POND MONITORING SYSTEM

Design Dialogues Coursework Part 2

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CONTENTS

1. INTRODUCTION

This report will demonstrate the design and evaluation process for a visitor-centred physical and digital system, which can be installed in the grounds at Napier University Merchiston Campus as a part of the urban permaculture project, called *Lions Gate*. It will focus on aspects of permaculture and UX.

Permaculture can be defined as a holistic approach, which aims for relationships between elements, so they can interact with each other. The main assumption of this approach is to cover the surrounding space and act in a way that reflects sustainable thinking. Permaculture promotes active connection with nature, not against it. Permaculture design process is based on agricultural and social design principles with mission to reduce our impact on the environment (Whitefield, 2016).

PerAqua is a system that embraces both physical and digital design. In this project permaculture has been used to create a system that can monitor the water pool, including flora and fauna, with factors such as water purity and temperature in mind.

PACT

PACT framework is a valuable tool that allows the system designers to focus on a specific situation. It attempts to understand the needs of a potential users, how the user will use the system and how will interact with it. This will help the person involved in creating a system to generate relationships between activities that should be completed. The designer should be also able to understand what kind of technology may be needed to meet the requirements of the designed system.

According to the above information, there is also a need to consider introducing special features for people with visual disabilities or learning difficulties.

People – Visitors of Merchiston Campus, Students, Teaching Staff. The age range of this group vary between 19 and 65 years, since potential users can be both young people who are planning to study at Napier University, those who are currently studying; as well as those who are teaching.

Activities – Provide relaxation, interactive learning experience, information, communication and entertainment.

Context – The mobile App service will be in available in both outdoor and indoor areas making it not dependent on to the weather condition. The physical installation will be placed at Napier University garden; and in that case, the weather can influence on the user experience due to the weather condition.

Technology – Video Cameras, Arduino Board, Analog pH Sensor, Temperature Sensor, Wi-Fi, Local Computer, Solar Panels, Mobile Devices

The two main purposes of the system are: a) to create a quiet space at the ground of Napier University Merchiston Campus, where everyone can enjoy the closeness of nature and, b) to provide users with mobile app so they can monitor the pond gather information about it.

The project assumes the use of physical and digital space. The physical space (pond) is located in the Merchiston Campus of Napier University and is available to everyone, both visitors, students and teaching staff. Digital space requires the use of technology needed to monitor this tank (including input and output digital signal devices). The artefacts required for the installation are:

1) Two cameras steaming the real-time videos from above and from the bottom of the tank, so that everyone can follow the water life.
2) Solar panels located in the campus. All devices that require electricity, will be connected to the solar system.
3) Arduino board to connect the sensors to the system.
4) Local computer to store and transfer collected data.
5) pH and temperature waterproof sensors to measure the water quality and to make sure that there are suitable conditions in the water for living creatures (fish).
6) Wi-Fi to transfer the data collected to the computer; and from computer to mobile devices. The wireless transmission will reduce the pollution of the surrounding space.
7) Mobile Devices to use the App.

in order to create circulation, there also a solar energy powered electric pump can be installed if needed. The pump would allow oxygenation of the water but would also give opportunity to implement several structures for visual stimulation.

Technology embedded in the natural environment, which is a water reservoir, can help in integration with nature, better understanding of it and evoke a sense of greater responsibility for the environment, primarily among young people. The closeness of nature can also to improve well-being and user experience.

User Experience consists of feelings, thoughts and willingness to engage in activities involving interaction with technology (Benyon, 2013). User's involvement is a UX meter.

Focusing on UX enables design to focus on the user. It increases the chances of a project's success when it finally comes to market.

2. DESIGN APPROACH

Design thinking is an iterative process that focuses on understanding the user, assuming assumptions and defining problems. During this process a designer tries to identify alternative strategies and solutions that may not be visible at our initial level of understanding. Design thinking provides a solution-based approach to problem solving. Design thinking is extremely useful in solving problems that are poorly defined or unknown in the initial stage of the project, by re-designing the problem in a human-oriented way. Design thinking involves continuous experimentation: sketching, prototyping, testing and testing concepts and ideas. It tries to empathize with human beings. That involves ambiguous or inherently subjective concepts such as emotions, needs, motivations, and drivers of behaviours.

Design thinking is non-linear process. It means that the designers continuously use their results to review, question, and improve their initial assumptions, understandings and findings.

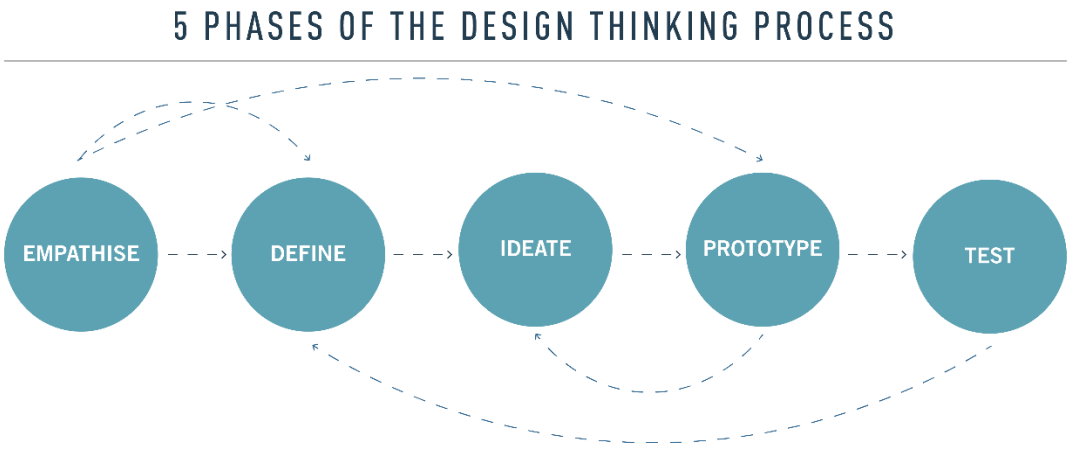

Figure 1. Five Phases of the Design Thinking Process. (Image source: https://careerfoundry.com/en/blog/ux-design/what-is-design-thinking-everything-you-need-to-know-to-get-started/)

Challenging our assumptions and everyday knowledge is often difficult for us humans, as we rely on building patterns of thinking in order not to have to learn everything from scratch every time. We rely on doing everyday processes automatically.

REMOTE LOW-FIDELITY MOBILE APP PROTOTYPE USABILITY EVALUATION WITH PARTICIPANTS.

According to ISO 9421-11 standard (Organisation Internationale do Normalisation, n.d.), usability can be describes it as: *"The extent to which a product can be used by specified users to achieve specified goals, with effectiveness, efficiency and satisfaction in a specified context of use."* Usability is hence more than just about whether users can perform tasks easily (ease of use); it's also concerned with user satisfaction—for a system to be usable, it has to be engaging and aesthetically pleasing, too.

Remote Usability Testing is a good technique because:

• It often saves time and money when compared to lab testing, and allows for a wider range of participants with no need of their presence in the lab.

• Conducting test in the user's environment delivers better results in many cases than a lab environment.

The first usability evaluation was conducted online (on SurveyMonkey website). The total number of participants was five. Two of them were recruited from graduates from the School of Computing at Edinburgh Napier University, and three others were students, who are currently doing HND at Edinburgh College. All participants were residents of Edinburgh, aged between 19 – 35. Evaluations were carried out individually. Participants were provided with the low-fi prototype in PNG format, information about the system and testing procedures. They were also provided with an agreement form which they were asked to complete. Participant data was anonymized and kept only until the end of the evaluation process.

Prototyping has a benefit of involving end users of the system meaning, that is likely to be more suited to the requirements, allowing the user requirements to be validated.

PROTOTYPE EVALUATION RESULTS

The questionnaire consists of 10 (both qualitative and quantitative) questions:

1. How engaging is the design of the prototype?
   (Extremely engaging, Very engaging, Somewhat engaging, Not so engaging, Not at all engaging)

2. How likely is it that you would recommend this app to a friend or family member?
   (1 – 10)

3. What did you like about app?
   (Open question)

4. Overall, how would you rate app?
   (Excellent, Very good, Good, Fair, Poor)

5. Do you like the colour scheme?
   (Yes, No)

6. Is the design easy to understand?
   (Yes, No)

7. Did it take you more or less time than you expected to find what you were looking for on the app?
   (A lot less time, A little less time, About what I expected, A little more time, A lot more time)

8. How would you describe the app in one or two words?

   (Attractive, Boring, Busy, Clean, Clear, Cutting edge, Friendly, Impressive, Distracting, Confusing, Efficient, Engaging, Intuitive)

9. What improvements would you make to the design of the website?
   (Open question)

10. After reviewing the design, how likely are you to explore the website?
    (Very likely, Somewhat likely, Not so likely, Not at all likely)

The feedback gathered from participants during the interactive prototype testing *(APPENDIX A)* provided satisfying results. Most of the participants answered each of the questions and seemed happy with the

overall design and functionality ideas. There were a few suggestions from the respondents in question 9 (What improvements would you make to the design of the app?). The suggestions were: to change the icons colour to darker for more contrast, more spacing between sections and to connect the app with social media.

3. UNDERSTANDING

3.1 PERSONAS

User personas are a fictional representation of the ideal user. They focus on the goals of the user, that individual's characteristics and the attitudes he/she displays. They also examine what the user expects from the product. Each user persona should have a name and a backstory. Additionally, personas inspire the imagination and keep the focus on the user.

The purpose of personas is to create reliable and realistic representations of the key audience segments for reference. These representations should be based on qualitative and some quantitative user research and analytics. *"The personas are only as good as the research behind them*." (usability.gov, 2018)

User – Napier University Student

Name:

Ann Scott

Nationality:

British

Personality:

A person who has interests in new technologies. She is computing, and she has interests in programming and online services. She uses her iPhone to communicate with her friends and family via FaceTime app and Facebook messenger. She likes sharing photos and videos.

Occupation:

Business Information Technology student

Age:

23

Family status:

Single

Expertise:

Expert in computing with high understanding of the internet.

Interests:

Cinema, parties, ecology, music, history, travel, sport

Reason for using other mobile apps:

Booking cinema tickets online, shopping online; getting information about latest business news, relaxation.

User experience goals:

- Provide the user with mobile app that will help with reducing stress caused by exams and coursework deadlines.
- Simple, secure, usable and interactive system that is well designed.
- Easy login
- Compatibility - The app should work on iOS platform.

User – College Student

Name:

Emilio Hernández

Nationality:

Spanish

Personality:

He is people-oriented and fun-loving. He loves spending time with his family and helping others.

Occupation:

College student /Healthcare course

Age:

19

Family status:

In relationship but not married

Interests:

Gardening, health, sport, outside exercise, travel, parties

Reason for using other mobile apps:

Reading news, finding information about his favourite football team, posting on Facebook

User experience goals:

- Simple, secure, usable and interactive system that is well designed.
- All data of the application should be validated.
- Easy login
- Compatibility - The app should work on Android platform.
- Large icons, suitable font types and sizes as he has some eyesight problems.
- Easy to understand content.

3.2 USER STORIES

A user story focuses on defining the user's main goals that can be achieved through a specific system. It addresses issues related to the problems faced by potential users. The analysis of user stories tries to answer questions how to help people and make their lives easier. The user stories usually support a prototype design, which is the visualization of collected information such as requirements and user needs.

The user stories below were extracted from interviews with potential users of the *PerAqua* App who were interviewed during user research stage in the Napier University Merchiston and Edinburgh College Granton Campuses.

Ann Scott:

"I am a Napier University student interested in ecology and a healthy lifestyle. I really enjoy studying at the university and gathering knowledge about the topics that interest me, however I am experiencing lots of stress during the end semester assessment time, especially before Christmas. My dream is to reduce the stress to minimum and to be able spend my free time at uni among friends surrounded by stress-less environment next to the pool. Perfectly if I could have an opportunity to see what is happening with fish there because I love and care about all living organisms."

Emilio Hernández:

"As a final year college student, I don't have much free time. If I find any, I mostly spend it on studying because my main goal is to pass all assessment with good grades to be able to study at university. My dreamed university is Napier because it's based in the city I currently live with my girlfriend and because of the courses they offer and the low cost of the courses. Although I will have Higher National Diploma in Healthcare, I don't feel its something I want to do in the future. What I enjoy doing more is programming. My aim is to study Software Engineering at Napier. I attended the open day there and really enjoyed the Lions Gate project. I like the idea of making it more interactive. It will help to reduce stress and to make the area more sociable and enjoyable. This project can help people to understand the importance of permaculture and its principles."

4. ENVISIONMENT

4.1 DESIGN OF PHYSICAL ELEMENTS OF THE SYSTEM

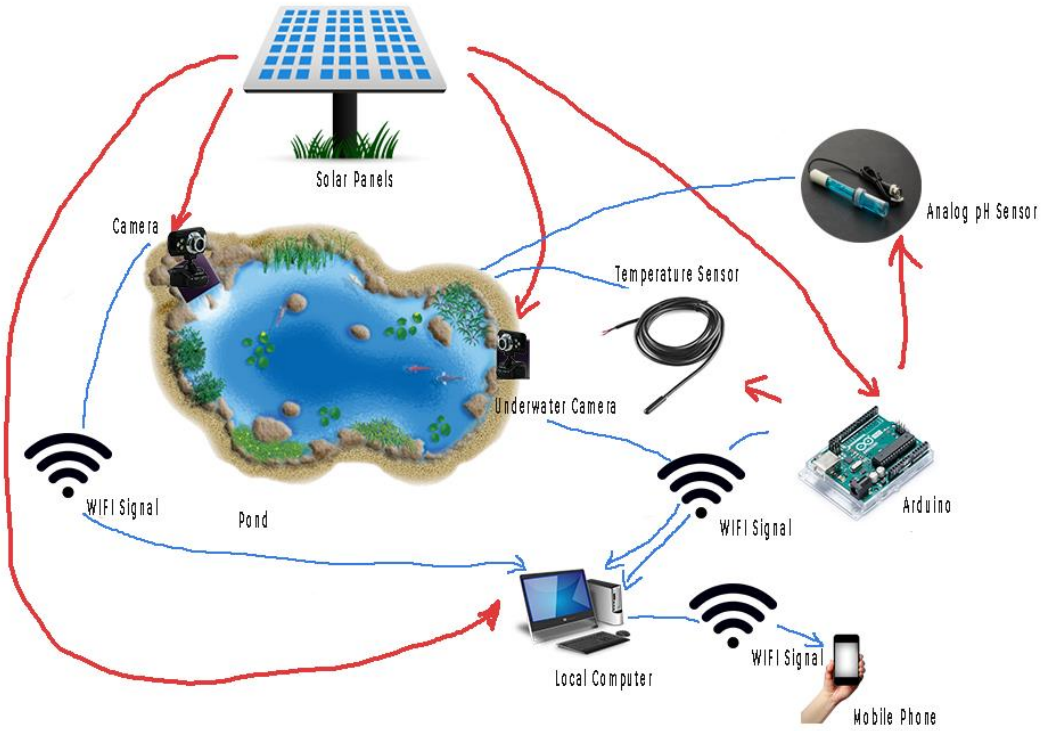

Figure 2. The Pond Monitoring System Physical Design

To visualise the overall idea of the system, there were low-fi prototypes for physical and digital design created.

The image above presents how the system will work. The main point of the system will be the pond. Above the water and below it there will be video cameras installed. They will record and transfer data wirelessly to the local computer. The local computer will also collect data from 2 sensors placed in the water to

measure the water quality. All hardware used for this project will be powered by solar panels, located at Napier University.

Working prototypes with design principles, that meet the system requirements defined in research stage of the project, allow testing research to be conducted in order to make sure the product meets the needs of clients and users (stakeholders). The testing documentation should be created to record all important data gathered.

4.2 DIGITAL DESIGN

Figure 3. Initial Screens of PerAqua App (Digital Design)

The system will allow the user to monitor the pond from the mobile App. After registering and login in to the system, the user will be provided with a main screen. The main screen will show a few options to allow the user to have overall idea about the system and what they can expect from it. “Read about the project” section will show information about it and will allow the user to understand the ideas behind it. There will be also some information about the permaculture and *Lion’s Gate* included as well. “Visit the Pond” screen will display 4 options to choose from: Top View, Underwater View, pH and Temperature. Each of the options will have their own page that will open when the user clicks the button in the menu. The data will be transferred from local computer to user mobile wirelessly.

Colour Scheme

The selected colour scheme for the app has been inspired by colours of the nature. The main colour is blue (#78cde1). There will be also some light brown, dark grey, light blue and black elements included.

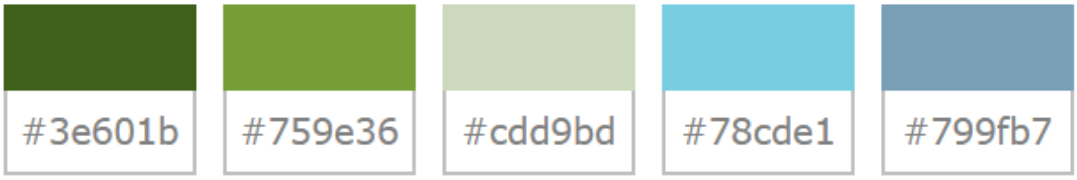

Figure 4. Colour Pallet

Typography

Open Sans font is easy on eyes and can be good for regular consumption. Open Sans size 12-14px will be used in the body text / main content and 24–26px for headings. Elements in the navigation will be Montserrat, size 14-16px.

Icons

Their design will correspond with other elements of the app and the colour scheme. They will be based on existing system icons to keep consistency across the app, so they will not confuse the user.

5. TESTING

User testing will be held to evaluate the designed deliverables and obtain measures of system success in terms of both usability and functionality. User testing as a form of participatory research is a common practice in both HCI and UX. It allows participants to describe experience during interview and by completing questionnaires that follow interactions with the system. Sessions will be conducted in the "quiet area" outside Edinburgh Napier University campus. The participants will be asked to bring their own mobile devices to download, install and access the mobile application and to provide the feedback on it. These sessions will also allow to test the system using various mobile devices and find out if there are any compatibility issues.

User interviews can be a great way to extract information from users to understand their user experience as well as the product's usability and the design ideas. They are cheap and easy to conduct.

MEASURING USE ENGAGEMENT

User engagement refers to the quality of the user experience, which emphasizes the positive aspects of interaction with the online application, and in particular the desire to use the application for a longer and repeated use. User engagement is a key concept in the design of mobile application, motivated by the observation that successful applications are not simply used, but are engaging. Users invest time, attention and excitement in using technology and try to satisfy pragmatic and hedonistic needs.

Measurement is critical to assessing whether web applications are able to effectively engage users and can inform about the design and use of applications. The most common ways to assess user engagement include using self-reporting measures, such as questionnaires; observational methods: e.g. facial expression analysis and speech analysis. For this project again, the questionnaires will be used. Another one, that will be employed is observation of using the system. It will be based on eye-tracking method, that require special software and hardware. Both hardware and software are available in the Napier University.

MEASURING ACCESSIBILITY

Accessibility is the practice of making your websites usable by as many people as possible — we traditionally think of this as being about people with disabilities, but really it also benefits other groups such as those using mobile devices, or those with slow network connections.

WebAIM (available at: https://webaim.org/) is an online tool that offers complete web/mobile accessibility services. The service can help ensure that the mobile app is accessible and usable to those with disabilities.

This tool will be used to measure the quality of the app with accessibility in mind.

6. EVALUATION

An expert review involves a single expert walking through a product via the User Interface (UI) and looking for issues with the design, accessibility, and usability of the product. There's no fixed process to follow, and the expert review can vary from professional to professional as well as from product to product. The more expertise the reviewer has in usability and UX design, the more valuable the input of that person will be (in most cases).

Recruiting an expert is a great way to conduct further UX research; however, there is a risk that the expert will go into the project deeper than he/she should and the whole project will require more changes than expected. Because of that, the designer should consider all pros and cons of recruiting an expert before it happens.

The final evaluation of the project will include usability evaluation, measurement of the UX with a tool called Attrakdiff (available at http://attrakdiff.de/). There will be 5 participants invited to take part in the evaluation process. Participants will be chosen from postgraduate Napier University Computing Department students, so the usability evaluation will have heuristic character.

This instrument is used to evaluate software or website that have interactive features. The (Hassenzahl, Platz, Burmester, & Lehner, 2000) evaluation focuses on measuring the feelings of users when using the website; with emphasis on hedonic and pragmatic dimensions.

AttrakDiff consists of 28 pairs of contrasting with each other words (like for example good – bad). These words are marked by participants on a scale of -3 to +3, where "0" is a neutral value. The above numbers give 7 options for each pair of words. The pairs of words are divided into three different categories - Pragmatic Quality (PQ), Hedonic Quality (HQ) that includes stimulation and identity; and Attractiveness (ATT).

Pragmatic Quality defines effectiveness while Hedonic Quality defines the emotions that accompany the use of the website. The ATT set defines attractiveness and general concerns about the website.

(Hassenzahl, 2018) stated that a product has both pragmatic and hedonic attributes, which influence the product's appeal. According to that, AttrakDiff, which was initially created to measure the above values, seems to be a good solution.

7. CONCLUSION

Various design techniques and methods used have allowed me to design an interactive system prototype that meets user requirements. Use of personas and user stories helped in the user research process. For the system to be successful, it has to consider many factors to determine if its investment is worth the risk and how you can control the risk.

Planning is very important because it allows to carry out various design stages so owning ideas and exploring them allows to consider all options. It will also allow to identify the problem and solve them as soon as possible.

The designer must consider ethical factors that can affect the organization's reputation and the reputation of the interactive system. Ethical factors include data protection and policy and law. An ethical look at a person focuses on making sure that data is stored in accordance with the data protection act. With data used only for the purposes for which it was collected. Users should be told what and how the data is used.

8. BIBLIOGRAPHY

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Hassenzahl, M. P. (2018, 11 28). Retrieved from Hedonic and ergonomic quality aspects determine a software's appeal. Proceedings of the SIGCHI conference on Human Factors in Computing Systems: https://dl.acm.org/citation.cfm?id=332432

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9. APPENDENCES

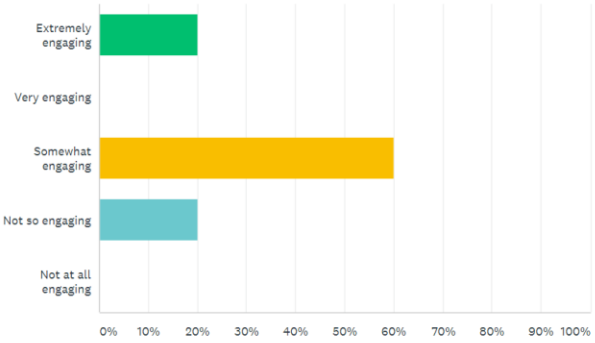
9.1 DATA COLLECTED FROM THE LOW-FIDELITY PROTOTYPE EVALUATION

Q1

Customize | Save As

How engaging is the design of the prototype?

Answered: 5 Skipped: 0



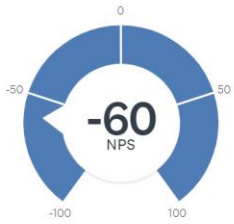
ANSWER CHOICES	RESPONSES	
Extremely engaging	20.00%	1
Very engaging	0.00%	0
Somewhat engaging	60.00%	3
Not so engaging	20.00%	1
Not at all engaging	0.00%	0
TOTAL		5

Q2

Show Benchmark | Customize | Save As

How likely is it that you would recommend this app to a friend or family member?

Answered: 5 Skipped: 0



DETRACTORS (0-6)	PASSIVES (7-8)	PROMOTERS (9-10)	NET PROMOTER® SCORE
60% 3	40% 2	0 0	-60

Q3

Save As

What did you like about app?

Answered: 5 Skipped: 0

RESPONSES (5) WORD CLOUD TAGS (0)

Apply to Selected Filter by tag Search responses

Showing 5 responses

I liked the explanation of permaculture because I didnt know what it was
12/3/2018 12:58 AM View respondent's answers Add tags

I liked the logo and icons
12/3/2018 12:56 AM View respondent's answers Add tags

It is hard to say because I was provided with the image prototype only
12/3/2018 12:55 AM View respondent's answers Add tags

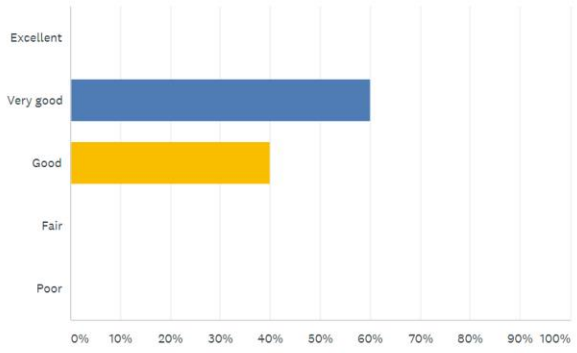
the colours and interactions that can be made in the future
12/3/2018 12:53 AM View respondent's answers Add tags

Q4

Show Benchmark Customize Save As

Overall, how would you rate app?

Answered: 5 Skipped: 0



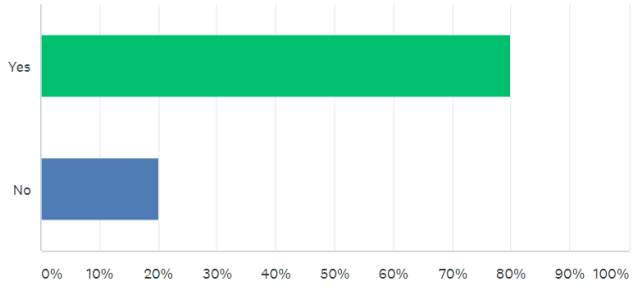
ANSWER CHOICES	RESPONSES	
Excellent	0.00%	0
Very good	60.00%	3
Good	40.00%	2
Fair	0.00%	0
Poor	0.00%	0
TOTAL	5	

Q5

Customize | Save As

Do you like the color scheme?

Answered: 5 Skipped: 0



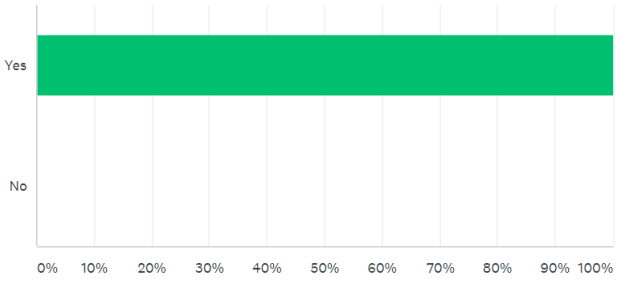
ANSWER CHOICES	RESPONSES	
Yes	80.00%	4
No	20.00%	1
Total Respondents: 5		

Q6

Customize | Save As

Is the design easy to understand?

Answered: 5 Skipped: 0



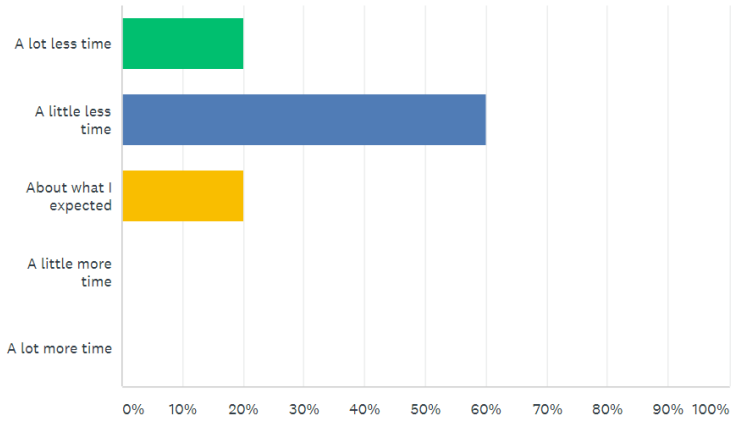
ANSWER CHOICES	RESPONSES	
Yes	100.00%	5
No	0.00%	0
Total Respondents: 5		

Q7

Show Benchmark | Customize | Save As

Did it take you more or less time than you expected to find what you were looking for on the app?

Answered: 5 Skipped: 0



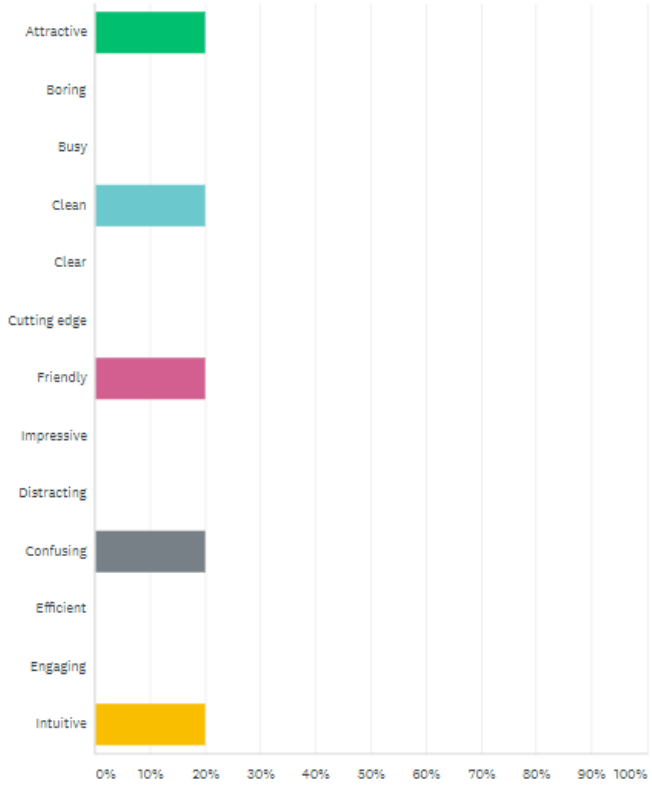
ANSWER CHOICES	RESPONSES	
A lot less time	20.00%	1
A little less time	60.00%	3
About what I expected	20.00%	1
A little more time	0.00%	0
A lot more time	0.00%	0
TOTAL	5	

Q8

Customize Save As

How would you describe the app in one or two words?

Answered: 5 Skipped: 0



ANSWER CHOICES	RESPONSES	
Attractive	20.00%	1
Boring	0.00%	0
Busy	0.00%	0
Clean	20.00%	1
Clear	0.00%	0
Cutting edge	0.00%	0
Friendly	20.00%	1
Impressive	0.00%	0
Distracting	0.00%	0
Confusing	20.00%	1
Efficient	0.00%	0
Engaging	0.00%	0
Intuitive	20.00%	1
TOTAL		5