Augmented Reality Activity Book

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Introduction

The need for a client

The project began a team effort to create an augmented reality children's book. However, the brief we received allowed for a great deal of flexibility. We could do any book for any age range on any topic. We could write the book ourselves, find a classic, partner with an author. To give us some kind of scope, we really needed to narrow down our focus. We began researching the effectiveness of augmented reality with reading as well as ebooks which are a precursor of this technology. Our findings indicate that introducing AR picture books or animated books too early can interfere with reading development and language acquisition. Therefore, we decided to narrow our age range to children who can already read so we picked ages eight to twelve.

Because there are ethical concerns from the university regarding testing children and none of us are experts in childhood literacy, we opted to partner with an educational organisation. This could have been a school or a charity that could provide us with guidance and set some parameters. Essentially, we needed them to act as our client. We found one in the form of a local children's literacy charity The Hackney Pirates.

The client: The Hackney Pirates

The Hackney Pirates are children's literacy charity in east London that helps students ages 8-12 who can already read but are at risk of falling behind. These students come from various schools in the borough and are referred to a weekly off-site program that not only catches them up, but according to the impact report (Hackney Pirates, 2017) often helps them surpass their peers. This programme has a pirate theme which proves highly engaging.

According to the Director of Learning, Lily Eastwood, they go on "pirate-themed reading adventures" and create their own stories of "beautifully insane writing" which go through rounds of editing until they become a book. This book is a major source of pride for the students. They offer several other activities throughout the year, including the book launch, plus radio and theatre activities. The goal is after the school year, students enter the next grade more confident in their reading and in themselves. Our final client is the Director of Education Lily Eastwood and our primary contact is session leader Aaron Piper.

Meet our Staff Team

Figures: Hackney Pirates cafe, workshop & team. Lily top middle; Aaron bottom right.

Our team

Amy Marie Phillips: Product owner and Researcher
Maintains the client relationship. Responsible for ensuring the experience meets the timeline, educational research, and client brief. Wrote the project documentation, research paper and the group paper.

Beth Green-Armytage: UX Lead
Responsible for the user experience and usability of the AR application. Utilising research and best practices for child-focused applications. Created user personas, user journeys, wireframes of the application, written content and printed book design.

Lizeng (Julia) Zhu: Content Designer and Animator
Lead on the content design and visual language. Responsible for the animatations, chapter icons and creation of the all target images.

Alex Wachsmann: Games Designer
Collaborates with both UX and games programming to ensure sound games design strategy. Responsible for games design document and overall concepting.

Philip Greene: Games Programmer and Technology Lead
Determined the technology to be used and how games should be implemented. Programmes half of the experiences

Alvin Wei: : Games Programmer and Scrum Master
Ensures that technology milestones are met. Implemented code reusability. Programmes half of the experiences.

Background

What is AR

Unlike virtual reality, which aims to immerse the user, augmented reality (AR) is a hybrid between the real world and the virtual in that the viewer can still see his or her space but also the interactive experience. “Augmented reality holds the promise of creating direct, automatic, and actionable links between the physical world and electronic information.” (Schmalstieg and Hollerer 2016). It requires a tracking component, a registration component and a visualisation component. It registers the user’s viewpoint in the real world (ie in proximity to the book, for example) and maps it to the virtual experience. To do this, most experiences need some sort of target image that triggers the AR software. Finally, to be considered AR, the experience must have interactivity, be both real and virtual, and have 3d elements.

Client project

The Hackney Pirates mandate is to “develop the literacy, confidence and perseverance of young people in Hackney, so they achieve both in school and in the world beyond.” (Hackney, 2017). They do this by giving them activities where they can challenge themselves and also produce a result they can be proud of. This includes a book they they write, publish, and launch, and our project was to “bring it to life” with augmented reality as a further tool for engagement.

Business case

Our timeline is rather tight, so it makes sense to align with an existing project instead of spending time creating an existing project. Because Hackney Pirates is a charity, they do not have the funds to do this kind of work on their own but would be able to use it to further engage and inspire the children. It is also a chance for our team, particularly the ones who have not done client work, to have the experience of 1. Working to client needs 2. Being guided by subject matter experts 3. Seeing their work go out to the public.

Project definition

Objective

To create an AR experience based on a book the Hackney Pirates is co-writing with local children. Their poems, stories and maps evoke a sense of place (places special to each child) and we will use them to bring their work to life using animation and gamification through an AR app.

Scope

Hackney Pirates has existing materials (and will be acquiring more), so Kingston students will not need to create a storyline from scratch but rather build on what they have. They also have some existing characters we may opt to use. It is important that we ensure each child feels like he or she has contributed and been able to see their part represented. There are roughly 120 child-written components.

Deliverables/ Interfaces
It is important that we create a finished product instead of a working prototype. This is the kind of project a child should be able to take away and show their family. The actual product form will be up to our group. In the past, they had a project using Blippar but it does not have to be that.

Constraints
The staff are quite busy, so while they are here to help us, we must be mindful of their time. We will need them for research, in particular, as we have an ethical board unlikely to approve research on minors.

Service journey

The AR book fits into a greater overall strategy by The Hackney Pirates. We have diagrammed it here for clarity.

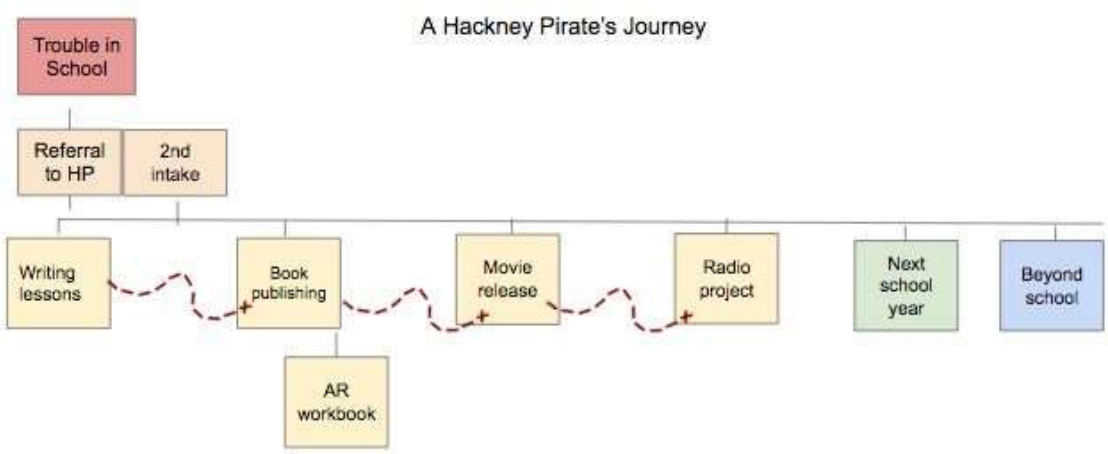


Figure: A student's journey through the Hackney Pirate program with the added component of the AR activity book.

Project management

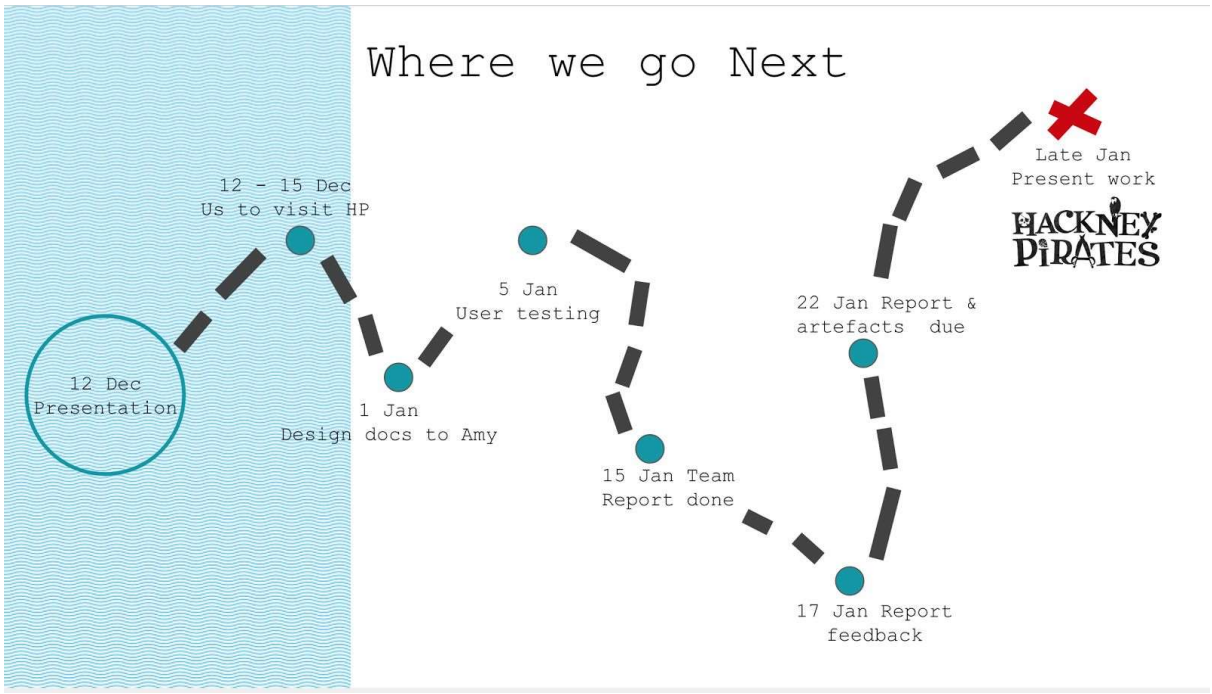


Figure: Somewhat ineffective pirate map project plan. Check the appendix for a detailed project timeline with timings of items due, who is responsible, and dates.

Methodology:
Most technology projects of this nature would use an agile methodology. However, an interesting component of this AR book is that it interfaced with a publishing deadline which is a very traditional waterfall style project. Their publishing date was fixed, and we could not progress without their book. Additionally, because not all the children enter the programme at the same time (there are two intakes), we were waiting for the second batch of children to complete their stories. Because the Hackney Pirates were waiting on stories, they did not know what the children were writing about in enough detail to determine the chapters. Without a chapter breakdown, we would struggle to know what games to do or how many intro animations would be needed. These constraints lead to a waterfall style project plan.

However, with several weeks downtime waiting for assets, we sought to leverage that time. We knew there would be at least five chapters and that we would have the quiz. Therefore, the programmers could begin building a basic structure to the game that would be iterated as we had more details. In the meantime, the others could do academic research, UX research, and early games design and animations with the existing assets. This was also an excellent time to start testing the technology and target imaging mechanism. This iterative pattern of working fits the definition of being agile, and thus our project was a combination of both traditional and agile methodology.

Changes in scope:
Originally part of the benefit to partnering with The Hackney Pirates was to leverage an existing book. Together we had planned to augment the book that the children were working

on to “bring it to life.’ This changed early on, however, because of our need to add better target images. We had seen some mock ups of their book and realised it wasn’t going to work. Previously, we had hoped that the letters of the work would be different enough to serve as a target. We then requested that the designer add a page at the end of each chapter for the target images. This was briefly agreed upon.

After The Hackney Pirates costed the freelance designer’s time to add pages and the printer’s fee, they realised it would be cheaper for us to create an “insert” to the book. As each chapter needed one of these inserts and we had already been compromising to fit each chapter onto a single page, our workbook idea was created. We have covered the cost of the initial ten workbooks which are to be split between our team and the Hackney Pirates. After that, we will provide the digital file and they will decide how many they will need, how to distribute them, and if they will charge for them as an item in their shop. They plan to have one attached to a display with a tablet so that anyone can come in and use it regardless of whether they own a device.

While initially, it was disappointing not to augment their actual book, as our research had indicated an advantage of AR would be to have their book visible throughout the experience, there has been a clear benefit. If we had target image in the book when it launched in early December, we believe it would have detracted from the print book. They had all of their holiday break to read to the book whereas they might have been more inclined to be playing the games. Additionally, the games would not have been ready that early, so having a negative experience would have caused people not to come back when the whole experience was ready. By our printing the workbook, we were able to do more target images, control the entire look, and have more time to create the games and overall experience. It still tie back to the original book much like a workbook accompanies a textbook.

Tools:
We used a Trello as a way to provide visibility of what everyone was working on as well as Slack, Whatsapp and email. Shared documents lived in Google drive so that multiple people could work on the same one. Slack proved least effective for communication because people prefer email and messaging apps. We used Whatsapp for urgent needs and email for topics that we wanted in writing. In future projects, we would revert back to Slack and perhaps use to for a combination of the two uses. It probably would just take some dedication and getting used to to properly implement Slack.

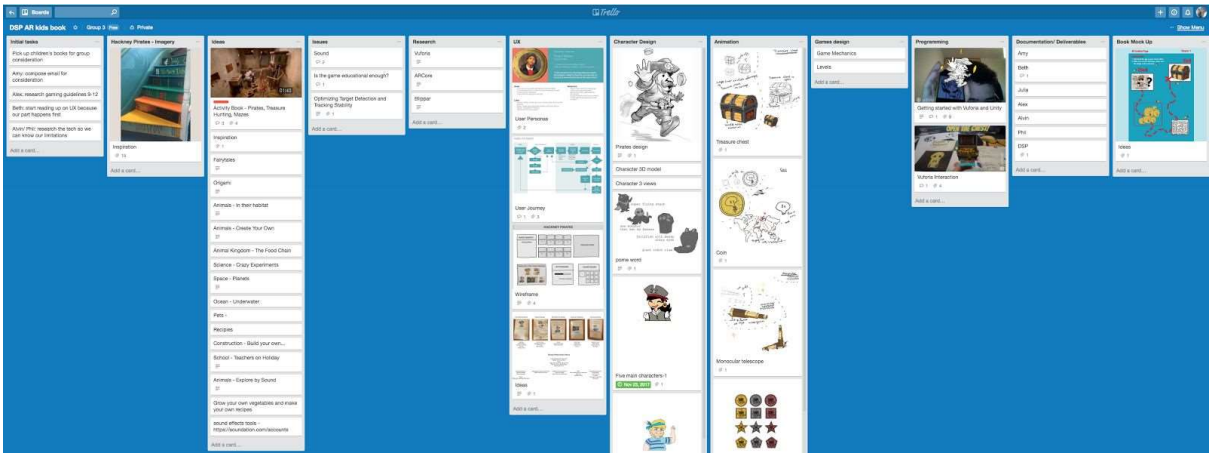


Figure: Screen capture of Trello board

Research

As this was an academic project, The Hackney Pirates were flexible in most factors relating to the AR book. Together we devised the following success criteria as part of the project brief.

1. **Representation:** We must ensure each child feels like he or she has contributed and be able to see their part represented. There are roughly 120 components including poems, stories, and maps, so grouping will be key. Additionally, there are two cohort intakes, one which starts later, close to the deadline.
2. **Engagement:** This product should enhance their learning and continue to make reading fun for them. It should not detract from their stories but rather encourage them to keep wanting to read and write and find their voice. One way to do that will be through continuing with their sense of ownership.
3. **Multidisciplinary:** It should rely on solid academic research, UX research, custom animation concepts with games design strategies and using our technology expertise.

In developing the AR activity book project, the group also sought to answer the following research questions:

1. How can AR be used to enhance children's engagement when reading their own/ their peers' writing?
2. How can animations and gamification be added to the AR experience in a way that encourages learning?
3. What pedagogical concepts are most useful in guiding the AR experience for improved literacy in children?

To answer these questions, we looked AR best practices, particularly in training and education, ebooks, educational ICT which contained some overall best practices with education and technology, and finally pedagogical research into literacy, reading comprehension and language acquisition.

In the appendix is a shorter list of key research takeaways that was distributed amongst the team for an overview and quick implementation within their individual components.

AR in education

While there is some concern in the educational community that AR is successful in learning because of a novelty effect (Akcayir 2017), most early research has been positive. A useful feature of AR is to allow for highly interactive experiences within the learning environment in a way that provides context (Wu et al, 2014). Wu goes on to say that educational AR is not just using AR in an educational setting but the implementation and integration of AR in to the learning environment itself.

AR books are similar to print books except that virtual images are superimposed on the pages which can enhance the experience (Billinghurst and Dunser, 2012). They go on to say how AR can be added to pre-existing material, which was the original intent of The Hackney Pirate project, and can provide contextual content to the to lesson.

AR has been successful in:
Enabling users to express new identities through role-playing and to explore a real site by interacting between both the real and augmented world (Lee, 2012).

Providing contextually-relevant content to the learner in a digital narrative that supports motivation and social collaboration (Laine et al, 2016).
Creating a scientific environment outside a school environment and bridging the real and virtual content (Laine et al, 2016).

AR can be used to both hide objects from a user's sight or highlight objects to him (Ioannides et al, 2017)

The main benefits of AR are learning gains, motivation, interaction, and collaboration while the main limitations are maintaining the information, paying too much attention on the virtual aspects and AR being intrusive to some people (Bacca et al, 2014).

Best practices:
*A key for immersive learning is to provide "**authentic explorations within the real world**" (Dede, 2009).

***Gradual immersion method (GIM)** consisting of three increasing models to ease the user from 2D to 3D to AR (Sanabria and Aramburo-Lizarraga, 2017).

***Scaffolding** which can mean providing instructions in between interactions (Iannides et al, 2017)

***Affordances:** authenticity, collaboration, community, connectivity, exploration, multisensory, shared knowledge, and student-centred (Sheehy, 2014).

***Giving time to complete tasks** particularly in allowing more time to read instructions or to go back and read them for children with learning disabilities (Lin et al, 2016)

***Work with existing topics** that children are already aware of an have an interest in (Suarez-Warden and Barrera, 2017)

Animation in e-books:
We know that animated cartoons can increase students' knowledge and understanding of scientific concepts (Dalacosta et al 2009). It can help with help with gaining attention, cueing focus, and presenting information as well as being useful in transitioning topics. In e-books, for example, animated pictures can help learners match non-verbal information with the story to facilitate story comprehension (Schnotz and Rasch, 2005). A well-balanced video storybook (in terms of both sound and animations) has been found to help children stay more attentive, particularly in subsequent readings. (Verhallen & Bus, 2009) Using animated

storybooks with well-implemented standalone technology can have an added benefit for vulnerable and at risk children by improving learning conditions (Bus, Takacs and Kegel 2015).

Learners use animations to gain knowledge by extracting pieces of it, particularly interesting details, and adding what they already know (Lowe, 2003). We leverage this by the chapter introductions. The student will see a map, a continent, a relevant animal and plant to the place.

However, animations can cause cognitive overload (De Koning et ll, 2007), particularly with less visually developed (Hoffler, Prechtl and Nerdel 2010) or younger learners (Dalacosta, et al 2009). We can avoid this, or at least mitigate it, by designing animations that are less demanding or by cueing. De Koning et al 2007). One way to do this is to indicate arrows or markers to help the learner find the animation so they are not already cognitively taxed before the animation begins.

Gamification in education:

Gaming can be useful for students for increasing cognitive functions such as memory, visual perception and sequencing (Martinovic et ll, 2014). Martinovic draws the distinction however, with it being “purposeful playing.” He sites how even action games can help in cognitive functions as they contain planning, decision-making, and logical reasoning.

Children to better with digital games when they have a supportive, tech savvy adult. This is such the case that when testing children in a lab, researchers find the presence of themselves can alter the student’s enjoyment and intrinsic motivation in the learning process. (All et al, 2016).

Games can aid in engagement and understanding of the curriculum (Griffin and Butler, 2005). An example is games helped students in Indonesia remembering difficult subjects, such as names and events in history (Chowanda and Chowanda 2016). Games can be used to provide context and aid in learner’s understanding. The games designer must decide if the game itself is doing the teaching or if the teaching comes about from the activity itself (Branco et al, nd).

While much is said about video game theory, board games, sports and other traditional games show good examples of game theory and design and should not be overlooked (Barba et al 2009). Traditional games such as bingo have been useful in reading skills (Sella et al 2016) In designing the multiple choice quiz, for example, we consider non-digital games design theory.

Leaderboards are coming gamification tactics. However, in reading both leaderboards and goal setting as competition can be stressful. More effective is in self pacing, avatars awarding status and tracking one’s own progress (Wehbe et al 2014). Rewards, in general, only serve to promote longer reading initially but the effects wear off over time (Ronimus et al, 2014). Some best practices in games include: quest-based learning, use of narrative and themes, Bloom’s taxonomy (Level 1: Remember, understand, apply. Level 2: Analyze and evaluate. Level 3: create), and considering failure as a second chance. Badges,

achievements, and awards can be useful, but the biggest effect on whether a game is engaging in an educational setting is if the curriculum itself is interesting to begin with (Kingsley and Grabner-Hagen, 2017).

Finally, a strategy for games design can be to aid in students' meta-cognition. Metacognition is the awareness and understanding of one's own thought process through: self-planning, self-monitoring, and self-evaluation (Kim, Park and Baek, 2009). This manifests itself in problem-solving and decision-making in games. In the case of The Hackney Pirates AR workbook, the students have choices to make in the crazy maze to do it as fast as possible to try to gain as many coins as possible or some combination of the two.

Educational ICT

The goal of bring technology in education in to be useful pedagogically, not just be be impressive. (Haydn 2013). We thus choose to implement AR into this book as a means for learning and engagement and not just because we can noting that the device is the tool not the teaching. In particular, technology should be supplementing reading as demonstrated by (Bromley 2012) who goes on a journey of discovery using a smartphone to get more information.

Technology can be distracting if not done correctly. Music and sounds in interactive experiences can be particularly distracting and many are not adjustable (Smeets & Bus 2013).

The role of parent or teacher in implementing the technology for learning is crucial as parental attitudes toward technology greatly affect learning outcomes. (Vanderlinde 2014) Even more so, the behavioral pattern between the parent and child, for example reading an AR book, shows that the interactions which are child-lead instead of parent-lead (ie the child is setting the pace and the interactions) is substantially more effective for cognitive attainment (Cheng et al 2016). The difference between ICT at home versus school has to do with the level of structure, especially when not supported by the parents (Somekh 2010). Somekh goes on to describe the "second digital divide" where teachers might avoid asking children to use technology outside the classroom in case the children do not have proper access. However, the more technologically advanced students will be using the technology for their schoolwork, even if it is not assigned, thus further putting the other students at a disadvantage. For these reasons, we look to implement technology that can be simple to use and handled by the students without adult help but that will also be fun to use with adults. This is so important that we made it a secondary persona after the student.

Technology in education can level the playing field among users if there is an inclusive access to devices. Experiences like AR in a diverse group of learners can provide social engagement, present material in another format, and provide authentic activities (Sheehy et al, 2014).

Pedagogy: Engagement and motivation for literacy

Finally, for our AR book experience to be most effective for learning comprehension, we examined general pedagogical best practices for engaging and motivation young learners. We also sought to support the qualities laid out in the Framework for 21st Century Learning: creativity, innovation, critical thinking and problem-solving. (Partnership for 21st Century Learning, 2007)

Best practices:
Kinesthetic representation (having students move) (Marzano, 2010).
Provide **collaboration, choice and challenge** (Parsons et al, 2015).
Tasks should be **personally meaningful** (DeLay, 1996)
Experiences become memorable when they are **tactile** (Purcell, 2014)
Give children a **role** to play (Starke, 2012)
Include a **paper-based** aid (Fiorella, 2012)

Method

User experience research & design (UX)

The User
Meetings were held with the stakeholders at Hackney Pirates to gain a solid understanding of the business aims and ethos as well as establishing user personas. With iterations, the primary user persona Victor was created, serving as an archetype of Hackney Pirates and a central reference point when making design decisions. Secondary personas of staff and guardians were also made, as they would be users of the application.

Primary Persona

Victor Walker

Pupil/Pirate

11 years old at secondary school
Attends Hackney Pirates once a week

"I like adventurous learning because people find English really boring but you can also do work and have adventures at the same time"

Goals

- To be proud of his work, sharing with friends & family
- To be entertained and to have fun with something he made
- To see his work come alive
- To get better at reading and writing

Likes

- General - Ninja Turtles, rap music, football, jokes, silly voices & drawing
- Books – Beast Quest, Kensuke's Kingdom & Horrid Henry
- Games – Minecraft & Pokemon

Behaviors

- Doesn't have time for boring things
- Likes to be surprised & scared
- Spends lots of time playing games with friends
- Can get frustrated with communication
- Occasionally finds being patient hard
- Energetic

Figure: Primary User Persona

Carol Innis

Parent/Guardian

40 years old
Working Mum with two children

"Sonny has improved in his level in reading and is more confident. I am grateful that his teacher suggested the Pirates. It's more than an after school club "

Goals

- To see her child's reading and writing improve
- To see her child's confidence grow
- To see her child proud of his achievements
- To see her child happy and making friends
- To be safe environment (physically & digitally)

Behaviors

- Local busy mum
- Tech savvy although tries to limit her children's time online
- Community spirited
- Strict with her children during the school week

Pain Points

- Finds getting her children to read a challenge, especially at the end of the day
- Thinks her children spends too much time online
- Sometimes compares herself to other mums

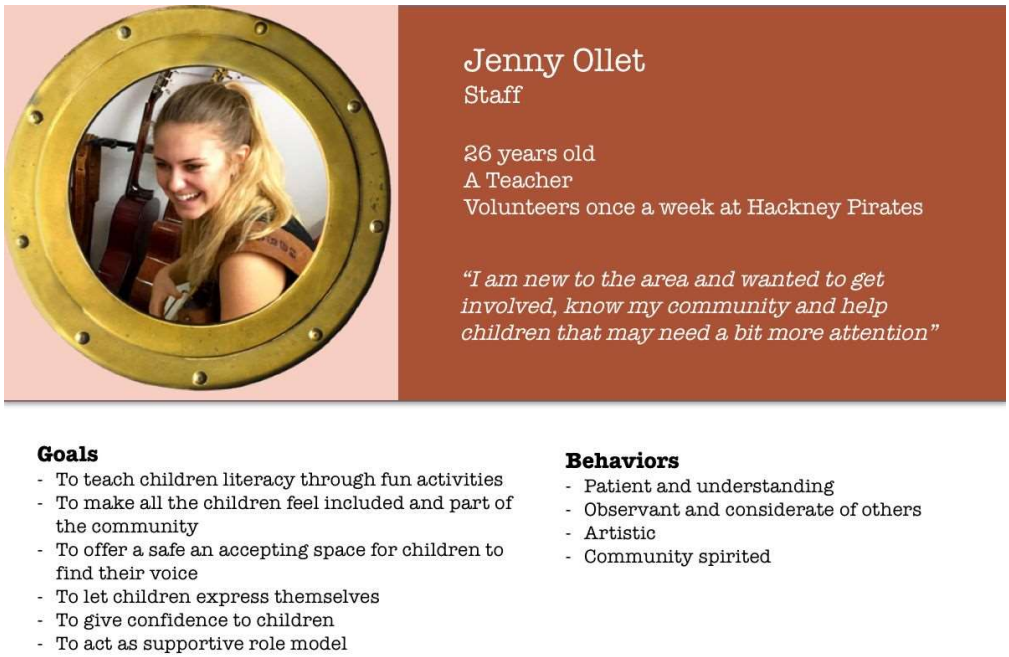


Figure: Secondary Personas

Materials:

With the presence of three physical objects; the main story book (produced by the stakeholders), the AR activity book and the tablet containing the app, navigation and interaction between these were important challenges and considerations to ensure this 'multi-tasking' would not take away from, but enhance the digital experience and interactions in the content and gameplay. Simple, but effective design decisions were made such as printing the activity book using a 'wire o' binding that kept the book flat when open on a table enabling one hand to turn a page, whilst the other remains holding the tablet. This also assisted with the technology, where image targets triggering AR are best when completely flat without a slight curve that is common in traditional bound books. The hardware was too selected to ease navigation between the physical objects and a small Android 9 inch tablet was chosen in order for the children to comfortably hold it with one hand when necessary.

Style:

Through discussion, it was discovered the Hackney Pirates did not keep a style guide, but rather five ambassador pirates that emulate their core values, e.g., Persevering Polly. Aside from the inclusion of these characters, we were to have free reign for the design of the app, the physical activity book and the AR interactions.

The Pirate's headquarters in north London is an inspirational place, bursting with colour, creativity and playfulness, so keeping this aesthetic was key. Alongside this, a decision was made to use elements from the main story book (that was designed by an outsourced graphic designer) in order to maintain a visual connection between all the components. A style guide was created to give direction and inspiration throughout the design process.

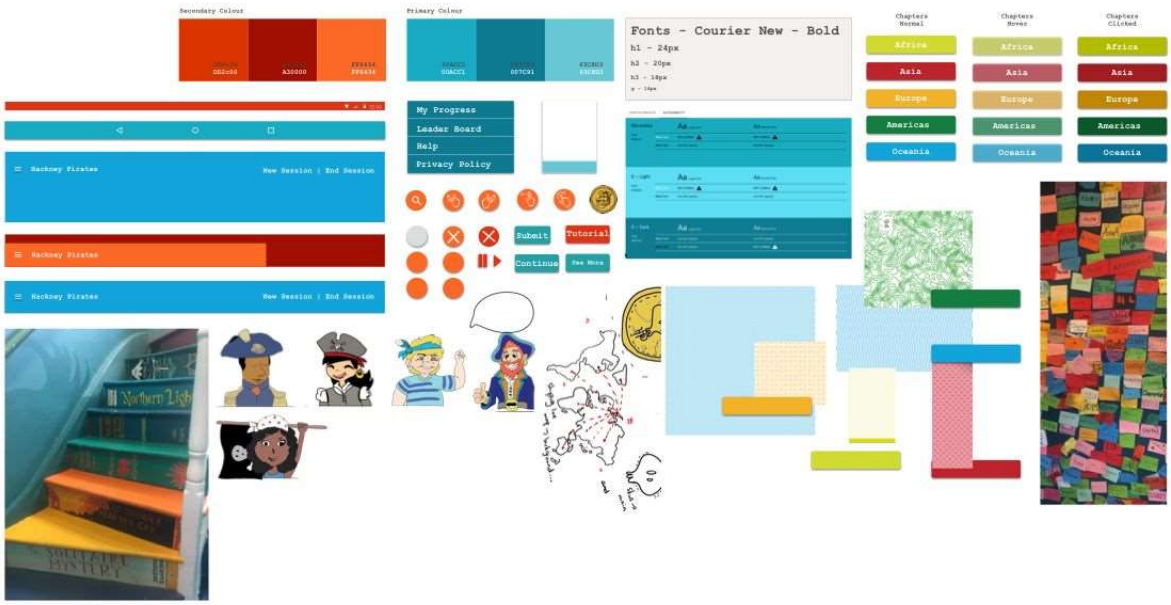


Figure: Style Guide

Design Principles:

Children between 7 – 12 years old are considered to understand and be capable interacting with digital environments and the notation of metaphors compared to their younger compatriots (Nam, H., 2010). In order to create a successful experience Nam suggests limiting interaction design rather than creating brand new interactions that would increase the learning curve, not only for the children, but the adult too, who may be needed for assistance (2010). If the adult can effectively use the application, this has a positive impact on the child's success and engagement. The key idea being, keep the interaction design simple using prior metal models, which is a notion that is repeated throughout literature on design guidelines including Norman's book the Design of Everyday Things (1998) and Schniederman's Golden Rules (Dix, A., et al., 2004. p283) regardless of the age of the end user.

Applying this to the design, the application kept a simple homepage layout with the left-hand area designated to help and assistance and the main content taking the remaining two thirds. This layout includes familiar elements for those that are frequent and act as a 'safe space' before new interactions are experienced through the AR interface.

The design of the physical book, also followed a simple layout with one image/AR target per page and written instructions at the start to give the user the basic necessary knowledge. Written, paper instructions are also said to be effective when used with technology. We would have written instructions throughout the book for each activity however, due to schedules of printing, we included these in the application.

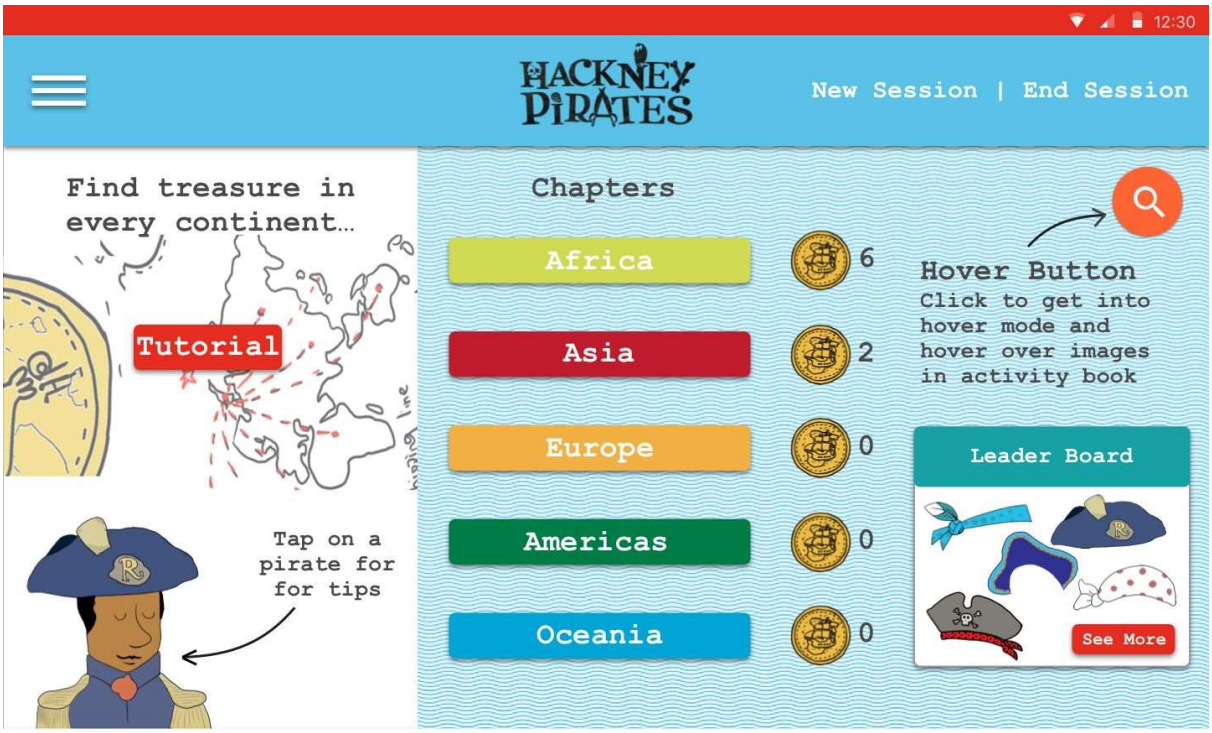


Figure: 4 App Homepage

The app endeavoured to keep in-line with traditional design principles applicable to graphical user interfaces (GUI) to promote learnability, flexibility and robustness (Dix, A., et al., 2004. p261) which, coupled with iterations and testing leads to an effective, efficient and satisfying experience for the user, (Tullis, T. & Albert, B. 2008. p8) the fundamental objective of the project. One focus of the project was the inclusion of AR so research into designing for human-computer interactions through AR were made and key findings applied and combined with GUI design.

The Nielson Norman Group suggests that AR effects the user experience in three ways: i) decreasing interactive costs ii) decreasing cognitive load iii) decreasing attention switching (Li, A. & Fessenden, T. 2016). This can be true for AR as a single interaction, however, this project combines and incorporates AR with the aid of books and an application, so the challenge was to unite all interactions to produce a meaningful and rounded experience. This was partly achieved through the content of the activities selected such as general knowledge on the contents and memory games and, using their work as interactive questions that would also encourage reading engagement.

Although AR is becoming more prevalent in the everyday, there has yet to been a widely accepted set of design principles targeted solely toward this technology. Rather designs have been based on principles and metaphors of traditional GUI and not till after, within iteration phases, are adaptations and new metaphors made for the new interface (Billinghurst et al., 2005).

Billinghurst et al., looked into this lack of progression through the abilities to modify/interact with the AR objects, and researched design principles that would allow for intuitive interfaces. By creating a physical object (with sensors) so that a virtual object is manipulated through the interaction with the physical object, he looks at bridging the gap between virtual and real. Billinghurst coins the phrase 'Tangible AR' (2005) which combines

principles of GUI and Tangible User Interfaces (TUI) including: support for spatial 3D interaction techniques; multi-handed interaction; and matching the interface object affordances to the task requirements (Billinghurst et al., 2005) to result in a step closer to a seamless interaction with a virtual object. TUI was a term first introduced by Hiroshi Ishii at the MIT Media Lab exploring the idea of creating and manipulating physical digital bits that graphical user interfaces are incapable of (MIT Media Lab. 2017).

The physical activity book used in this project, was not manipulated to the extent of Billinghurst's projects, but the interactions devised through the AR gameplay, such as the maze where the user moves the physical book into order to move the virtual ball, lends itself toward TUI and with developments and iterations further interactions such as these will be included in the app.

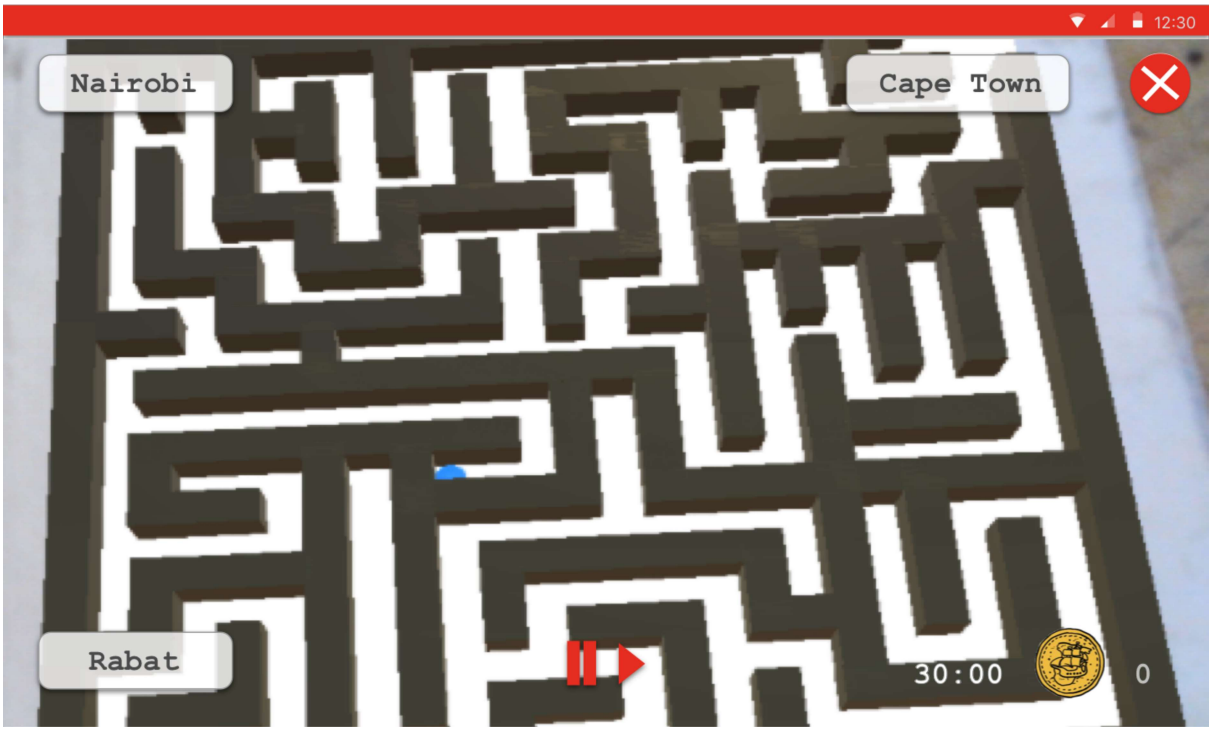


Figure: The Maze Interface

In another study, the evaluation of three AR games, Wetzel et al., concludes with a set of guidelines to aid success in order to prevent the technology overtaking design and experience aspects due to the novelty factor which is common place (2008). In the guidelines, it is advised that not all interactions need to solely be in AR, but that a combination on physical and digital objects (Wetzel et al., 2008) tend to be more successful. With the user having to use the physical book to work through and trigger the AR interactions, a more meaningful and engaging experience is formed. This echoes the sentiment found in earlier research that paper based instruction is effective for student attention.

Meta, a company based in Silicon Valley has been working with AR and hologram since 2012 and have created a set of design ideas to support 'Spatial Interface Design' (Meta. 2017) for this emerging technology. Although, the Hackney Pirates is a handheld tablet based project, many of the ideas from Meta were used as inspiration as a way to rethink traditional 2D/flat GUI design principles. Key findings from Meta were:

- Introducing new tools and metaphors will need to be considered carefully as prior mental models assist in reducing the learning curve described as 'The Neural Path of Least Resistance'
- Place tools and contents in space around the user
- Distinguish between tools that the user interacts with and content
- Always try to use hand manipulation rather than buttons
- Avoid flat icons and use physical characteristics that mimics the objects in real life to aid affordance
- Miniaturize content and tools in order for greater exploration
- Use the 3D environment rather than nested menus
- Use sound effects, lighting effects, glowing or visual cues for feedback
- Avoid distortion or blocking of user's reality, rather overlay metadata to enhance reality

Online style guidelines for designing apps were also consulted during the design phase such as the android material guides where design principles are based on the metaphor of paper and ink (Material Design, 2017) with emphasis on shadows, light and dimensions of to enhance affordance and feedback.

Design Decisions:
With gained AR knowledge, online design guidelines and GUI principles, a summary of key design decisions using the heuristics from Schniederman's eight rules and Nielson's evaluation heuristics (Preece et al., 2016. p507) have been made.

Simplicity and Consistency
The style guide, created for the project, allowed for consistent design across the app and the physical book. Colours were established where the blue hues represented navigation and the orange with interaction points. This colour system aided with principle of synthesizability and learnability; how the user assesses/understands the current state of the system using the knowledge previous actions (Dix. et al., 2004 p261). The activity book was designed to include two games, two animations and two quizzes for each of the continent chapters. With five chapters in total, this meant that the interactions would be many and varied, so colour played a vital role.

Figure: Icon Set

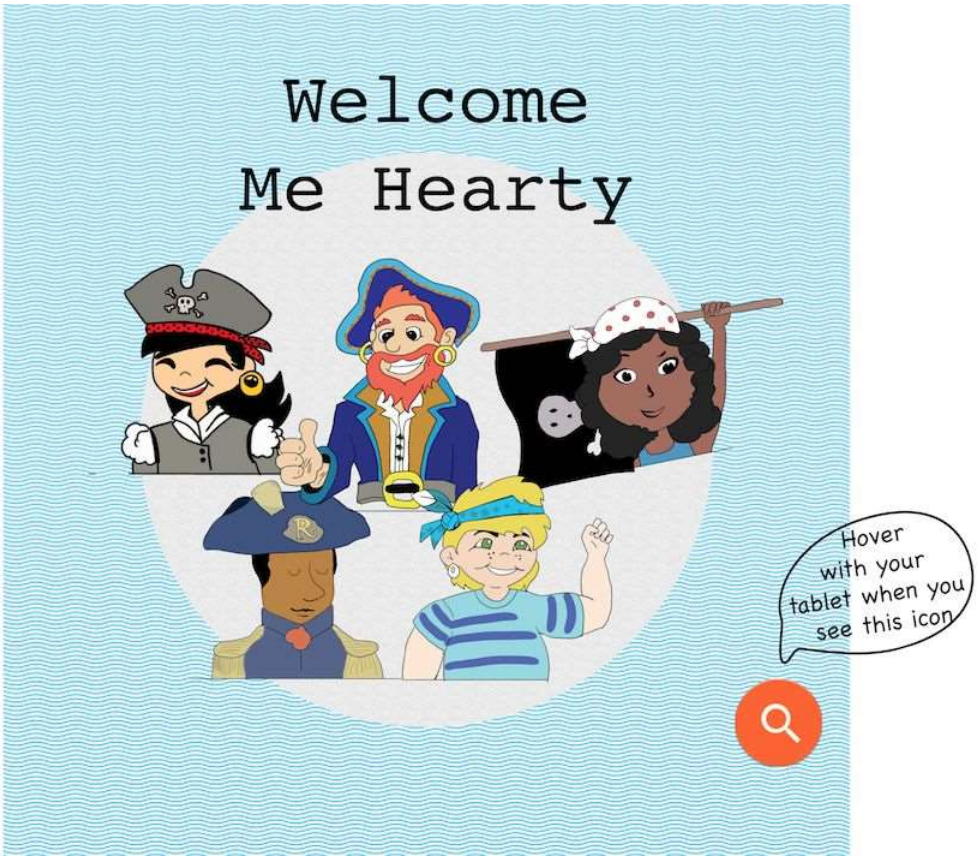


Figure: Example Activity Book Page

Universal Usability:
Help features and a tutorial button were placed on the homepage to enable those with lesser digital skills to quickly and easily adapt to the new interface. Once the user navigated away from the homepage, the ambassador pirates were used in a way to give tips when tapped on, as well as encouraging the user throughout the activities.

Established design elements such as the three-horizontal bar menu, was included to aid navigation and was a feature the users were likely used to. At all points, if the main navigation bar was absent (during the AR interaction), a large red button was always visible in the top right-hand corner of the page to allow the user to exit the current page and return to the homepage.

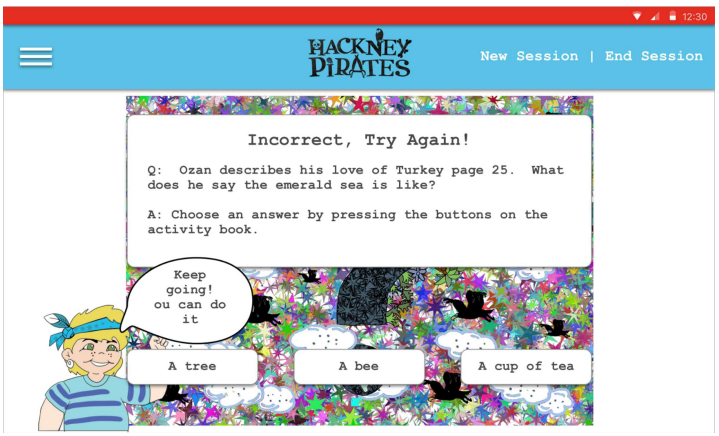


Figure: 8 Quiz

Feedback and Dialogs:
The use of colour changes and shadows were implemented one way to suggest affordance and to give the user feedback. Another method was the introduction of dialog boxes to guide the user through the activities as well as for the quizzes themselves. Although, this method of interaction has been considered less flexible/popular with users (Dix. et al., 2004. p266), it was a way to keep the user flowing through the activities between the more freer interactions, as well as helping with error prevention. At the end of each game, a dialog box appears to let the user know how many points they earnt and the button to continue with the next activity. If they decided to return to the homepage, their points were updated next to the coin of the continent they were currently in.

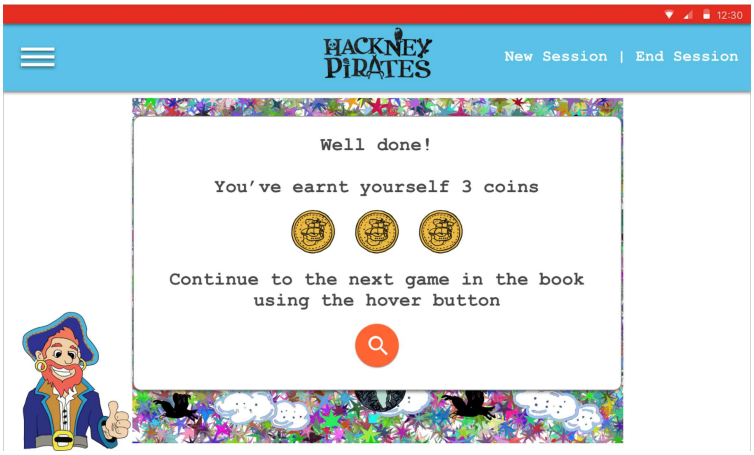


Figure: 9 End Game Dialog Box

Replicating the Real World:
The project was based around stories and books so swiping motions icons were used to continue to the next page, as a way of replicating page turning, an improvement on a simple button. The globe illustration will be used as the main menu for the user to select a continent to enter. Through an icon suggesting a swiping motion, the globe will turn which mimics the affordances of a real-life globe. The waterfall collecting coin game includes right and left buttons for interactions during the game. However, as we have more iterations to come, ideally the user would swipe in an upward motion on the barriers to have more flexibility and control.

Figure: 9 Real World Metaphors

Control and Reversibility:
We endeavoured to make the app an explorative space, allowing the user to enter any continent at any time, rather than controlling a rigid order of play (originally considered). This reflects the spirit of AR - a discoverable and enhancing technology.

Privacy and Safety:
This project was centered around children aged between 9 – 12 years using an app accessed from the Google Play store. Child safety and privacy was essential to all those involved including the children themselves, the Hackney Pirates and the parents and guardians.

Looking to established and respected brands as well as government guidelines for the under 13's, we found a few key aspects that caused us to make changes.

The USA has a government body called COPPA (Children's Online Privacy Protection Act. 1998) which gives a comprehensive guide to protecting children online using mobile applications. It states if a child is under 13 and any personal information is requested, parental consent must be collected (iubenda. 2017). This included images that a child could be recognised. As we originally had a leaderboard where images of the children with pirate hats were posted, we made a change to allow for the selfie to be taken and saved to the device, but not to publicly post them. Although this was an American site, a decision was made, to not take chances.

Returning to the UK, the government website also provides essential safety measures and urges that applications for under 13's to be created as a 'walled garden environment' (Gov.UK 2016) to provide an extra level of safety. This was relayed to the programmers of the project.

As a way for the children to upload their scores and leave the game, we originally considered the possibility of a signing in feature which would also allow for them to return to the app where they left off last. However, as this would mean storing personal data, a decision was made to enable the function of 'new session' and 'end session', where the child enters their first name before they leave which, along with the score gets posted on the

leaderboard before setting the score to 0 for a new player.

As an addition to the app, a privacy policy was put in place as a way for the group to be transparent and to assure staff, parents and guardians of their child's safety.

Rules:
Researching further into children's safety, many sites such as Snapchat and Penguin Club have a rules and tools page. As some of our interactions will allow for text input from the children (currently only the entering of a first name), a set of rules were established to let the children know what language was and was not acceptable as well as reinforcing the values of the Hackney Pirates. This was added onto the privacy policy and help pages.

Design

Game design & mechanics

Game System: Android Tablet
PEGI 9 Rating
Prototype link: https://invis.io/ERFFM1YD7SU

Game outline:
The children AR book consist of several chapters: all with gameplay and animation scenes. It begins with the player selecting the first chapter and being greeted by their pirate captain explaining the quest they are about to embark on.

The children, with the help of the story and maps they have created, are being ordered by the captain to collect as many coins as they can in order to unlock the mystery treasure chest at the end of the game.

The game has three factors: The Goal, the journey and the achievement. The goal is set as the children are asked to select a pirate hat of their chosen which they would like to unlock meaning they have set themselves a goal to unlock the hat. The journey begins as the children set sail to different continents embarking on different quests collecting coins through answering quiz based on the stories the children have written about and coin collecting challenges. The achievement is set as the children's journey comes to an end and the have completed their quest and at last get to unlock the mystery treasure chest with their chosen hat.

The player will face multiple challenges that requires their full attention to the game environment and task that have been set to them as the aim for the game is to not only test the children's literacy skills but also their drive e.g. their rapidity such as 'how much time to they take on each chapter/game', 'which literacy game are they quicker at and which game are they fastest". We want to give the children a sense of ownership as this game is created through their stories.

Gameplay:

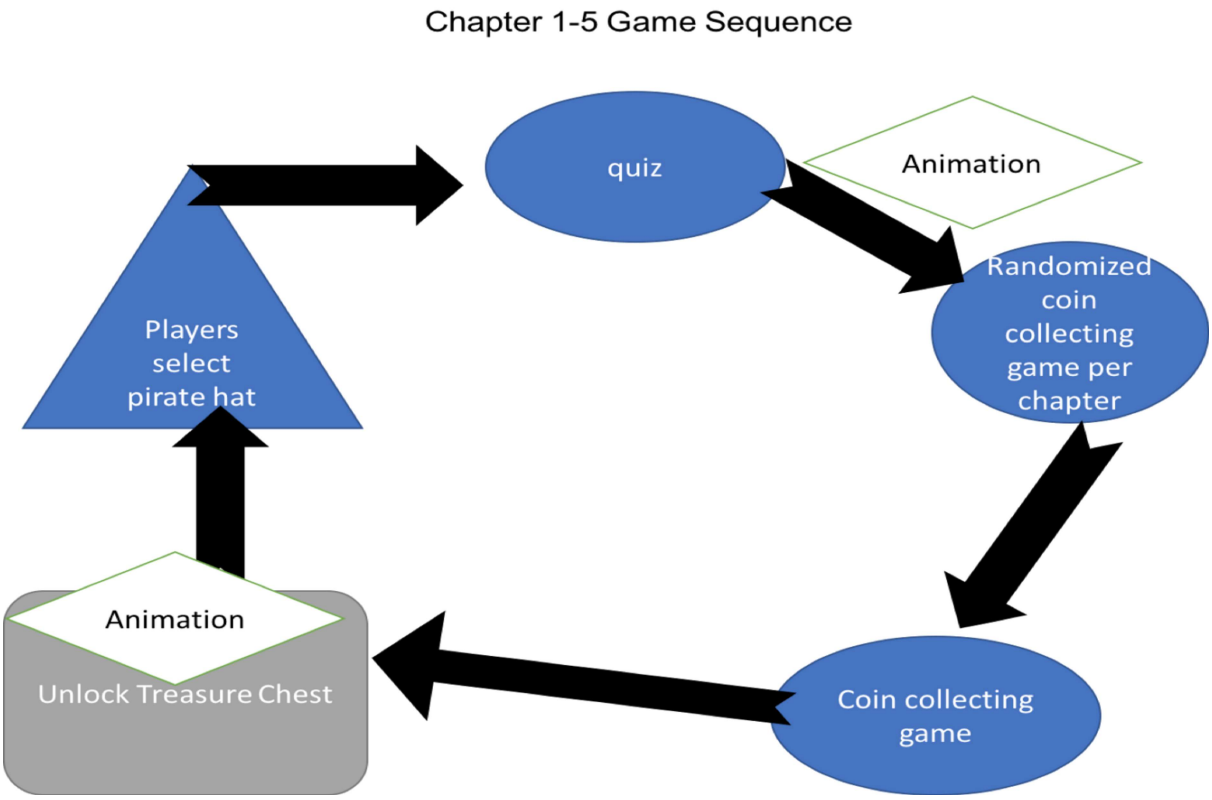


Figure:Gameplay flow across chapters

Our game is divided in 5 chapters, each having a specific element to it based on places that have been specified by the children in the story book. Those places include: Africa, Europe, Asia, Americas and Oceania. The game will test the children's knowledge as they embark on their quest to reach the treasure chest unlocking the hidden treasure.

The game starts off by allowing the children to select one of the five pirate hats which, they would like to unlock from the treasure chest. The game has animated scenes spread through the chapters bringing the children's story and the game world to life. As the game is an augmented reality game, the front and back camera of the tablet are put into use in order to play the game as the player will make use of a target which, will not only be used to display the game world, but also to be used as a tool (controller) in several gameplays.

Each chapter has the same layout, for example:
Chapter 2 Asia: This chapter will have elements of Asia and the countries within the continent. As every chapter, this chapter consist of 1 animated scene, 1 quiz and 2 games.
The layout will be as follows:
Animation: Animation of Asia
Quiz: (question Based on book)
Game 1: Coin collection – fishing: a coin collecting Game where the player has 30 Seconds to catch as many fishes from the water collecting 1 coin per fish.
Quiz -Multiple Choice Question; (Based on the continent)
Game 2: Coin Collecting – Fixing leaked ship: The player will have 30 seconds to fix as many leaked on the ship as they can each fixed leak will get the player one coin.

Figure: Target for fishing Game

Figure: Target for 'Fixing leaked ship' game

Each game in each chapter has a purpose in terms of giving the children not only title of a pirate every chapter represents the journey they go through but also, making it challenging

enough for them to push themselves to aim higher in regards to collecting more coins then, either they previous had or could get at the current moment they're playing the game.

Game Mechanics:

Choosing the right game mechanics was vital, we wanted to ensure the children have as much interaction with the game as possible. We decided the children have full control through the device and through the target images. In this game, there are two sets of mechanics: pressing/touching a button on the device in order for the game to do something and moving the target/ make use of a virtual button to interact virtually with the game world.

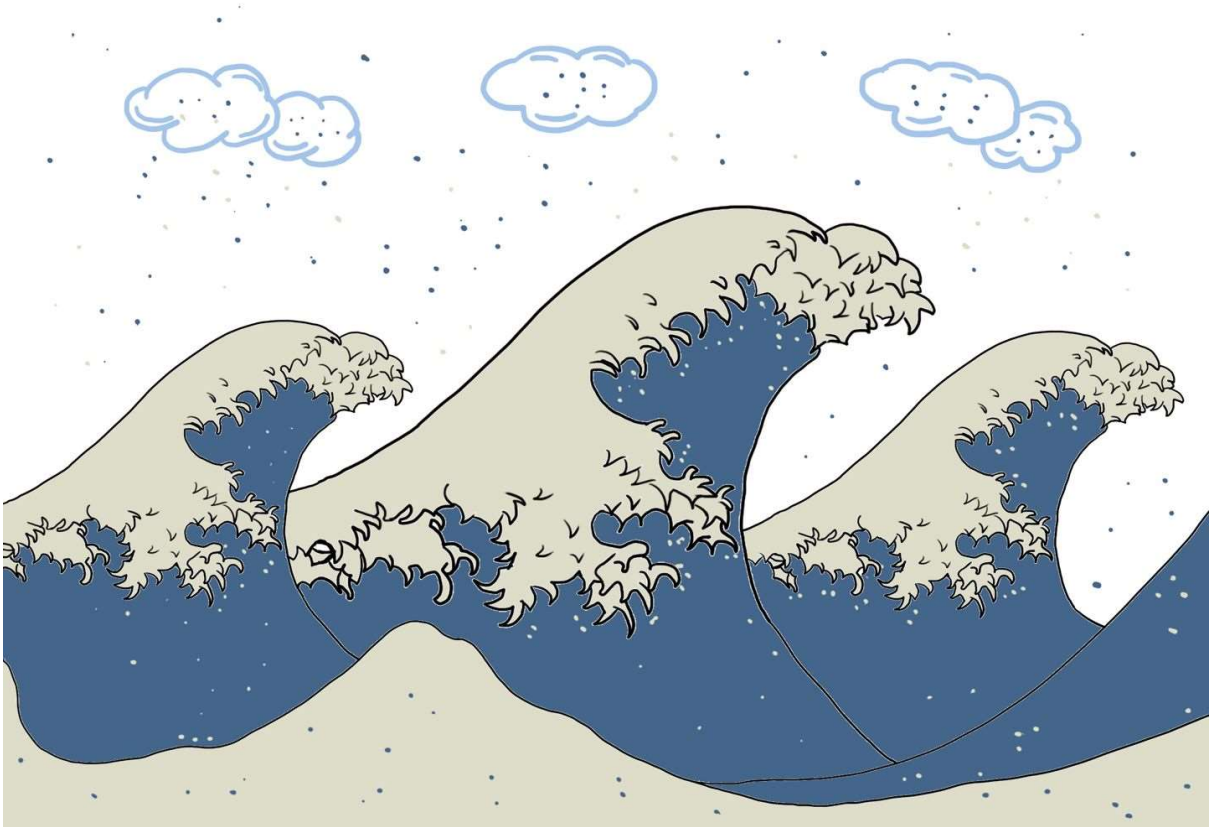


Figure: Waterfall Target image

The target image acts as an interactive platform where the player makes use of it in order to aid with the gameplay such as:

With the Waterfall game the player will now make use of the device itself using the button, as the player presses the button each wall will rise and decline.

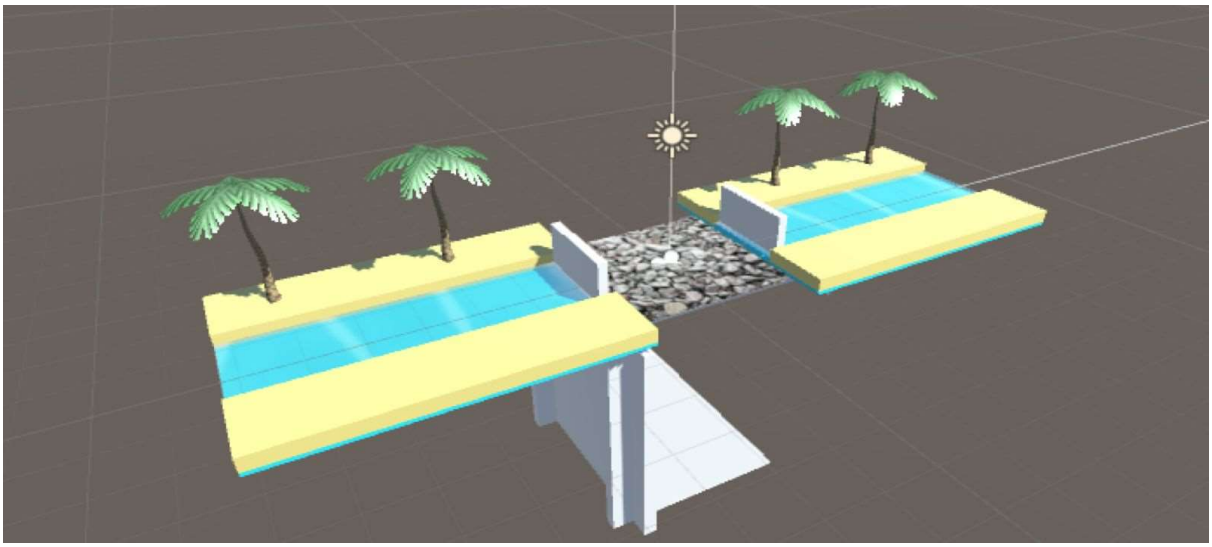


Figure: Waterfall game 3d structure

Game Experience:

As the game is a pirate themed game and the stories are based on different continents the children have written about, we ensured to include as many elements from these continents as possible in terms of sound, animation, game world and gameplay. We have come to the conclusion that sound for the game is a main factor in the game reason being is that the sound has to be coherent with each chapter. Each chapter has its own unique sound based on the continents e.g. Africa – Talking Drum (an hour-shaped drum).

The game not only brings the children game to life and allow them to relive their stories, but it also allows them to be a part of it. As the children will be collecting not only coins to unlock the treasure chest, but also stickers that they have created themselves enabling them to customise their hat and taking a selfie with it giving them the experience of being a pirate and a sense of achievement.

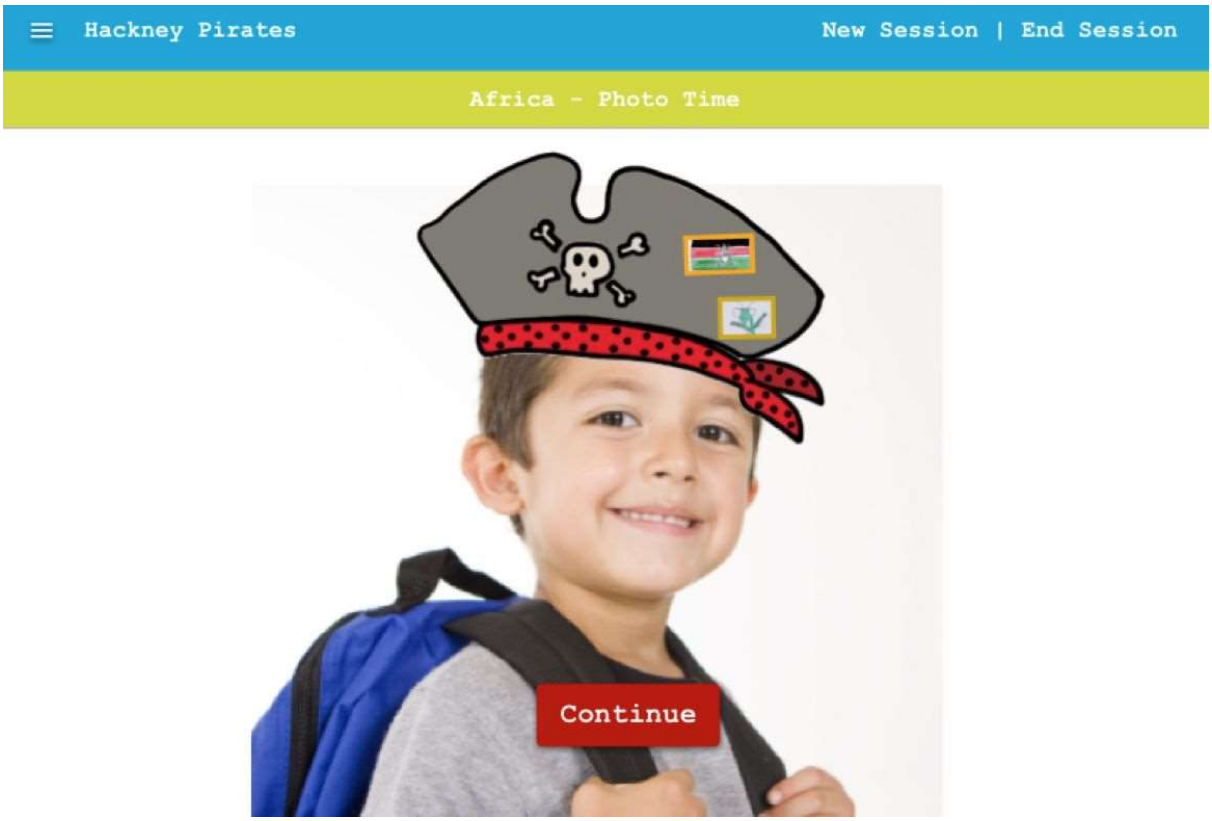


Figure: Young student selfie with the pirate hat prize.

Reflective Comments:
As the Game Designer/Design Lead, I have been put in charge in identifying the core mechanics of the game which was one of the important fundamental of the game allowing the children to have enough interaction within the AR world.

The challenges around game designing for education/children is that the game corresponds to the age group for example a game that targets children between the ages of 5-10 the level or in better terms 'difficulty' level needs to fall in line for children between those ages as a child that is 10 may have less difficulty playing the game than a child that is 5.

If having the opportunity to design another game with the likes of this if time and budget weren't put into consideration, the things I would have done differently would be clearly mapping out what game mechanics allow for a more interactive feeling for the children in terms of what allows them to engage with the game more. When designing a game, it is important to create a game which the user can fully connect with which, I believe this project enables for the children as they are connecting with their own story through the game.

Content design & animation:

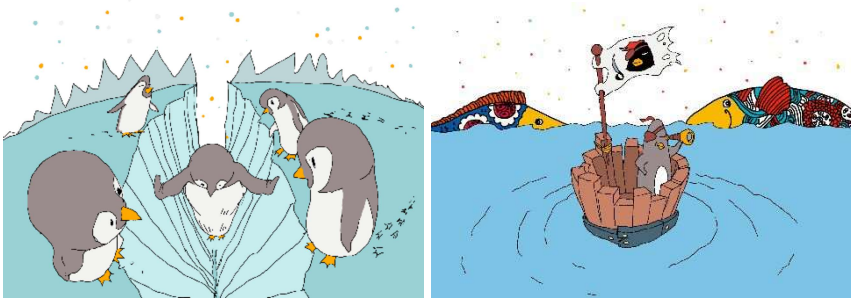
Aim:
-Have more fun when children are reading
-Simple animations can easily explain knowledge to children
-Quickly receive information

Design requirements:
-First, pirate characters and pirates' hats, pirates are themed around the whole project.
-Second, two types of animation for each chapter, total have five chapters, one is a 3D type of short animation and a 2D type of short animation.
-Third, other types of 2D digital drawing, including conceptual drawings, coins design, contents design and 25 target images.

Style & Visual language
The visual language is a system of communication using visual elements. Speech as a means of communication cannot strictly be separated from the whole of human communicative activity which includes the visual and the term 'language' in relation to vision is an extension of its use to describe the perception, comprehension and production of visible signs (Cherry, 2018).

There are many ways to express visual language, many elements to express the visual language.

Elements:
- Basic element: shape, light, shade, colour, texture, space and so on.
-Image symbolization, so that resonate with the audience and designers
-Character action and character language.



Figures: sample target images.

As an AR children's book project, the elements used in the visual language and style should not be too complicated to be simple and understandable. The above two pictures as an example, simple lines, and colour. It is easy to explain the contents of the white picture. children have innate sensitivity to colour. Colour is like a language, attracting children's attention to books and promoting children's exploration and study of book knowledge (Wang, 2016).

Less developed visualisers (learners) can benefit equally from static and animations but highly developed visualisers (i.e. visual learners) can actually benefit from static images over animations. The reason is that they have to fill in visual details and also may have less cognitive overload. Therefore, we have decided to use simple animations that do not overload the students (Höffler, Prechtl and Nerdel, 2010). Simple graphics designed to make it easier for children in the audience to understand the content of the book straight away, so as not to be confused by the volume of information.

Style:

In summary, the production of simple, and moderate amount of graphics, leaving children more acceptable. Style Simple, fresh, cute, colour-based, in order to design 2D or 3D animation and pictures.

Animation:
Animations can be a bridge to communicate with children and can help their children effectively read. The opportunities this provides for collaboration with students from all over the world should not be underestimated, and it carries the additional benefit that a language barrier can be immediately overcome through the medium of animation, so it is a fantastic starting point for building up ties and a sense of community across borders with your students (Fractus Learning, 2018).

There are two different kinds of animations, one for 2D animation: map animation for each chapter, another for 3D animation: treasure chest open animation. Although using a simple style, but it is necessary to add some small amount of -information in the animation, the animation will add some unique elements, so that children to find knowledge. In regard to people noticed details in the animation: The study suggests components of the animation can attract attention either because they (a) change substantially more than their surroundings, or (b) change substantially less than their surroundings (Lowe, 2003).

Figures: 2D and 3D animation

2D map animation:
A short map animation for each chapter. Each map animation around 6 to 8 seconds. This idea is a telescope looking for a target, in this destination there are some special animals. Telescope is also a pirate theme will not be missing a thing, did not draw the telescope directly, but rather to choose a telescope point of view to find the target.
Each section of the characteristics of animals, are the local characteristics of animals. These animals also appear in the children's teachers, hoping to be closer to the child's heart. The book consists of five chapters, the first chapter of Africa, walking in the forest elephants. The second chapter of Asia, a monkey playing on a tree vine. The third chapter of Europe, a bird soaring in the sky. The fourth chapter of America, Puma Sleeping on the Prairie. The fifth chapter of Oceania, the joy of fish on the sea. Post-use After Effect, the telescope to find the target part and the animal part of the synthesis, coupled with some special effects to complete a short animation.

3D treasure chest open animation:
3D animation, is a treasure chest open animation, it is about 2 seconds. The treasure chest also belongs to the pirate theme indispensable, reflecting the spirit of adventure. Use MAYA software, first build the model of the treasure chest, the two parts of the box and lid can be separated for the back of the brake animation more convenient. UV mapping, textures and materials. I have drawn a total of five textures, one for each chapter. Treasure chest open

action like a human speech in the mouth, more to give the chest of vitality and personification.

Digital Drawing

Characters & Hats:
After a big departure from the outset, identify a pirate as the protagonist and run through the book. Seize the pirate's several characteristics. First, the hat of the pirate: Second, the special sign of the pirate: the skull. This skull design is quite as formal as an ordinary skull, it looks more interesting, and looks like an expression, and the content of the book echoes. Third, only one foot of the pirates. The overall design is more lively and interesting uncle pirates.

Figure: Branded assets from Hackney Pirates each with a different character profile and means of challenging and motivating the children.

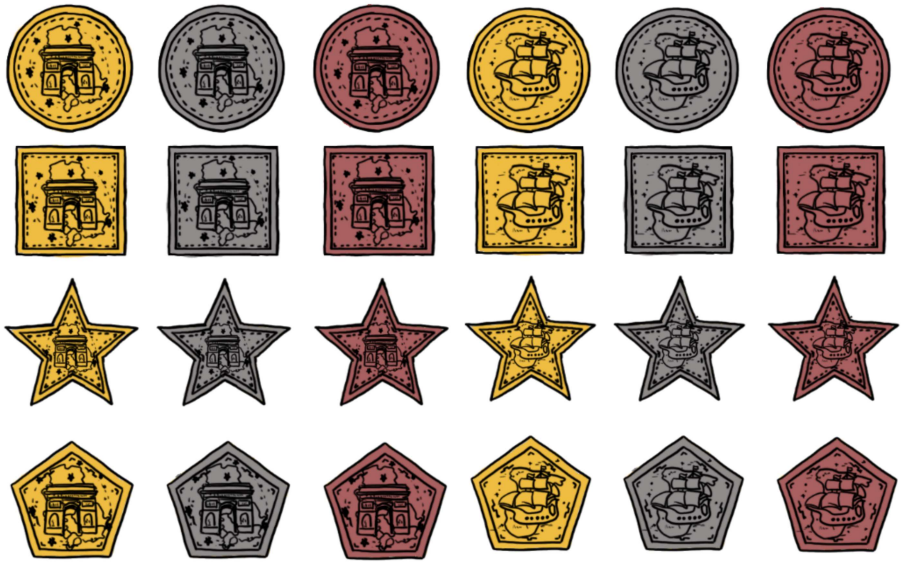
This is just the beginning of the sketch, and Hackney Pirates exchange, they would like to use Hackney Pirates' five characters, and finally identified a total of five chapters, each chapter have one pirate. Then these five pirates digital painting, and to facilitate the back of the production. In drawing the five pirates, separate hats a layer. Hats are used as a selfie for kids, with every kid wearing a pirate hat. So, this is the first part of the content, is also one of the core content.

Contents Design:
Contents include a total of five chapters, the first chapter is Africa, the second chapter is Asia, the third chapter is Europe, the fourth chapter is the Americas, the fifth chapter is Oceania. The content is a chart composed of five chapters of islands. The map is one of the main elements of this project, but also a very important part. The entire content is designed with very regional islands, including the small island next to the main island, the sailing vessels, and the stars in the sky.

Figure: Contents page chapter design

Coin Design:

Coin design, coins are the elements that need to be used in the coin collection game in each chapter. A total of 12 coins per chapter. Each chapter has 4 coins, each coin has three, namely, gold, silver, copper. There are 4 groups, divided into 4 different shapes, round, square, star, pentagon.

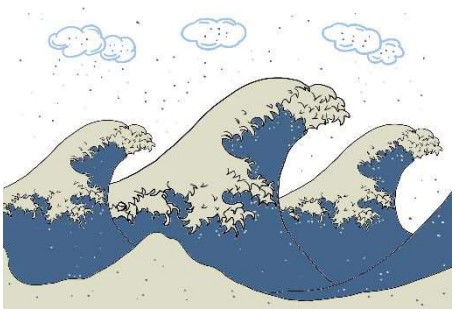


Figures: coin design, slightly different per chapter based on regional profile.

Each chapter has a different pattern. Some will cloud the map, others are famous attractions, while others will be divided into day and night. Coins design will still use the map element. There is only one random coin in a coin collection game to be collected by the

player at a time. The rest are fake coins, so each chapter has so many different coins, including different colours and shapes, but the same pattern.

25 Targets Images Design:
Targets images are used as a recognition of a picture, a mobile phone or tablet can recognize the picture appears a game. Each target image is related to the game content. When drawing Targets images, the biggest problem is that do not understand the programming language, the pictures produced do not meet the requirements.



Figures: two target images.

Because of the simplicity of the style and uniform style, I added some elements to the picture. For example, the above two pictures, the first picture water wave, the details on the spray will increase a lot. The second picture, add some similar elements beside the main images. Mainly in both ways to ensure that the picture can be identified.

Others:
A short animation of a special word. It is the very first thought that a few special words are selected in each poem to make a short animation. For example, there is a poem selected four special words, sea monster that eat my banana, jellyfish with beady scary eyes, giant robot clam. There is one aquatic creature in these four special words. Each aquatic creature designs a personified image to do more interesting moves. However, since the project was too big and give up at the very beginning, I think it is a good idea and should be preserved. Such words look for the game, gives the child an expedition feeling, feels a few treasures in every poem. Let children be more interested in reading, but also help children read and understand.

Technology

We sat down in the university library with busy games programmers Phil and Alvin who took a break from troubleshooting to kindly answer our questions. The interview has been edited for length and clarity. Let’s jump right in!

Figure: Games programmers testing the targets in the library. (L to R: Phil and Alvin)

What technology did you use for the Hackney Pirates AR activity book and why did you choose it?

Alvin: Vuforia and Unity. Unity is the game development platform and Vuforia is the plugin that allows for AR functionality. This current version of Unity 2017.2.0F3 has Vuforia built in.

Were there any technical constraints or other considerations?

Phil: These programmes were chosen because both are free, and our client does not have a budget. And also, we wanted to try using them!

We also opted for Android technology (via the Google Play store) because more people have Android phones and tablets over Apple's iOS, particularly in disadvantaged communities.

A technical constraint at the university is that since we require a specific version of Unity, we could only use two machines as the rest were running an older version.

How were the games made? I know this seems obvious to you. But how would you explain it to, say, a pirate?

Alvin: Through blood, sweat and tears!

Phil: First, you have to make the scene. And then you have to code each part of a game or everything that's made (in Unity that's described as a component). You break down all the different parts or components: like this question, this button. And we make each thing, check the controls. Start with the most necessary element. Once those are working (like the button) then you can go on to the next thing like put the questions in. So now you have a quiz which is just one part of the game.

Or for the fishing game you have to make a spear, a fish, the timing and then you have to make them all work together. So when the spear collides with the fish (we say they are parented- so when the two touch), then you have to pull it out. We have to build the UI element or the controls so you can do that. Now you've caught the fish but you still have to push buttons to "collect" the fish, so we have to code that the fish disappears and implement (increase) the score.

What does implementation mean and how is this achieved?

Alvin: It is a fancy way of saying "making the game." So basically what Phil just said.

You mentioned controls. What is a control?

Alvin: A control is how you interact with the game: tilting the tablet, touching the tablet or table with virtual buttons, an accelerometer (the thing that feels you moving within the tablet).

Phil: We have a variety of them in this workbook. Virtual buttons are probably the most interesting though. These work by detecting if the image targets features at the location of the button are covered up.

Since your hands are never completely still, its a bit hard to touch a virtual button. But also you don't want to touch one by mistake. So we have a progress bar, and you have to hold the button down for a bit. This ensures you are touching it on purpose.

What did you do and what decisions did you make?

Alvin: Not all the games design ideas were feasible. There were lots of ideas requiring models. But we didn't want to make something too heavy for Julia, the animator. So we had to think of games related to the content but wouldn't require too many models like props or objects such as the fish. There was one involving landmarks and having to make each one would have been too much.

Phi:: We had to make everything and implement everyone's work. We agreed to most things. Maybe we should have been less ambitious at the time, but even now I want to do all those other things!

How did you divide up the tasks between the two of you?

Phil: We played to our strengths. Alvin did a lot of the repeating elements or he'd do the waterfall and then other similar games. And he did all the quizzes and the chests are linked to the quiz. I did the coconut and fish games. So we didn't step on each others toes.

Alvin: It just happened. Phil did 4-5 games. I did waterfall, boat and quiz. Make quiz count as two points!

Phil: The quiz is really hard and goes throughout the whole book.

How did you work with the games designers, UX, animator and researcher?

Alvin: We commutated by Whatsapp and once had a marathon six hour Skype call with the games designer Alex.

Phil: It needed to be simple enough to be suitable for children, fit the theme, have some AR interaction, and go along with the research. So it was a long call! And we used Trello and Slack..

But less about the tools and more about the ideas. How did you take their input and apply it to the finished product?

Phil: We first took client requirements and inspiration from the book like the colourful fish on page 31 and it became a game. We used the wireframes from Beth, the UXer, for the UI elements so the button placement, fonts, etc and also the printed activity book. We worked with Alex to figure how the games worked and how the user will play and win/lose. Amy gave us cognitive elements to factor that we used to make the games educational. And we worked with Julia's animations for elements in the game and for target images.

What is your favourite game and why?

Alvin: I felt like the quiz turned out pretty good. But as far as most fun to play would be the coconut one… because shooting stuff.

Phil: Spear fishing because I think it just stands up the best on its own. Like you could release it as its own app.

Is there a relationship to your favourite games and the ones that were most difficult to build?

Alvin: The quiz was the hardest one, so it felt the most rewarding when it was done. The randomising was really difficult.

Phil: Randomising is hard because it has to pick a random question from a text file and randomise positions of answers so the correct answer isn't always left or the middle one. And then pull the correct answer from the file.

Alvin: So there's a text file now of all the correct answers and another of all the wrong ones.

Tell us about troubleshooting. Were there any challenges and how did you overcome them?

Phil: Testing the targets was really scary because if the printed targets don't work or aren't good enough, the app is broken and you can't use it at all so everything breaks down. We tested them a lot before releasing them to Beth to make the print book.

What did you learn over the course of this project?

Phil: Until now, I had never designed for augmented reality. I was excited but a bit nervous because it is new and I hadn't done it.

One thing we learned about about target images and the requirements needed to ensure the targets were augmentable out of 5 stars. So we tried to get 5 star rating on each image so no repeating patterns, creating sharp straight lines (we actually used star shapes instead of circles for example) enough contrast.

Virtual buttons work by detecting which part of the target is covered by the user's hand. So it needs to have features that will go under the user's hand and be obstructed. Covering them up means you are pushing the button. If there is nothing to cover up (so no points, stars, edges, etc) then the system won't recognize a button being pressed.

What would you have done differently if you had more time/ budget?

Phil: We would have implemented even more games, a leaderboard, and improved the selfie component. And maybe making it look nicer.

Alvin: We would have also loved to have a video editor to make cool videos for the project both in the game and to promote it. Kids like special effects, right? Maybe more of those too.

How did you test the games to make sure they worked?

Alvin: We got to play them to test them. I'd give mine to Phil to try to break and then he hands it back. It's a good thing so we can fix it. But bad too because it's broken. It is better that we spotted it first and not someone else.

Are you confident that people will be able to do them without any help? What do you do to make sure they can?

Alvin: We made each game simple for the kids. The controls are simple, one mechanic and one objective. They don't have to learn a lot to play each game.

Phil: That's where the work with Beth came in with the tutorial text. Before you start each game, a set of instructions appear and the play button. And only once you've pressed the button does it start. And each game relying on only one mechanic means- say you aren't say tilting and pressing the tablet at the same time

What resources did you use in terms of help or guidance/ templates, etc?

Phil: Vuforia has samples and tutorials on the unity asset store, sample codes, sample scenes.

Alvin: You have to learn by doing. You tell me and I forget, teach me and I may remember and involve me and I'll learn. Remember the phrase? It is like in school when the teacher tells me a bunch of stuff and I forget. For this we just had to get started and figure it out. But for me I realised, you have an image target and then you have an AR game. It is not that

much different than a regular game, just change a few things. The image target is important but you otherwise make it the same as a normal game.

Phil: Like the quiz you'd still make the same if it was on a PC it is just adding AR elements. So instead of clicking with mouse you're using virtual buttons. But same quiz concepts apply.

What advice would you give to someone else who wants to make a game for the education market?

Phil: There's loads of questions that you'll need to be able to answer and that gives you a content rating which is really important.

Alvin: Definitely research ethical stuff and what they can and can't do because it involves kids. Keep the games simple because if you're teaching kids educational games, you want to teach them something. You don't want to have to spend a long time teaching them how to play the game first.

What would you ideally like to see happen to this game in the future?

Alvin: It would be nice to complete it and show it to the charity. Really long term, maybe have it go to other related charities. Or they could hire us to do it!

Phil: The quiz concept is probably the most transferable.

Alvin: We'd just have to change the code a tiny bit if we wanted to change the questions and answers as these are stored in a text file. And the maze questions instead of being on Africa could be on a different lesson.

Phil: The quiz idea could form part of a customisable AR book where each element could be tailored to the users needs, being able to make small changes to the theme such as changing the theme from a desert to a forest theme, palm trees to pine trees etc. That way it could apply to other subjects for different types of lessons.

Thanks a lot, guys! Now get back to work!

Discussion

Client feedback

Aaron Piper <aaron@hackneypirates.org> 12/6/17

to me, beth

Hi Both,

This is looking awesome! Thank you so much for sharing, I want more than anything to crack the chest open and see whats inside...

thanks,

Aaron

Figure: client email after a check in having provided a video sample

Feedback from the client has been consistently positive. We are aware that this could be because it is a university student project or because it is pro bono. However, taken with that lens aside, we have maintained regular contact and check ins with them as well as sent them samples of work in frequent intervals. This has served to not only ensure that we are delivering to their expectations but also create a sense of excitement for them.

The team at Hackney Pirates displayed one of the animations of blue fish coming out of the treasure chest during the book launch in December to show students and their families a teaser of the upcoming AR project. They were so excited that when one of our team went into the shop for a coffee several days later, the people at the counter were even telling customers about it. The Hackney Pirates rely on volunteers in the community, both as individuals and businesses, to help them create these experiences for the children and thus their responses are generally positive.

One of the most important parameters the Hackney Pirates set was that each child should feel included and have his or her work represented. We satisfied that through the design of the quiz randomising through all the questions related to each child's poem or story. When user testing the workbook with the Hackney Pirates, they indicated that we met this requirement. They also tested several games and we recorded their feedback in the form of quotes: "ooooh," "go go go!," "this one is my favourite," and the note of "the client is making shooting noises." This leads us to surmise that they are very pleased.

Handover

We have met with Aaron from Hackney Pirates and have developed the following hand over plan to transfer the project from our team to theirs. We, as a group, decided not just to contribute our time but provide them with a few materials as a donation to ensure they have the best chance of transitioning this project successfully.

1. Finish/ test all the games, even if after our university deadline
2. Send them the print files and vendor information for print workbook
3. Provide them with: 5 printed copies and 1 Android tablet device
4. Train them on the app and games so that if the kids have questions, they can help
5. Usability testing of the final book via The Hackney Pirate team which will not be used for the university but rather our own understanding of our work and so that the children know that their opinions matter.
6. Aaron will solicit questions from the kids about the project so that we can video answer them
7. Present to the children, either by video or in person depending on availability

Future Usability Testing:
Ideally, we would have liked to have made direct observations of the children playing the game, taking notes of facial expressions and verbal behaviors. However, due to time constraints with ethical forms, we relied on the staff at Hackney Pirates for feedback during the design process.

Once we deliver the application and AR book, the staff will give relay general feedback on how the application was received, as well as allowing us to handout brief surveys (via them) to the

children to get further information such as whether there were some aspects or games that the child preferred.

We have adapted our questions from Janet Read's paper, Validating the Fun Toolkit: an instrument for measuring children's opinions of technology (2007) which looks into the requirements of creating a survey for children. The most important aspect is that the child can read and understand the questions (p120), so considerations were made in the language used, as well as discussing with staff if they potentially would read out the questions to the group if problems occur. Once a child understands a question, Read explains that answering with multiple choice options can overload the child, or using yes or no can be too easy (p120) and so visual aids are an alternative and are recommended for children over 7 years of age (Shields et al. 2003 cited by Read,. J. 2007 p121).

Read developed the Fun Toolkit in 2002 as a method for children to express opinions about technology that could be interpreted as meaningful and reliable data whilst being "fun, fast and fair" (Read,. J. 2007 p122). It consists of three areas: The Smileyometer where children tick which facial expression most reflects their experiences; The Fun Sorter, placing cards on a table in best and worst positions; and the Again Again Table where they tick if they would like to do that activity again. Carrying out the full three tests would require much time from the staff at Hackney Pirates, so we have opted to use the Smileyometer and the Again Again Table.

Hackney Pirates Smileyometer will be accompanied by a short set of questions such as:

- I didn't have to ask for help when playing the game
- I would show my friend the app
- Instructions made sense to me
- I found all the games fun
- I found some of the games too hard
- I found some of the games too easy

Figure: Smileyometer from (Read,. J. 2007. p121)

Again Again Table: Would you like to do it again? Put a tick in the box for your answer.

	Yes	Maybe	No

Figure: Example of the Again Again Table (Read,. J. 2007. p121)

Limitations

Access to children:
As evidenced above, a major limitation of this project has been the limited access to the children. This is primarily a result of the stringent, but necessary, ethical review board process at Kingston University. While we are confident that our study would have easily met the ethical guidelines, the board timelines were such that the plan would not have been approved in time. This limitation is why we partnered with children's literacy experts The Hackney Pirates. However, no matter how much they understand childhood development, they are not children. Testing the client instead means that we miss out on the immediate and honest feedback of the students.

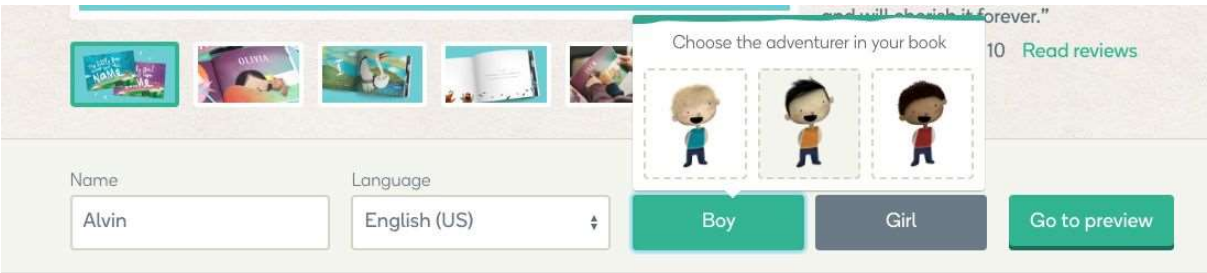
Tech:
Another limitation was the type of technology. We decided early on to use Android tablet because more people use Android over Apple's iOS. However, we went a step further and decided to purchase a durable and affordable tablet for their usage in the shop. All the testing of the games were done on this budget tablet because it most closely would reflect the client user experience. However, this tablet did crash frequently, and we were unable to determine if the cause was the game application or the tablet itself.

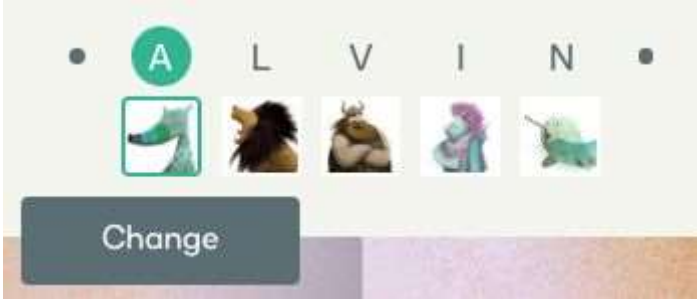
Time:
Finally, the greatest limitation is of time both as the university deadline as well as our individual schedules. Everyone reflected on what we would have done differently if there was more time to implement this AR book. There is always more to research, explore, try, and test. Specifically, had we had more time, we would have wanted to keep refining and troubleshooting. As our deadline is before Hackney Pirates' timeline, we will keep this project

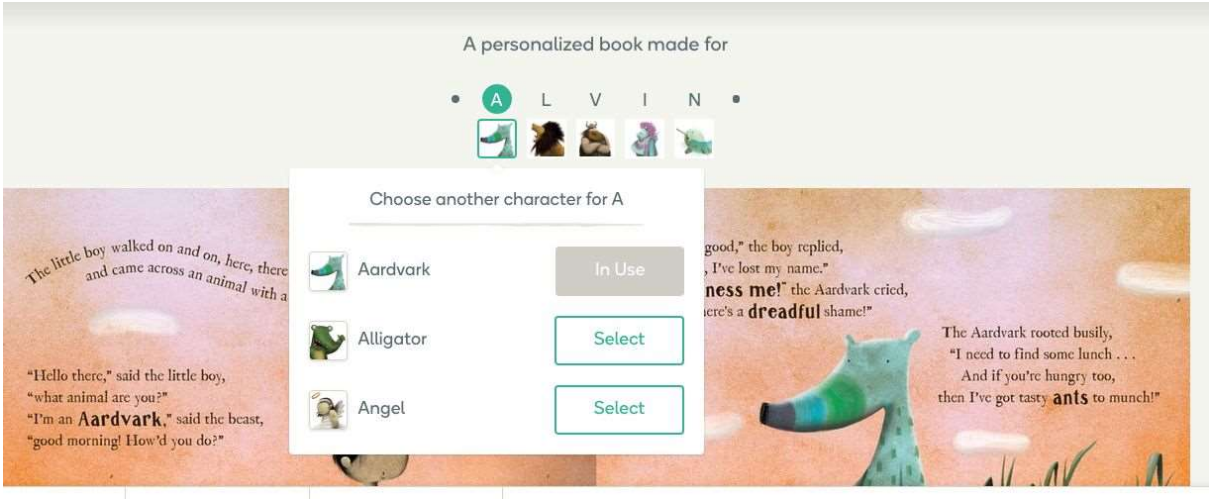
going. The Hackney Pirates made the decision to tell the children about our project, after careful consideration, and as such, they are anticipating this book. They are clients but also a worthy charity with expectant, eager children. We will deliver because, frankly, they are waiting.

Future work & broader implications

In addition to finishing the project and the handover listed above, we have also considered the future work and its broader implications. Our project was unique in that the questions were related to the children's stories and poems. However, the technology behind it could be used for other topics or school subjects. As the questions are simply in a text file, they could be amended by a teacher based on their lesson, or, in keeping the Hackney Pirates ethos, questions based on another cohort of children's' stories. Our animations and games are specific to this project, but with limited customisable options, we could provide an interface of simple options. For example, instead of African animals- South American rainforest ones. Instead of European landmarks- Asian ones. Icons and background colours could be changed to fit the educational theme. The inspiration for this is Wonderbly (formerly Lost My Name). Here you can see how the base story is customised by gender, basic look, and child's name. Recently, however, they've added new animals so that there is some option for each letter and thus more stories to tell.







Figures: Limited customisation options for a print on demand book for children by Wonderbly.

Conclusion

Figure: A user with the finished workbook and AR app

In conclusion, we created a successful multidisciplinary augmented reality workbook for children to help engage them in their reading and writing exercises. Our project sits

alongside a pirate-themed book that the children created. As it came out after the book, it does not detract from the children's accomplishment but instead continues to provide enrichment and engagement. This can be used for activity programming along with their book to continue fostering a sense of pride in their work.

While, our current iteration may feel small in that it is one group of children struggling with reading in one borough in one city, we like to think of it similar to another ocean-based children's tale. There is a man on the beach throwing the starfish who had washed up on the shore back into the sea. A boy asks him what he is doing. The man explains. The boy questions how it will make any difference because there are just so many starfish. The man throws another and says "it made a difference to that one." Such is engaging this group of children at this time and in a neighborhood in which we live. Whether it can scale and later become a business, we don't know. But we do know, it made a difference to those ones.

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Appendix

Original brief

CI7810: Digital Studio Practice Project Brief October 2017

Augmented Reality for Interactive Children's Books

The Brief:
Augmented reality (AR) is a live, direct or indirect, view of a physical, real-world environment whose elements are augmented by computer-generated sensory input such as sound, video, graphics or GPS data.
You are asked to:
• Explore present innovations and industry practices in the area of Augmented Reality. What technologies and applications are available? What level of customisation are they providing?
• Use the acquired knowledge to create an interactive children's book using an existing AR application, based on your acquired knowledge, or developing a customised one.
• You should cover aspects of user experience design, interactivity, the use of animation and the gamification to make your deliverables stand out and be competitive on the market
Suggested Tasks:
• Contact the Mentor; access the resources and confirm any support they might offer
• Review suggested literature, tools and techniques
• Explore the existing applications and choose the one that will fit your purpose the best; justify the choice
• Create a prototype

Mentor: Vasileios Argyriou
Skills: Research skills, Computer Graphics and Animation, Development of interactive prototypes; familiarity with high-level programming environments
Resources: Existing Creative Concept, Research Reports, iCat (KU Library online service) for publications etc.

Starting point:
http://computer.howstuffworks.com/augmented-reality.htm
http://mashable.com/category/augmented-reality/
http://www.geek.com/apps/disneys-augmented-reality-coloring-book-brings-characters-to-life-1635959/

Last year's project blog:
https://augmentedrealitychildrensbook.wordpress.com/

Future Development: You have the opportunity to become an expert in a new field.

Sample client emails

lily@hackneypirates.org

Move to Inbox | More | 6 of 6

Possible collaboration: AR kids book (Kingston University) Inbox x

Amy Marie Phillips <amymariephillips@gmail.com> 10/18/17
to crew

Hi Lily,

I called yesterday and was given your contact details because you might be interested in collaborating our university project.

We are an interdisciplinary group of postgraduate students at Kingston University who have been brought together to design an Augmented Reality (AR) children's book. Our team is: 1 games designer, 1 animator, 2 user experience designers, and 2 games programmers.

As Dalston resident, I was familiar with Hackney Pirates' work and thought it might be interesting for the group to have an actual client on the project to set requirements and provide expertise as needed. We are reaching out to your organisation exclusively because we think our goals of promoting childhood literacy in a creative way align well with yours.

We do have some academic requirements that must be adhered to, but for the most part, our project is flexible. We could bring an existing book "to life." We could also take one of your paper folding projects as part of a game/story and bring in AR. Perhaps there is something else you had in mind with an upcoming initiative you have?

I am acting as product owner and would be your contact. I would be available to come in Thursday or Friday morning or anytime over the weekend if you are interested in pursuing this collaboration. This would help us understand your needs so we can create the brief. We must pitch a rough preliminary concept on Tuesday to our class to commence module kickoff.

Warm regards,
Amy

Lily Eastwood <lily@hackneypirates.org> 10/19/17
to me, Crew

Hi Amy,

Thanks for your email - it sounds very exciting!

I'm a little time constrained - I'm in at 11 tomorrow after an early meeting, and then I'm free til 12. So if 11 works we could chat?

Before we meet it's probably a good idea to tell you some of our constraints - so you can decide whether we still sound suitable!

- We usually deliver our projects, but with guest collaborators, so we are the facilitators but have others help with precisely the bit you're talking about - the product!

- Our projects are usually planned up quite far in advance, which may or may not fit with your timeline. This could potentially fit with aspects of our summer term project (where we record audio with the Young Pirates) or it could be a standalone one week summer holiday project.

- If it was using an existing text, that could also be exciting, we're making a book right now! We'd just need to do a bit of a check in about where you'd publish it an it's uses etc.

Let me know what you think and if you can make tomorrow morning.

All the best,

Lily

From: Amy Marie Phillips <amymariephillips@gmail.com>
Sent: 18 October 2017 10:32:58
To: Crew
Subject: Possible collaboration: AR kids book (Kingston University)

Amy Marie Phillips <amymariephillips@gmail.com> 10/19/17
to Lily

Hi Lily,

Thanks for getting back to me. 11 will be great.

Looking forward to meeting you!

Best,
Amy

Lily Eastwood <lily@hackneypirates.org> 10/19/17
to me

See you then!

Hi Beth,

Thanks for your mock up. Here is what Dom has said:

Re the additional pages for the interactive app - I'm happy to design them, if you forward me their drafts I'll have a look at it.

So to conclude:

1. Dom is happy to design the pages which is great as it means they fit seamlessly into the rest of the book.
2. You will be proving the three images and their chapter variants for the red boxes.
3. If you could send those to me I'll then send them across to him.
4. I have forwarded him your draft so that he can see how the page functions.

I'll be away on holiday next week and returning to the office on 27th November, If you need to contact anybody at our end Lily is happy to act as an emergency contact in my temporary absence. To confirm her email is Lily@hackneypirates.org

All the best,

Aaron

From: beth Green-Armytage <betharmytage@gmail.com>
Sent: 16 November 2017 13:42
To: Aaron Piper
Subject: Re: AR update

Hi Aaron,

...

Aaron Piper <aaron@hackneypirates.org> 11/17/17
to beth, me

Hi Beth,

Quick update, I've spoken with Lily about the book and she is still super keen on the AR element, she has asked that it is on an insert or card that we can slide into the book as our printing cost and the designers time are tight. This could be a 2 sided A4 card for example. I'm going to ask that you put the insert together as it allows you more freedom and you won't be waiting for me/designer so will make the project easier to manage from your end as our designer has a lot of work to undertake I wouldn't want you to be relying on him for your deadlines.
I hope this still works well for you. In hindsight this will mean that the image is always flat and easier for users to engage with and much smoother for you to manage/control at your end.

I'm sorry if I have caused too much confusion.
Do feel free to message me with any thoughts or questions.

Thanks,

Aaron

Hi Aaron,

Hope you enjoyed your holiday! We are doing well here and are ready for assets. We've done tests and are just waiting on the chapter breakdowns and the book design files. We have planned to take the weekend the book is going to print to do a huge production push as we have a major presentation on Dec 12.

Can I confirm next steps:

1. **Assets and chapter breakdowns**. Can you supply please us with what you have to date so that Beth and I can start devising quiz questions out of everything available? If you know the chapter breakdowns now, that would be most helpful. Otherwise, we can wait until the book is ready for the printers.

2. **Printer files Dec 8**: Will you please send us the files as you send them to the printer? The google drive would be the best place or I can come with a drive. We can take those mockups and get a lot done ahead of the book coming out and our presentation.

3. **Testing:** Will either you are Lily be in the office in that quiet time between Christmas and New Years (ie Dec 27-29)? We would like to test you then. Otherwise, as soon as you are back in the New Year would be best for our deadline.

4. **Picking up the book**: I would like to come around in the morning Dec 11 to pick it up so we can have it for our presentation on Dec 12. The team will pop by later in the week when the kids have had a day to practice their launch activities, as you requested.

Also, we wanted to keep you excited (when you are probably up to your eyeballs in scraps of paper and kids bouncing from baked goods) so check out one of our favourite tests!
https://www.youtube.com/watch?v=0tAWq5fvsFU&feature=youtu.be

Many thanks for working with us on this.

Warm regards,
Amy

...

Aaron Piper <aaron@hackneypirates.org> 12/5/17
to me, beth

Hi Amy and Beth,

My holiday was amazing thank you I was in Morocco enjoying the sunshine. I'm so pleased to hear it's going well for you. I'm happy to say I can confirm a few things for you in this email as well as share the latest book incarnation. I'm going to share with you a drop box which has all of the young pirates work as well as the book pdf. the book PDF is in the _out folder. You are welcome to access the folders but I ask please that you don't edit or move anything as there are a few people working from the folders to compile the book and I would hate for any work to be missed from the book.

1. **Assets and chapter breakdowns**. The Chapters are, in this order: Africa, Asia, Europe, Americas, Oceania/Antartica

2. **Printer files Dec 8**: This will be in the dropbox I've shared with you

3. **Testing:** The office is completely closed between xmas and NY. I am back from annual leave on Monday 8th January if that works for you?

4. **Picking up the book:** We are launching the book on Monday 10th - Friday 15th next week, every evening between 17:30 ans 18:30 so if you are available you are welcome to attend one of our book launch days with our young pirates.

Could you re-share the video as I'd love to watch it but I'm getting an error message :(

All the best,

Aaron

Aaron Piper <aaron@hackneypirates.org> 12/6/17
to me, beth

Hi Both,

This is looking awesome! Thank you so much for sharing, I want more than anything to crack the chest open and see whats inside...

thanks,

Aaron

Aaron Piper <aaron@hackneypirates.org> 12/6/17
to me, beth

Hi Both,

This is looking awesome! Thank you so much for sharing, I want more than anything to crack the chest open and see whats inside...

thanks,

Aaron

Aaron Piper <aaron@hackneypirates.org> 12/15/17
to me, beth

Hi Amy and Beth,

We've had a fantastic week in sessions this week celebrating the release of the book with our Young Pirates. Tonight is the final launch event (17:30) please do come along if you want to.

I've been playing the AR video you sent across to me at the launch events and Young Pirates, teachers and families have been really hyped about the AR element of the book.

I'll be in next week until 21st and then I'll be off until the new year. Can I propose a meeting on Monday 18th or Tuesday 19th at 13:00 to check in with each other and for you to see the book as I know your planning on completing soon.

All the best,

Aaron

Aaron Piper Jan 19 (2 days ago)
to beth, me, Lily

Hi Both,

Firstly, thank you for finding the time to meet with me yesterday among your busy nearing-the-deadline schedules!

I showed the book you gave me to the team today and their all super exited by it and can't wait to see more. So a huge thank you and well done from us at the ship for all of your meticulous hard work on the project so far.

Good luck for Monday,

Have a great weekend!

Aaron and the team

Sample team communication

Reply all

Thu 09/11/2017, 16:19

Hi guys!

This was the recap email I sent to everyone. Biggest take aways:

Julia: as Beth said, they want to use their pirates and brand assets but we (you) can create everything else
Alex: there will be some changes to number of chapters that will affect you
Alvin/Phil: see the points about target images and accounts/ leaderboard.

Best,
Amy

Hi all,

To recap what has come out of our meeting.

Target images: we should be able to use the maps and the bolder words of the poem titles. None of the kids will be using "untitled" and currently, no one has matching titles. We did discuss using the compass but actually, each target needs to be different. If there are pages with mostly text, we might be able to use some of the HP characters. But we will try to work with what is already there.

Hackney Pirates brand:

We will use HP pirates for brand consistency and for the messages each character as they are useful in gameplay (like encouraging persistence). Some other concepts to consider bringing in are the secret passageway. Where we can have our own animations/ assets which Julia will create is the topics in the kids' stories.

Coin games:

Aaron/ Beth came up with the idea to have fake or decoy coins that relate to the kids' stories. Ex, falafels or chocolates. Obviously, only the coins count, so they have to pay close attention!

Accounts:

We need to clarify with the programmers about setting up accounts and having the chance to build an avatar. Can the leaderboard live in the game without accounts?

Multiplayer:

Right now the game is meant to be single player or two max if they are passing a tablet back and forth. There were some great ideas of having a "crew" but that might be out of the remit at this time.

Production clarification:

The primary students will be creating fables from the topics of their poems, apr 60. The secondary students are doing maps right now and we expect more in. Secondary students won't have fables as they have less time with HP.

Not all students will have maps due to time constraints. Aaron has plans to group those near maps to break up the text, but the layout and chapters are still being determined.

HP are sending the files to the printer on Friday 8/12 so we can have finals by then but structures with placeholders before that. The book comes out for Monday 11/12 and begins a week of book launch celebrations open to the public. We are encouraged to attend a bit later in the week so the kids have time to practice before meeting "guests."

Aaron has told us what HP plans to do after the book, and our timing works well with them finishing the book and moving on to their film project and other projects.

Next steps:

Amy and Beth will check in with Aaron next week. This will be after our presentation on Tuesday and considering subsequent faculty feedback.

Beth has already sent Aaron the deck and wireframes which he can share with Lily.

The KU team will figure out the technical questions, re accounts.

Aaron will get us existing brand assets and next drafts as they come in. He will meet with the designer on Tuesday and keep us updated on chapter numbers/ topics so that Alex can have a better idea of the structure for ongoing game design.

Lily/Aaron will countersign the NDAs and provide us with either a copy or the originals for our records.

I think that's it! Thanks all!

Warm regards,
Amy

From: Green-Armytage, Elizabeth
Sent: 09 November 2017 15:33
To: Phillips, Amy Marie
Cc: Wei, Alvin Y; Zhu, Lizeng; Wachsmann, Alex; Greene, Philip J
Subject: Re: AR kids book (Kingston University)

Hi All,

Amy and I met the Pirates this morning which went well. Amy is going to send all an email with what we discussed.

However, they are keen to use their five core pirates and not ours. So Julia, please don't work anymore on your pirate! So sorry as yours is really good. So for now, please work on the coins, treasure chest and a pirate's telescope.

I have uploaded some images of the pirates and their characters in the Google Drive folder.

Thanks,
Beth

From: Phillips, Amy Marie
Sent: 08 November 2017 16:37:04
To: Green-Armytage, Elizabeth; Wei, Alvin Y; Zhu, Lizeng; Wachsmann, Alex; Greene, Philip J
Subject: Re: AR kids book (Kingston University)

We have to clarify if each DPS (double page spread) has a map. If it has a map, we don't need icons or things added.

Aaron was meeting with the graphic designer last night so I think it will all be much clearer.

I can meet you on Slack tonight after 8 if you want some help preparing.

From: Green-Armytage, Elizabeth
Sent: 08 November 2017 16:26:01
To: Phillips, Amy Marie; Wei, Alvin Y; Zhu, Lizeng; Wachsmann, Alex; Greene, Philip J
Subject: Re: AR kids book (Kingston University)

Or,
Once the book is printed, can we use a section of each of the maps as a target and make that bit AR?

From: Green-Armytage, Elizabeth
Sent: 08 November 2017 16:24:29
To: Phillips, Amy Marie; Wei, Alvin Y; Zhu, Lizeng; Wachsmann, Alex; Greene, Philip J
Subject: Re: AR kids book (Kingston University)

Hi Guys,

I am trying to put a new presentation together to take to the Pirates tomorrow. I might not use it, but it will be good to have incase.

Again looking at the email I have some questions:
260 Pages
2 pages per young pirates allowing for their poem, fable and map
Approx 130 children.

if 5 chapters (minimum) - approx 52 pages per chapter - 26 children

if 6 chapters - approx 43 pages per chapter - 21 children

if 7 chapters - approx 37 pages per chapter - 18 children

if 8 chapters (maximum) - approx 32 pages per chapter - 16 children

I propose we have a game for each chapter. So it will be 5 - 8 games, depending on how many chapters they go for in the end.

If a kid does 8 coin collecting games will they get bored? If so, shall we alternate between coin collecting and mazes and or a Where's Wally/Pirate type thing?

I will know more tomorrow, but let me know your thoughts.

Beth

From: Green-Armytage, Elizabeth

Sent: 07 November 2017 17:59:14

To: Phillips, Amy Marie; Wei, Alvin Y; Zhu, Lizeng; Wachsmann, Alex; Greene, Philip J

Subject: Re: AR kids book (Kingston University)

Hi Guys,

Looking at the response to Amy's email, we may have to rethink some things. If there are 260 pages (2 per child) it means there are 130 children.

Is anyone around tomorrow to have a brainstorm to figure out how feasibly we can achieve all the objectives - mainly including all the children. As well as incorporating the places they have chosen to write about. E.g., Maybe we can have the country outline as a chapter on the homepage. Or instead of collecting coins, they could collect something relevant to the country?

I want to go into the meeting on Thursday with clear ideas from our end!

I'll be in Kingston all day tomorrow, so let me know if you are around to chat.

Have a good evening.

Beth

From: Phillips, Amy Marie

Sent: 07 November 2017 15:32:49

To: Green-Armytage, Elizabeth; Wei, Alvin Y; Zhu, Lizeng; Wachsmann, Alex; Greene, Philip J

Subject: Fw: AR kids book (Kingston University)

They are really quick to respond. Beth, can you make this day?

Please see Aaron's responses below and be ready with your requirements for Beth to take with her.

WOOOOO This is happening! :)

From: Amy Marie Phillips <amymariephillips@gmail.com>

Sent: 07 November 2017 15:28

To: Phillips, Amy Marie

Subject: Fwd: AR kids book (Kingston University)

---------- Forwarded message ---------

From: Aaron Piper <aaron@hackneypirates.org>

Date: Tue, 7 Nov 2017 at 15:14

Subject: Re: AR kids book (Kingston University)

To: Amy Marie Phillips <amymariephillips@gmail.com>, Lily Eastwood <lily@hackneypirates.org>

Cc: beth Green-Armytage <betharmytage@gmail.com>

Hi Amy,

I am glad to hear the project is developing nicely for you. I'm happy to talk with Beth. I love all of your ideas they sound like they will bring even more to this fantastic project.

I am available to talk with Beth on Thursday 9th at 11:30, I'll pencil it into my calendar now. I am meeting with the designer (Isabel) who is laying up and illustrating the book tonight and we are looking to finalise on the format of the book today so I will be able to give you a better answer shorty to the questions that you have.

1. How many pages are you expecting roughly?

I have been quoting 260 pages the break down for this is 2 pages per young pirates allowing for their poem, fable and map.

2. Will it be divided into chapters, and if so, how many?

Indeed it will be broken into a chapter for each region e.g. The Black sea and Mediterranean, Eastern Europe, the Caribbean, London as these are the regions with with our Young Pirates have chosen to write about. In summary I anticipate that we will have around 5-8 chapters.

3. Can we add some small image or icon in a corner so that we have something to map the AR to? Otherwise, it is challenging to scan a page in the correct place to have the effect come up.

You are welcome to have images that map across to the app. I will have to ask that they fit in with the design of the book, I will ask Isabel her thoughts when I meet with her later. It may well be that she has some stock illustrations we can use. e.g. a small compass or character

4. Is it possible to perhaps highlight/ bold/ enlarge a word from the poem for the same reason?

I'm sure this is possible. We would just need a list of the poems and which word you require to be in bold.

All the best,

Aaron

From: Amy Marie Phillips <amymariephillips@gmail.com>

Sent: 07 November 2017 14:24

To: Lily Eastwood

Cc: Aaron Piper; beth Green-Armytage

Subject: Re: AR kids book (Kingston University)

Hi Lily (Aaron and Beth),

We are progressing quite nicely but we are ready to get some feedback on our wireframes before we go too much further into design or coding. Would have you have a moment to chat with Beth, the UX lead?

Also, we have some graphic design queries. We've made some assumptions based on the first book you did but will need some more accurate info soon.

1. How many pages are you expecting roughly?
2. Will it be divided into chapters, and if so, how many?
3. Can we add some small image or icon in a corner so that we have something to map the AR to? Otherwise, it is challenging to scan a page in the correct place to have the effect come up.
4. Is it possible to perhaps highlight/ bold/ enlarge a word from the poem for the same reason?

What the team is thinking right now is that a randomised question will come up about the passages the kids have written (and this will randomise so there can be a question about most of them).

Example scan the treasure box at the end of the chapter and this question comes up:

Brian's poem said he had a moment that was really special. What was it?
Watching sunset with grandma
Eating pizza with friends
Running at the park

Or if the word sunset was bolded someone might scan that and see a cool sunset animation to accompany the poem.

In this way, we have both games and effects for the kids to interact with. But we need an item to map to.

I'll stop by tomorrow to drop off the NDAs for you to sign, but it will probably be before you arrive. Can you let me know a good chance to catch up?

Warm regards,
Amy

Project brief

Hackney Pirates: AR book brief

Purpose

The purpose of this document is to give Group 3 an understanding of the project available at Hackney Pirates and enable them to decide whether or not to accept the collaboration.

Background

Hackney Pirates is a children's literacy charity in east London. They work with students ages 9-12 who need extra help reading. The difference between Hackney Pirates and other charities is the way they engage and empower the children. Their program lasts either a term or the full school year, and children write and publish books. This program uses these books to not only help the children with their reading but also give them a source of pride in their accomplishment. Our contact there refers to the finished product as having "beautifully insane writing."

The program has a pirate theme throughout, and even the storefront feels like the inside of a ship with the workshop downstairs blue as under the sea. It is a very special place. The staff are extremely proud of their work and are very welcoming. They are keen to partner with us to bring AR to a current book in production and would like to surprise the students with it. There is also some opportunity to go and show the students how it works as guest speakers, as they have successfully done that in the past with the book's graphic designer.

Business case

Our timeline is rather tight, so it makes sense to align with an existing project instead of spending time creating an existing project. Because Hackney Pirates is a charity, they do not have the funds to do this kind of work on their own but would be able to use it to further engage and inspire the children. It is also a chance for our team, particularly the ones who have not done client work, to have the experience of 1. Working to client needs 2. Being guided by subject matter experts 3. Seeing their work go out to the public.

Project definition

Objective

To create an AR experience based on a book the Hackney Pirates is co-writing with local children. Their poems, stories and maps evoke a sense of place (places special to each child) and we will use them to bring their work to life using animation and gamification through an AR app.

Scope

Hackney Pirates has existing materials (and will be acquiring more), so Kingston students will not need to create a storyline from scratch but rather build on what they have. They also have some existing characters we may opt to use.

Deliverables/ Interfaces

It is important that we create a finished product instead of a working prototype. This is the kind of project a child should be able to take away and show their family. The actual product form will be up to our group. In the past, they had a project using Blippar but it does not have to be that.

Constraints

The staff are quite busy, so while they are here to help us, we must be mindful of their time. We will need them for research, in particular, as we have an ethical board unlikely to approve research on minors.

Hackney Pirates is a trusted entity with a very strong brand. We must take care when writing our blog component in how we refer to them and the project. We might need to sign NDAs have have the blog text checked if we are naming them instead of referring to them as a “children’s literature charity.”

Project tolerances

Time: The Hackney Pirates have the children until June, so they do not need the project completed to the same rushed timeline as we do. Our timelines are fixed.
Budget: There is no budget
Scope: We are open to be creative as long as the children all feel represented and the experience relates to their stories in an age appropriate way and ends in a finished product.

Criteria for success

1. **Representation:** While it might be challenging to bring all the children’s stories “to life,” it is important that we ensure each child feels like he or she has contributed and been able to see their part represented. There are roughly 120 components, so grouping will be key. Additionally, there are two intakes, so both must be represented.
2. **Engagement:** This product should enhance their learning and continue to make reading fun for them. It should not detract from their stories but rather enhance them and encourage them to keep wanting read and write and find their voice. One way to do that will be through continuing with their sense of ownership.
3. **Multidisciplinary:** It should rely on solid UX research, animation concepts created by us, using games design strategies, and use the technology planned by our team.

Risk

We will not have proper ethical clearance to research on the students and must use Hackney Pirates staff as the intermediary. They are children’s literacy experts- but they are not children.

The timeframe from Dec to Jan will be very busy for us, and we will be best served if we can have a clear idea early and build the structure while waiting for the assets. Additionally, we will have a report due around the same time, so the sooner we can research our individual components, the less panic at the end.

Project timeline

Timeline

DATE/ DUE DATE	MILESTONES	ACTOR
Oct 20	Initial meeting	Amy and Hackney Pirates
Oct 24	First presentation	Group 3

Oct 24	Confirm partnership	Group 3
Oct 24	Meet with Martin re: UX	Amy and Beth
Oct 31	NDA agreement between HP and group 3	Amy and Lily to negotiate Team sign HP countersign
ASAP	1st assets to team	Hackney Pirates
ASAP	Team begins research/ structure/ tech planning	Group 3
Nov 14	Initial prototype implementing AR features	Phil and Alvin
Nov 14	Initial treasure chest, coins and telescope concept images	Julia
Nov 14	Presentation and feedback	Group 3/ Moderators
	Implement the multiple choice quiz mechanics	Alvin
	Sound???	
	Implement maze game	Phil
Nov 23	Characters and Characters' hats	Julia
Nov 24	Printer research, order mockup/ samples	Beth
Nov 24	Rough drafts from second intake of kids	Hackney Pirates
Nov 28	All Coins	Julia
Nov 29	Initial wireframes due	Beth
Nov 29	Research findings to team	Amy
Nov 29-3	Updates to wireframes based on any additional research.	Beth
Dec 3	Code the application	Phil and Alvin
Dec 3	Rough draft of article	Amy (send to team/ Martin)
Dec 5	Animation,3D model, Rigging	Julia
Dec7	Content Design	Julia

1 Dec- 8 Dec	Typed drafts	Hackney Pirates
8 Dec	Pull questions on assets already received Populate quiz with questions/answers	Amy/ Beth
8 Dec	All illustrations/ models not contingent on HP stories ready	Julia
8 Dec	Pre-programming the games, leaderboard, and any ready AR	Alex, Alvin and Phil
8 Dec	Polish demo (Game/book juice)	Phil
8 Dec (late)	HP book files to printer/ KU team	Hackney Pirates
9 Dec (SATURDAY) 9 Dec (SATURDAY)	KU team work together @ KU Presentation training/ script Everyone update slides Demo construction Activity book layout _____ Beth- layout book, print mockups Julia- animations on new assets Amy- pres script, pull ?s on new assets, dummy deck Alex- demo work; present demo; practice Phil/Alvin programming	Group 3
10 Dec	Map animation add	Julia
11 Dec	Book launch week, term end	Hackney Pirates; Amy pick up printed book
12 Dec	Final presentation/ demo	Group 3/ Moderators (feedback)
12-15 Dec	Optional visit to book event	Group 3
1 Jan	First set of design/ Implementation drafts to Amy	Group 3
ASAP	Team research/ structure/ storyboards/ designs/ etc	Group 3

6 Jan	Team meeting @ KU	Group 3
6 Jan (pm)	Create target image for waterfall game	Julia
7 Jan (am)	Confirm image works	Alvin and Phil
7 Jan (pm)	Create 8 target images for known games	Julia
7 Jan	ALL GAME CONCEPTS FINALISED	Alex, Phil, Alvin
8 Jan (am)	Confirm 8 targets work	Alvin and Phil
9 Jan	Remaining targets finished; all 25 ready	Julia
10 Jan	Testing targets; iterations as needed	Alvin and Phil; Julia
11 Jan (am)	Images to Beth	Phil
11-12 Jan	Design print book	Beth
15 Jan	Early team report done for checking	Amy
14-17 Jan	Print book in process	Beth
17 Jan	Feedback for report changes	Group 3
18 Jan	Show print book; test games with HP	Beth and Amy
18-22	Final reports, Group report, video and prototypes	Group 3; ALL HANDS ON DECK!
22 Jan	Artefact and report due	Group 3
12 Feb	Feedback and grades	Moderators
Late Jan/ Early Feb	Present work to HP/ Hand over, training and meet the kids (or video meet them as option)	Group 3

Research takeaways

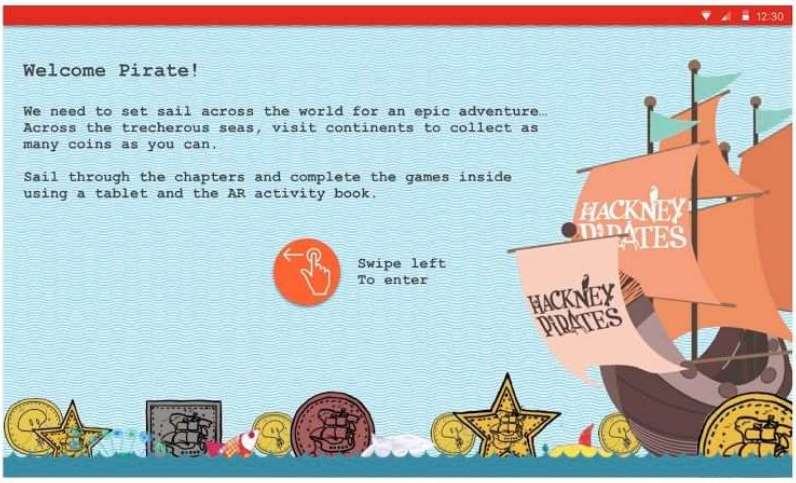
Key research takeaways for team

1. Sequencing difficult tasks is better easy, hard, easy, hard within chapter. Option to make each chapter more difficult. However, alternatives easy with hard motivates low achievers more.
2. Must be challenging but achievable
3. Time on task not effective measure because of different learning abilities and engagement
4. Gamification techniques (ie badges and awards) only work if the topic is interesting to begin with.
5. Positive benefits of AR may be because of the novelty factor. But while it is novelty, this time of it being effective, we might as well use it for engagement tool.
6. Tech savviness of parent/ teacher can strongly affect how well technology is implemented. Given the age of children, it is best that they can do it both on their own OR with a parent.
7. Future usage: most AR products aren't customisable for teachers
8. When using game theory, consider board game theory not just video games. This also helps with parent bias against gaming.
9. Watch for cognitive overload by too much task switching too quickly. High activity hotspots can detract from learning if not careful.
10. One of the highest ratings (or not) on AR experiences is interface design
11. Higher cognitive attainment is achieved when reading is child lead than adult lead (see cognitive aspects below)
12. Reading often is less a predictor of engagement than reading by choice
13. Animation provides a good way to gain the attention of a student and also to cue a student to focus on the most critical features of a screen display
14. AR is useful for Authentic explorations within the real world
15. Personally meaningful activities create the strongest learning experiences
16. Ultimately educational AR games more effective when teachers are involved in creation, not just academics
17. Having paper based instruction is more effective at directing student attention
18. Use themes to explore genre knowledge
19. Keller's learning model: motivational design process where the first step is to gain and sustain learners' attention and stimulate their curiosity to learn. The second step must guarantee that learning activities have been aligned with learners' personal goals and needs in order to be perceived as relevant.
20. Quest based learning is useful tool (ie quest to find and open the treasure chest)
21. Bloom's Taxonomy: Level 1 Remember, understand, apply (easy) Level 2 Analyze and evaluate (middle) Level 3 Create (ultimate)
22. <u>kinesthetic</u> representations of content results in substantial learning effects. (make them move but moving can be as simple as folding paper)
23. fantasy elements and the greater variety of learning tasks may have increased children's attention during gaming.
24. Gradual Immersion Method (GIM) consists of three intuitive modules wherein learners collaboratively achieve learning object goals through interaction with images and 3D models, in a sequential transition from 2D to 3D and then to AR.
25. Use sounds sparingly, particularly if they are backgrounds to actual word audio
26. Give children a role to play while reading.
27. Displaying/featuring children's writing helps foster reading engagement
28. Animations can motivate a child to return to an ebook they already read

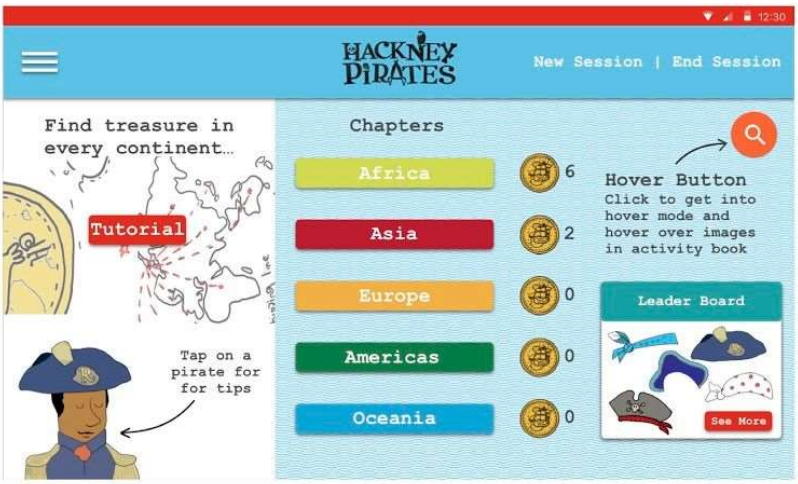
29. reusable instructional components known as learning objects (mazes, animations, etc) help acquire knowledge
30. AR is useful for providing context, interacting with the world, and perform activities

Cognitive classification
Semantic Memory
Spelling
Working Memory
Colour Perception
Visual Tracking
Mental Maths
Math Concepts
Reasoning
Matching Shapes
Problem Solving
Planning
Visual Motor Integration
Counting & Quantity
Visual Motor Speed
Spatial Perception
Selective Attention
Episodic Memory
Theory of Mind
Expressive Language
Math Numerosities
Music Perception
Inhibit
Organization

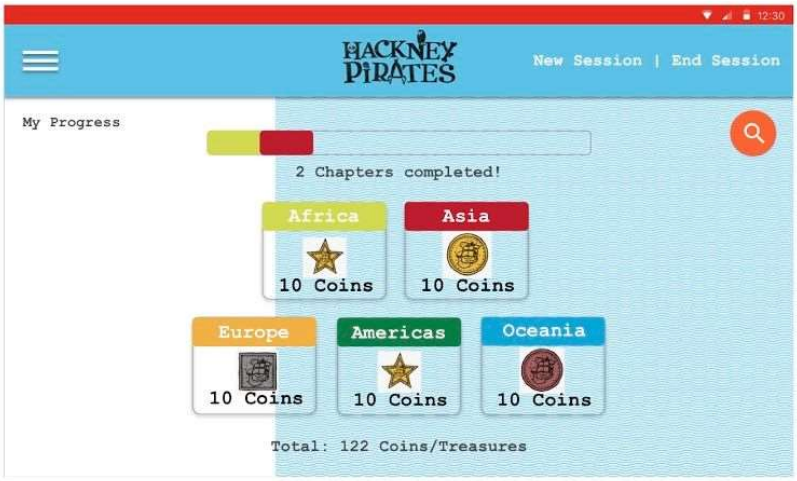
Wireframes



Enter Page

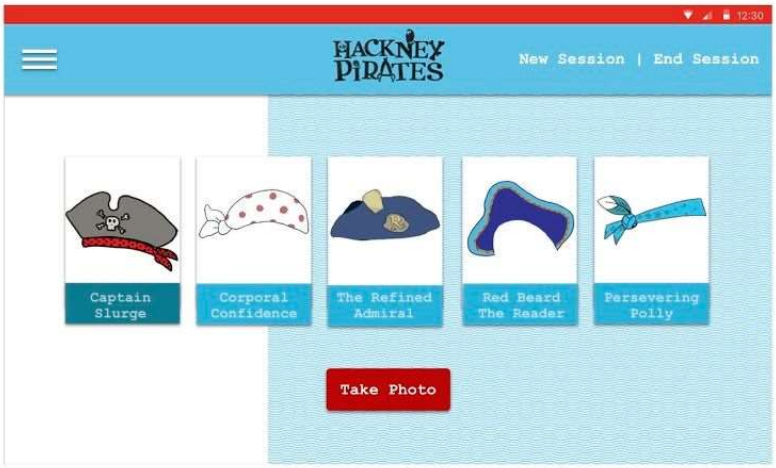


Homepage



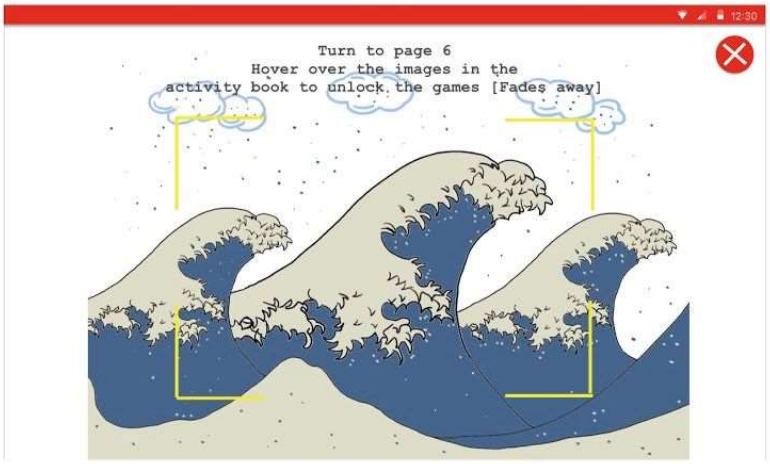
Progress Page

Leader Board

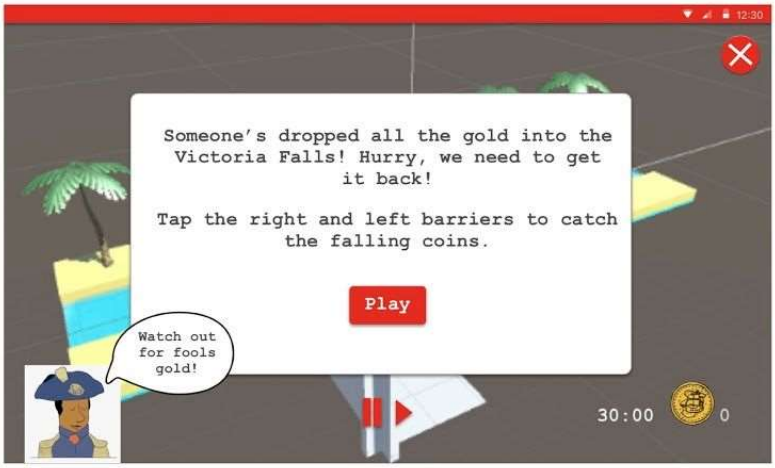


Selfie – Select Hat

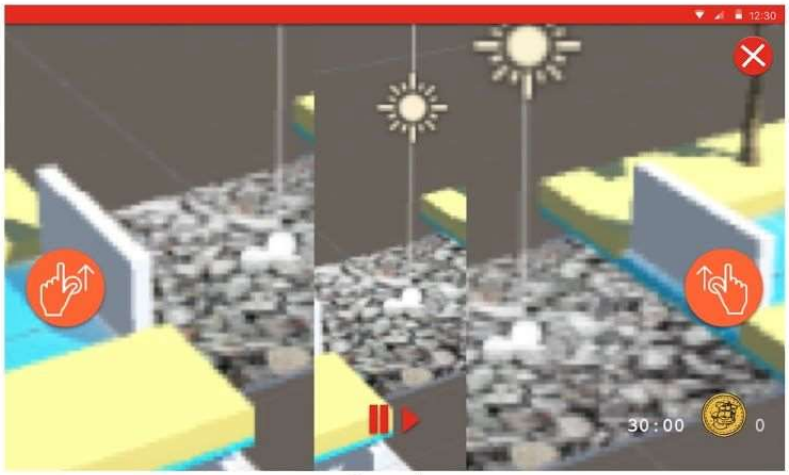
Take Selfie



Waterfall Target



Pre-Gameplay



Gameplay

Multiple choice questions

Chapter breakdown

Inside Cover	Us with pirate gear	1	
Instructions		2	
Welcome		3	
Contents			
Chapter	Item		Target Image?
Chapter 1 - Africa			
Animation	Menu or just animation		Country Button selected
Game	Waterfall	6	Water fall/waves
Quiz	Muliple Choice	7	Different shape ?
Game	Crazy Maze	8	Maze
Treasure Chest		9	Chest
Chapter 2 - Asia			
Animation	Menu or just animation		Country Button selected
Game	fishing/shooting spear	10	Fish
Quiz	Mulitple Choice	11	Different shape ?
Game	Fixing ship leaks	12	ship
Treasure Chest		13	Chest
Chapter 3 - Europe			
Animation	Menu or just animation		Country Button selected
Game	Coin Collecting Boat	14	Boat
Quiz	Multiple Choice	15	Different shape ?
Game	Guess the country/Map	16	Map
Treasure Chest		17	
Chapter 4 - Americas			
Animation	Menu or just animation		Country Button selected
Game	Donut Factory	18	Donut
Quiz	Multiple Choice	19	Different shape ?
Game	Card Matching/Memory Game with maps	20	
Treasure Chest		21	

Chapter 5 - Oceania/Antarctica			
Animation	Menu or just animation		Country Button selected
Game	shooting coconut	22	Coconut
Quiz	Multiple Choice	23	Different shape ?
Game	penguing sliding Game	24	Penguins
Treasure Chest		25	
Back Page		-	

Non-disclosure agreement

CONFIDENTIALITY AGREEMENT

THIS CONFIDENTIALITY AGREEMENT (the "Agreement") dated this _____ day of November, 2017

BETWEEN:

Hackney Pirates of 138 Kingsland High St, London E8 2NS (the "Client")

OF THE FIRST PART

- AND -

Kingston University Digital Media Students of Penrhyn Rd, Kingston upon Thames KT1 2EE (the "Contractor")

OF THE SECOND PART

BACKGROUND:

A. The Contractor is currently or may be retained as an independent contractor with the Client

for the position of STUDENT: UX designer, games designer, product owner, games programmers, animator. In addition to this responsibility or position (the "Retainer"), this Agreement also covers any position or responsibility now or later held with the Client.

B. The Contractor will receive from the Client, or develop on the behalf of the Client,

Confidential Information as a result of the Retainer (the 'Permitted Purpose').

IN CONSIDERATION OF and as a condition of the Client retaining the Contractor and the Client providing the Confidential Information to the Contractor in addition to other valuable consideration, the receipt and sufficiency of which consideration is hereby acknowledged, the parties to this Agreement agree as follows:

Confidential Information

1. All written and oral information and materials disclosed or provided by the Client to the

Contractor under this Agreement constitute Confidential Information regardless of whether such information was provided before or after the date of this Agreement or how it was provided to the Contractor.

2. The Contractor acknowledges that in any position the Contractor may hold, in and as a result

of the Contractor's retainer by the Client, the Contractor will, or may, be making use of,

acquiring or adding to information about certain matters and things which are confidential to the Client and which information is the exclusive property of the Client.

3. 'Confidential Information' means all data and information relating to the business and management of the Client, including but not limited to, the following:

a. 'Customer Information' which includes names of customers of the Client, their representatives, all customer contact information, contracts and their contents and parties, customer services, data provided by customers and the type, quantity and specifications of products and services purchased, leased, licensed or received by customers of the Client;

b. 'Marketing and Development Information' which includes marketing and development plans of the Client, price and cost data, price and fee amounts, pricing and billing policies, quoting procedures, marketing techniques and methods of obtaining business, forecasts and forecast assumptions and volumes, and future plans and potential strategies of the Client which have been or are being discussed;

c. 'Business Operations' which includes internal personnel and financial information of the Client, vendor names and other vendor information (including vendor characteristics, services and agreements), purchasing and internal cost information, internal services and operational manuals, external business contacts including those stored on social media accounts or other similar platforms or databases operated by the Client, and the manner and methods of conducting the Client's business;

d. 'Product Information' which includes all specifications for products of the Client as well as work product resulting from or related to work or projects performed or to be performed for the Client or for clients of the Client, of any type or form in any stage of actual or anticipated research and development;

e. 'Production Processes' which includes processes used in the creation, production and manufacturing of the work product of the Client, including but not limited to, formulas, patterns, icons, models, methods, techniques, specifications, processes, procedures, equipment, devices, programs, and designs; and

f. Confidential Information will also include any information that has been disclosed by a third party to the Client and is protected by a non-disclosure agreement entered into between the third party and the Client.

4. Confidential Information will not include the following information:

a. Information that is generally known in the industry of the Client;

b. Information that is now or subsequently becomes generally available to the public through no wrongful act of the Contractor;

c. Information rightly in the possession of the Contractor prior to receiving the Confidential Information from the Client;

d. Information that is independently created by the Contractor without direct or indirect use of the Confidential Information; or

e. Information that the Contractor rightfully obtains from a third party who has the right to transfer or disclose it.

Confidential Obligations

5. Except as otherwise provided in this Agreement, the Contractor must keep the Confidential Information confidential.

6. Except as otherwise provided in this Agreement, the Confidential Information will remain the

exclusive property of the Client and will only be used by the Contractor for the Permitted Purpose. The Contractor will not use the Confidential Information for any purpose that might be directly or indirectly detrimental to the Client or any associated affiliates or subsidiaries.

7. The obligations to ensure and protect the confidentiality of the Confidential Information imposed on the Contractor in this Agreement and any obligations to provide notice under this Agreement will survive the expiration or termination, as the case may be, of this Agreement and will be continuous from the date of this Agreement until 31 January 2018, except in the case of any Confidential Information which is a trade secret in which case those obligations will last indefinitely.

8. The Contractor may disclose any of the Confidential Information:

a. to such employees, agents, representatives and advisors of the Contractor that have a reasonable need to know for the Permitted Purpose provided that:

i. the Contractor has informed such personnel of the confidential nature of the Confidential Information;

ii. such personnel agree to be legally bound to the same burdens of confidentiality and non-use as the Contractor;

iii. the Contractor agrees to take all necessary steps to ensure that the terms of this

Agreement are not violated by such personnel; and

iv. the Contractor agrees to be responsible for and indemnify the Client for any

breach of this Agreement by its personnel.

b. to a third party where the Client has consented in writing to such disclosure; and

c. to the extent required by law or by the request or requirement of a court of law, a

regulatory body, or an administrative tribunal.

Avoiding Conflict of Opportunities

9. It is understood and agreed that any business opportunity relating to or similar to the Client's

current or anticipated business opportunities coming to the attention of the Contractor during the Contractor's retainer is an opportunity belonging to the Client. Accordingly, the Contractor will advise the Client of the opportunity and cannot pursue the opportunity, directly or indirectly, without the written consent of the Client.

10. Without the written consent of the Client, the Contractor further agrees not to directly or

indirectly, engage or participate in any other business activities which the Client, in its reasonable discretion, determines to be in conflict with the best interests of the Client.

Ownership and Title

11. The Contractor acknowledges and agrees that all rights, title and interest in any Confidential

Information will remain the exclusive property of the Client. Accordingly, the Contractor specifically agrees and acknowledges that the Contractor will have no interest in the Confidential Information, including, without limitation, no interest in know-how, copyright, trademarks or trade names, notwithstanding the fact that the Contractor may have created or contributed to the creation of that Confidential Information.

12. The Contractor does hereby waive any moral rights that the Contractor may have with respect

to the Confidential Information.

13. The Confidential Information will not include anything developed or produced by the

Contractor during the term of this Agreement, including but not limited to intellectual property, process, design, development, creation, research, invention, know-how, trade name, trademarks or copyright that:

a. was developed without the use of any equipment, supplies, facility or Confidential Information of the Client;

b. was developed entirely on the Contractor's own time;

c. does not relate to the actual business or reasonably anticipated business of the Client;

d. does not relate to the actual or demonstrably anticipated processes, research or development of the Client; and

e. does not result from any work performed by the Contractor for the Client.

14. The Contractor agrees to immediately disclose to the Client all Confidential Information developed in whole or in part by the Contractor during the term of the Retainer and to assign to the Client any right, title or interest the Contractor may have in the Confidential Information. The Contractor agrees to execute any instruments and to do all other things reasonably requested by the Client (both during and after the term of the Retainer) in order to vest more fully in the Client all ownership rights in those items transferred by the Contractor to the Client.

Remedies

15. The Contractor agrees and acknowledges that the Confidential Information is of a proprietary and confidential nature and that any failure to maintain the confidentiality of the Confidential Information in breach of this Agreement cannot be reasonably or adequately compensated for in money damages and would cause irreparable injury to the Client. Accordingly, the Contractor agrees that the Client is entitled to, in addition to all other rights and remedies available to it at law or in equity, an injunction restraining the Contractor, any of its personnel, and any agents of the Contractor, from directly or indirectly committing or engaging in any act restricted by this Agreement in relation to the Confidential Information.

Return of Confidential Information

16. The Contractor agrees that, upon request of the Client, or in the event that the Contractor ceases to require use of the Confidential Information, or upon expiration or termination of this Agreement, or the expiration or termination of the Retainer, the Contractor will turn over to the Client all documents, disks or other computer media, or other material in the possession or control of the Contractor that:

a. may contain or be derived from ideas, concepts, creations, or trade secrets and other proprietary and Confidential Information as defined in this Agreement; or

b. is connected with or derived from the Contractor's services to the Client.

Notices

17. In the event that the Contractor is required in a civil, criminal or regulatory proceeding to disclose any part of the Confidential Information, the Contractor will give to the Client prompt written notice of such request so the Client may seek an appropriate remedy or alternatively to waive the Contractor's compliance with the provisions of this Agreement in regards to the request.

18. If the Contractor loses or fails to maintain the confidentiality of any of the Confidential Information in breach of this Agreement, the Contractor will immediately notify the Client and take all reasonable steps necessary to retrieve the lost or improperly disclosed Confidential Information.

19. Any notices or delivery required in this Agreement will be deemed completed when hand- delivered, delivered by agent, or seven (7) days after being placed in the post, postage prepaid, to the parties at the addresses contained in this Agreement or as the parties may later designate in writing.

20. The addresses for any notice to be delivered to any of the parties to this Agreement are as follows:

a. Hackney Pirates

138 Kingsland High St, London E8 2NS

b. Kingston University Digital Media Students

Penrhyn Rd, Kingston upon Thames KT1 2EE

Representations

21. In providing the Confidential Information, the Client makes no representations, either expressly or impliedly as to its adequacy, sufficiency, completeness, correctness or its lack of defect of any kind, including any patent or trade mark infringement that may result from the use of such information.

Termination

22. This Agreement will automatically terminate on the date that the Contractor's Retainer with

the Client terminates or expires, as the case may be. Except as otherwise provided in this Agreement, all rights and obligations under this Agreement will terminate at that time.

Assignment

23. Except where a party has changed its corporate name or merged with another corporation, this

Agreement may not be assigned or otherwise transferred by either party in whole or part without the prior written consent of the other party to this Agreement.

Amendments

24. This Agreement may only be amended or modified by a written instrument executed by both

the Client and the Contractor.

Governing Law

25. This Agreement will be construed in accordance with and governed by the laws of England.

Additional Provisions

26. KU students will obtain approval before mentioning Hackney Pirates' project on social media

KU students will not reveal the book text until after publication. KU students will not redistribute copies of the book. KU students will submit the project for university work and text will go into both Turnitin and university library. KU students will use project for their online portfolio.

26. General Provisions

27. Time is of the essence in this Agreement.

28. This Agreement may be executed in counterpart.

29. Headings are inserted for the convenience of the parties only and are not to be considered

when interpreting this Agreement. Words in the singular mean and include the plural and vice versa. Words in the masculine mean and include the feminine and vice versa.

30. The clauses, paragraphs, and subparagraphs contained in this Agreement are intended to be read and construed independently of each other. If any part of this Agreement is held to be invalid, this invalidity will not affect the operation of any other part of this Agreement.

31. The Contractor is liable for all costs, expenses and expenditures including, and without limitation, the complete legal costs incurred by the Client in enforcing this Agreement as a result of any default of this Agreement by the Contractor.

32. The Client and the Contractor acknowledge that this Agreement is reasonable, valid and enforceable. However, if a court of competent jurisdiction finds any of the provisions of this Agreement to be too broad to be enforceable, it is the intention of the Client and the Contractor that such provision be reduced in scope by the court only to the extent deemed necessary by that court to render the provision reasonable and enforceable, bearing in mind that it is the intention of the Contractor to give the Client the broadest possible protection to maintain the confidentiality of the Confidential Information.

33. No failure or delay by the Client in exercising any power, right or privilege provided in this

Agreement will operate as a waiver, nor will any single or partial exercise of such rights, powers or privileges preclude any further exercise of them or the exercise of any other right, power or privilege provided in this Agreement.

34. This Agreement will inure to the benefit of and be binding upon the respective heirs, executors, administrators, successors and assigns, as the case may be, of the Client and the Contractor.

35. This Agreement constitutes the entire agreement between the parties and there are no further

items or provisions, either oral or otherwise.

IN WITNESS WHEREOF Hackney Pirates and Kingston University Digital Media Students have duly affixed their signatures under hand and seal on this _____ November 2017.

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Hackney Pirates client

_____

Signature:_____

WITNESS: _____

Name:_____

__ Address: _____

_

_____ WITNESS: _____ Address:

_____

Kingston University Digital Media Student

Signature: _____

Name: _____

Role: _____