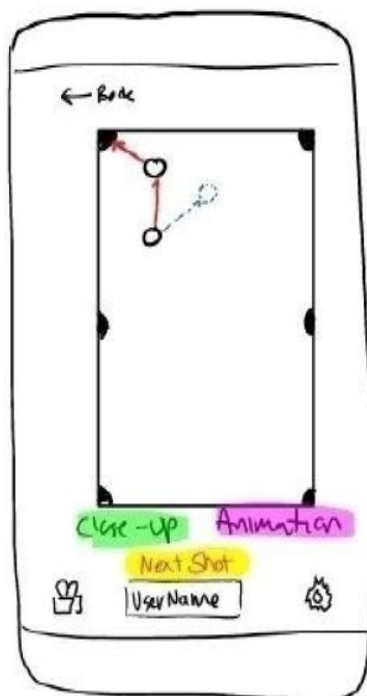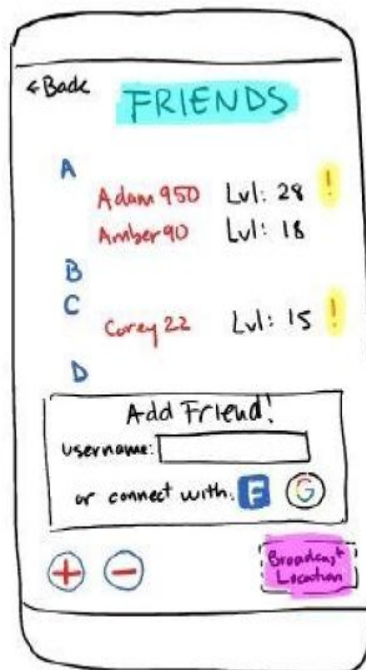- initiates "options" sketches when corresponding button tapped.

PLAY 1

PLAY 2

PLAY 3

PLAY 4

*END OF PLAY SKETCHES

-will loop back to "play 1" when "next shot" button tapped
-will go to "main 3" when "← back" tapped
-will initiate "Friends" sketches when friend tab (bottom left) tapped
-will initiate "Options" sketch when options tab (bottom right) tapped
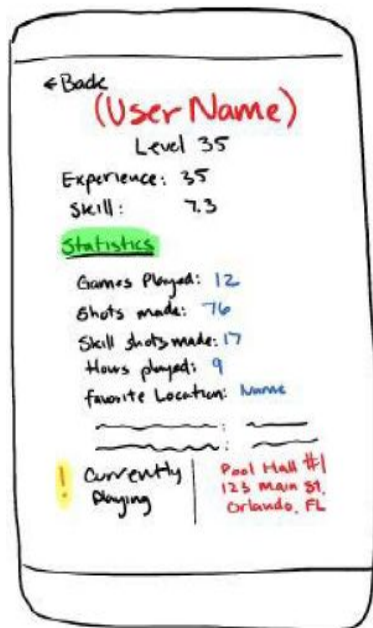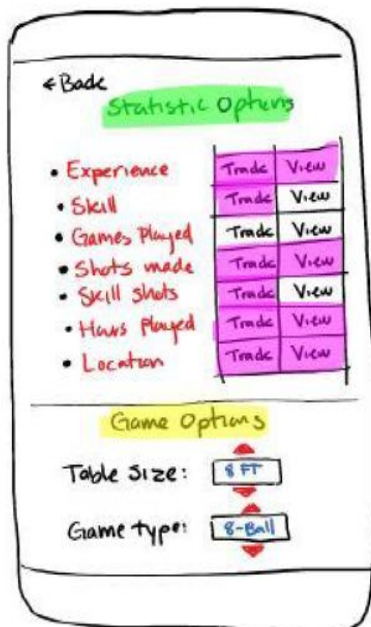
FRIENDS 1 **FRIENDS 2** **FRIENDS 3**

'END OF FRIEND SKETCHES

- return to "Friends 1" when "← back" tapped
- return to "main 3" when "← back" tapped on "Friends 1" screen
- "broadcast location" button on "Friends 1" screen gets highlighted when tapped, letting user
- Know that the feature is in use

STATISTIC 1

*END OF STATISTIC SKETCH

   - return to "main 3" when "← back" tapped

OPTIONS 1

*END OF OPTIONS SKETCH

   - "Statistic Options" track and view buttons will remain highlighted when tapped, signifying the user is tracking the statistic or making the statistic viewable for friends to see

   - return to "main 3" when "← back" is tapped