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Fearn, Warren ORCID logoORCID:
<https://orcid.org/0000-0002-2029-630X> (2024) A Service Design Approach: What are the barriers and opportunities to using augmented reality in primary science education? In: Animex Research and Innovation Conference 2024, 13 November 2024, Teesside University. (Unpublished)

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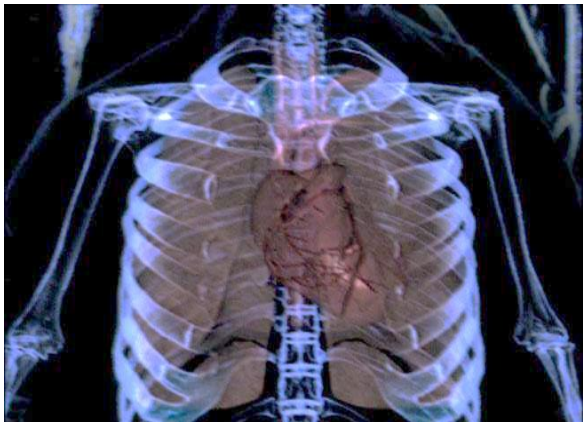
A **Service Design** Approach: What are the barriers and opportunities to using augmented reality in primary science education?

Animex Festival 12 11 24

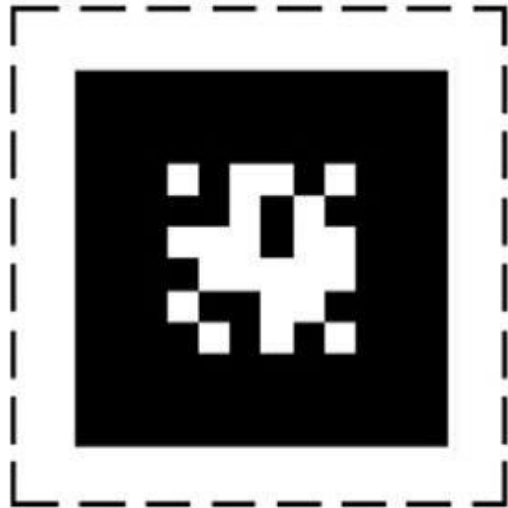
Warren Fearn
Associate Professor in Design
York St John University

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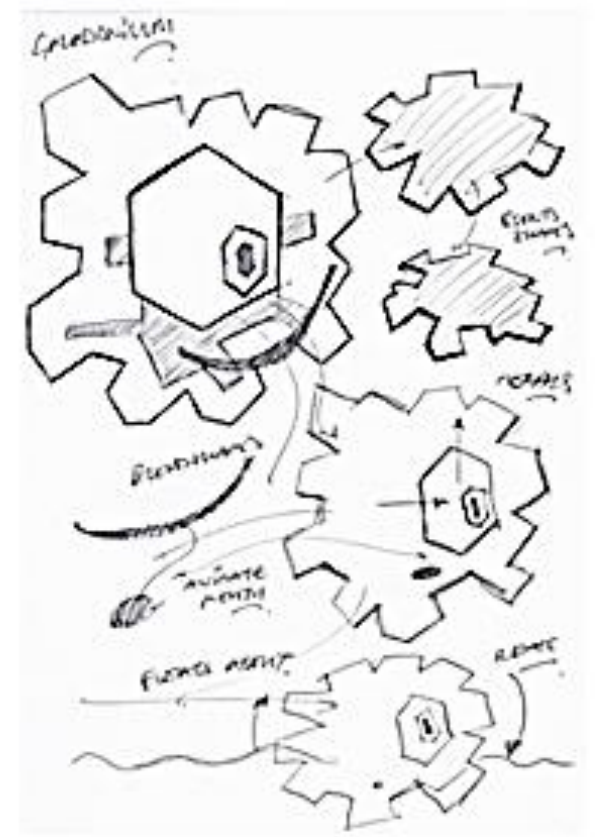


ARGON (Ar)



Point your iPhone, iPod Touch or iPad at the marker to view a 3D hologram

- **Discovered:** 1894
- **Atomic Number:** 18
- **Atomic Weight:** 39.948
- **Density At 0 C:** 101.325 kPa
- **Melting Point:** -189.35 C
- **Freezing Point:** -189.2 C



(Akçayir, Akçayir, 2017; Wang, et al., 2017; Radu, 2014; Yuen, Yaoyuneyong, Johnson, 2011), suggest educators and designers collaborate to **create sound pedagogy when developing AR applications** that maximise learning outcomes.

Silva et al. (2019) found that although educators recognise the potential of AR, the **adoption of such technologies within mainstream schools is rare.**

(Kerawalla, Woolward, Luckin, 2006; Bistaman, Idrus, Rashid, 2018) specifically, demonstrate that AR positively impacts the **teaching and learning experience** for primary science education.

(Wellcome Trust, 2017) that primary teachers within the UK education system are now only managing to devote an average of **1 hour and 24 minutes per week** to teaching science



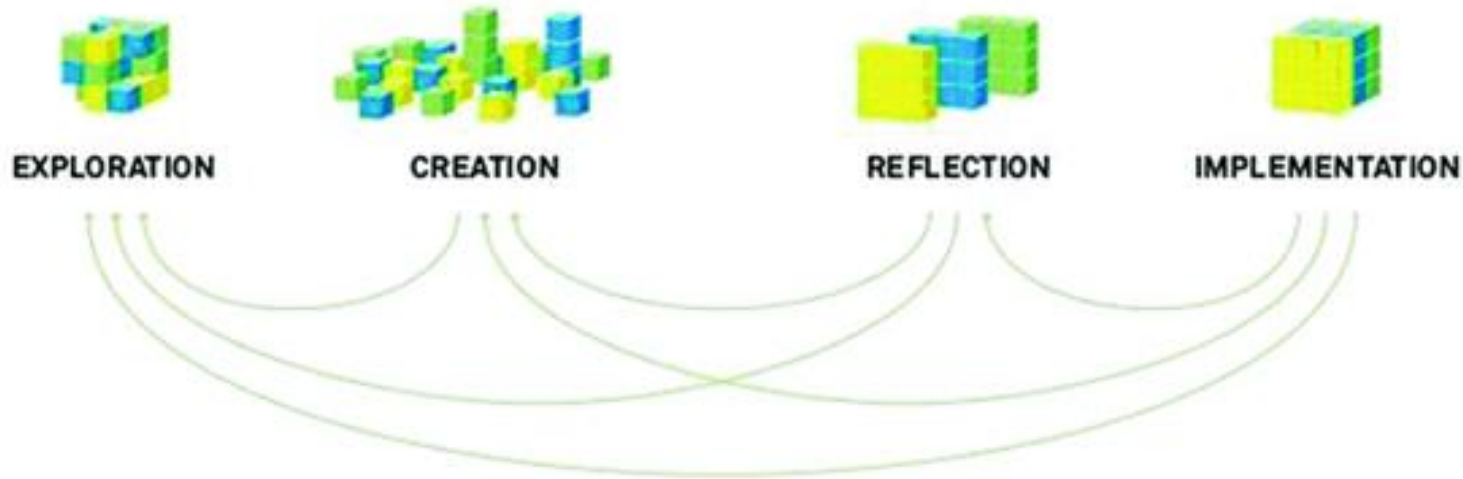
1) How can AR create new remote experiences outside of the classroom?

2) What are the barriers and opportunities for using augmented reality within primary schools?

Exploration:

Design Methodology

Service Design Thinking Process 4 Stage Process



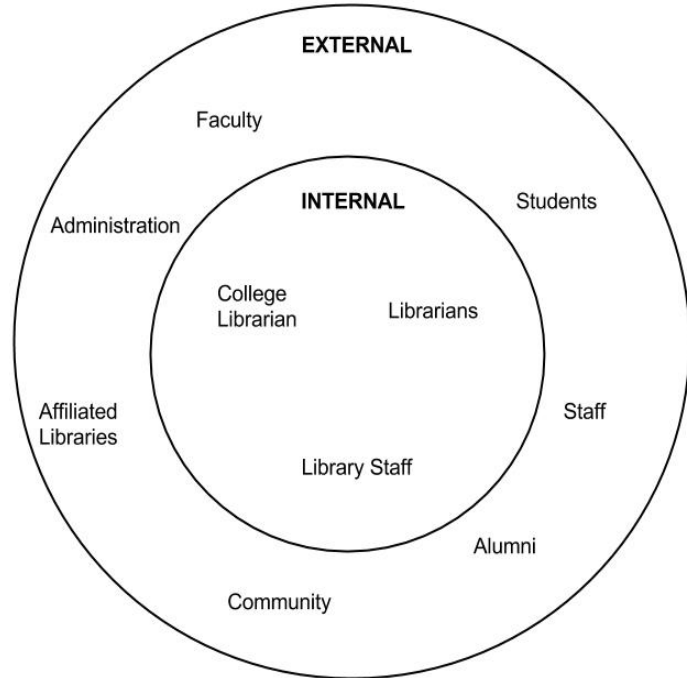
Stickdorn, Hormess, Lawrence and Schneider (2018)
This is Service Design Thinking

5 Principles of Service Design

1. User Centred
2. Co Creative
3. Sequencing
4. Evidencing
5. Holistic

Exploration:

Stakeholders / Education / Co-Creators



Nicky Waller

Primary Science Advisory Teacher at CIEC (Centre for Industry Education Collaboration) University of York



Tim Moat

Director of Communications and Development Ebor Academy Trust York



Ebor Academy Trust

Pupils - Keystage 2



Associate Professor Dr Katy Bloom

Associate Professor of Initial Teacher Education, School of Education, Languages and Psychology York St John University



Jake Reeves Kemp

Computing Specialist Lead Ebor Academy Trust York

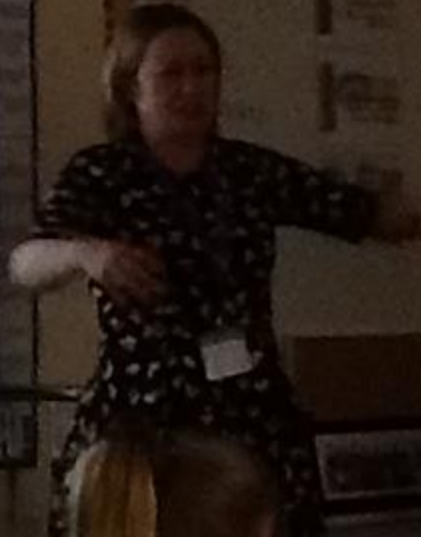


Emma Davies

Science Academy Leader Ebor Academy Trust York



Exploration: Classroom Observations



short science explanation video on See Saw to
what your group has found out
your scientific vocabulary so you sound like a science
GENIUS!

Information in your video must include:

- the question you want to find out and why this information might be useful?
- demonstration of what you did.
- how you made sure your test was fair.
- what you predicted
- what your results showed and whether your prediction was correct
- how well you think you worked as a group and how your team work might be improved

Year 5 go...

"MATERIALISTIC"

properties
particles
solid, liquid, gas
conductor, insulator
dissolve

The way I would describe the pattern is

What makes the best

The thing I noticed was

How.....?

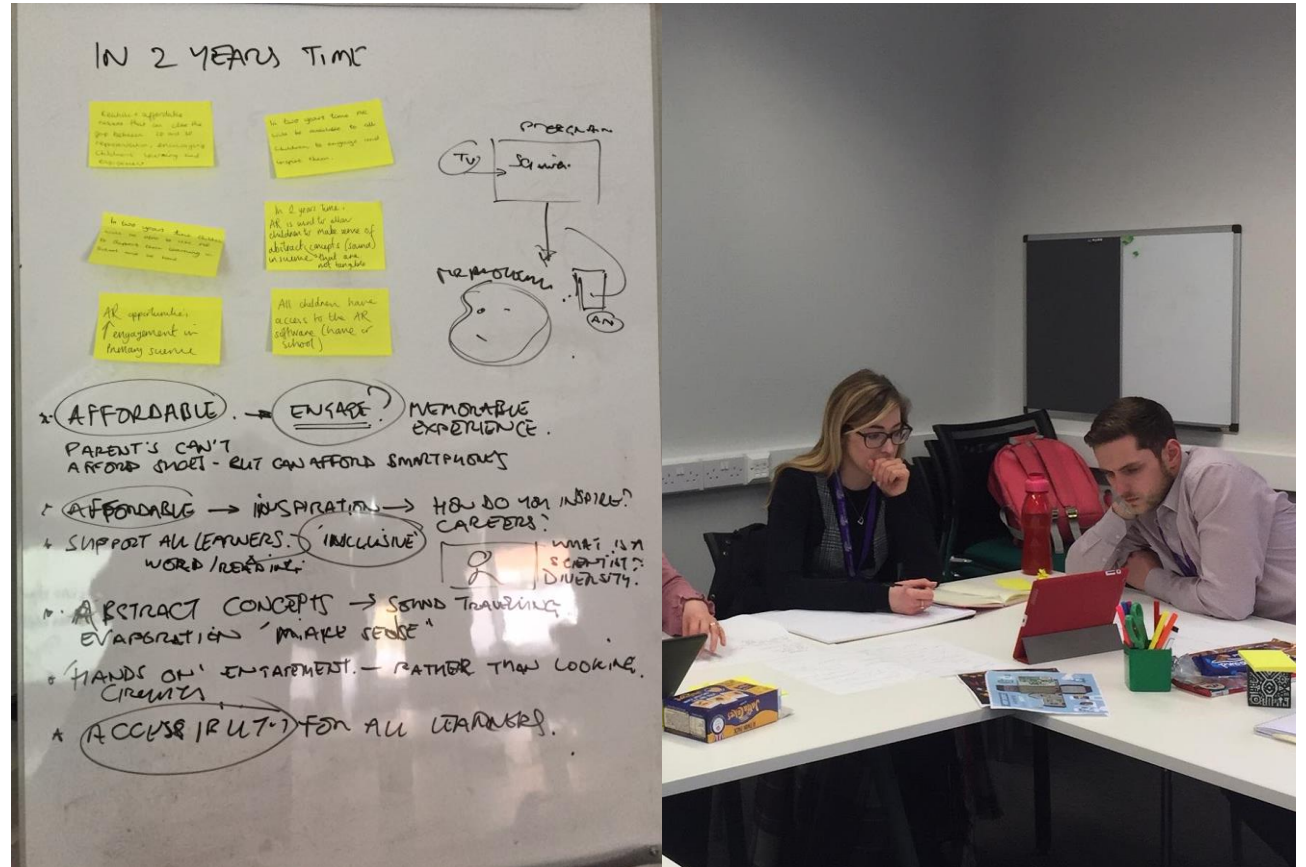
How many...?

Air Resistance!

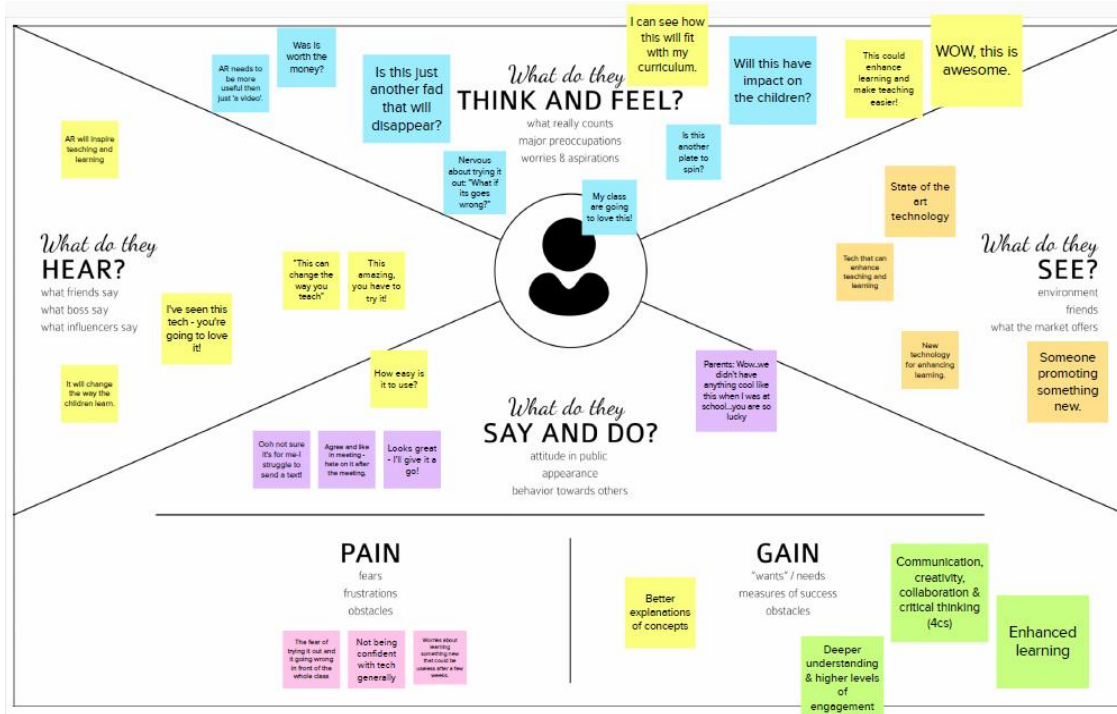


Exploration:

Focus Groups / Design Sprints



Exploration: Empathy Mapping

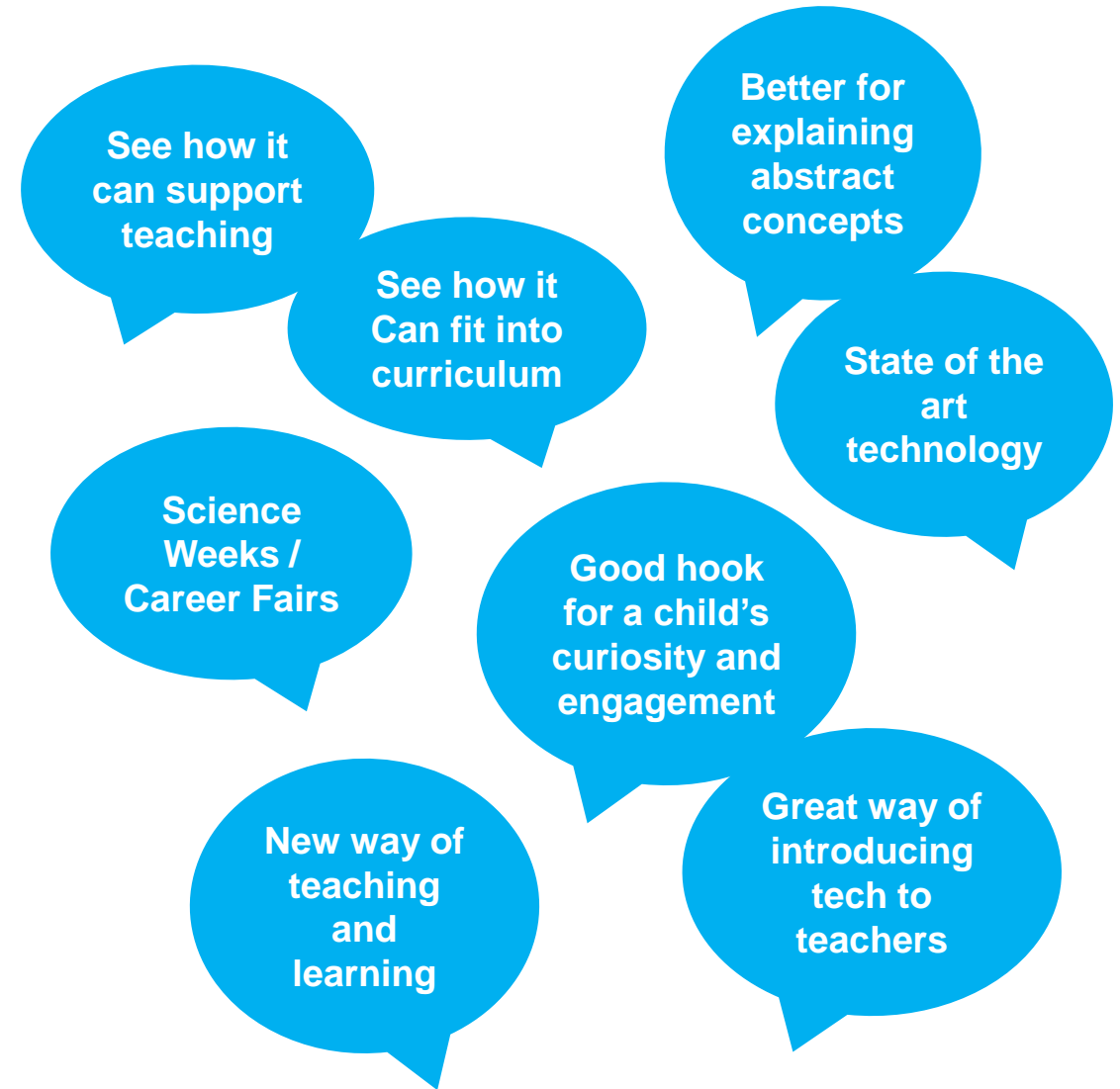


Exploration:

In Depth Interviews



Challenges

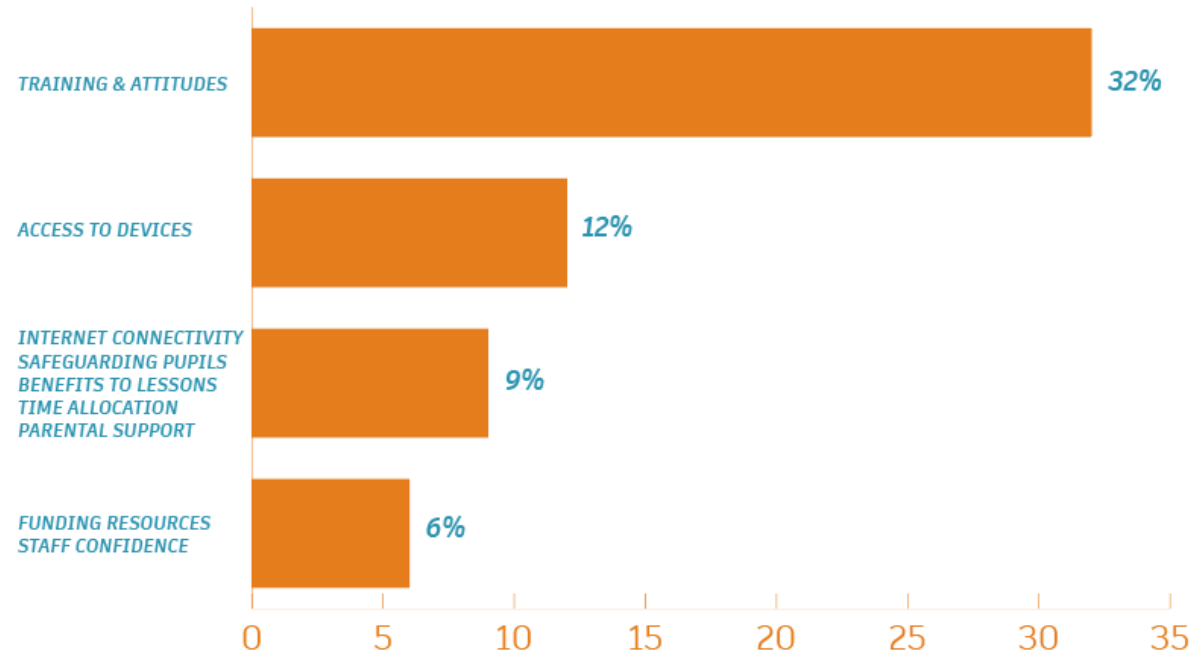


Benefits

Exploration:

Survey

62 Primary School Teachers



Affordability & Investment

Attitude & Confidence

IT Infrastructure (WI-FI)

Time Preparation

CPD & Training

Inclusive

Curriculum Alignment

Cross Curriculum (STEM)

Connecting Science to Real Life

Science Capital

Digital Divide

No Level Playing Field

Easy navigation

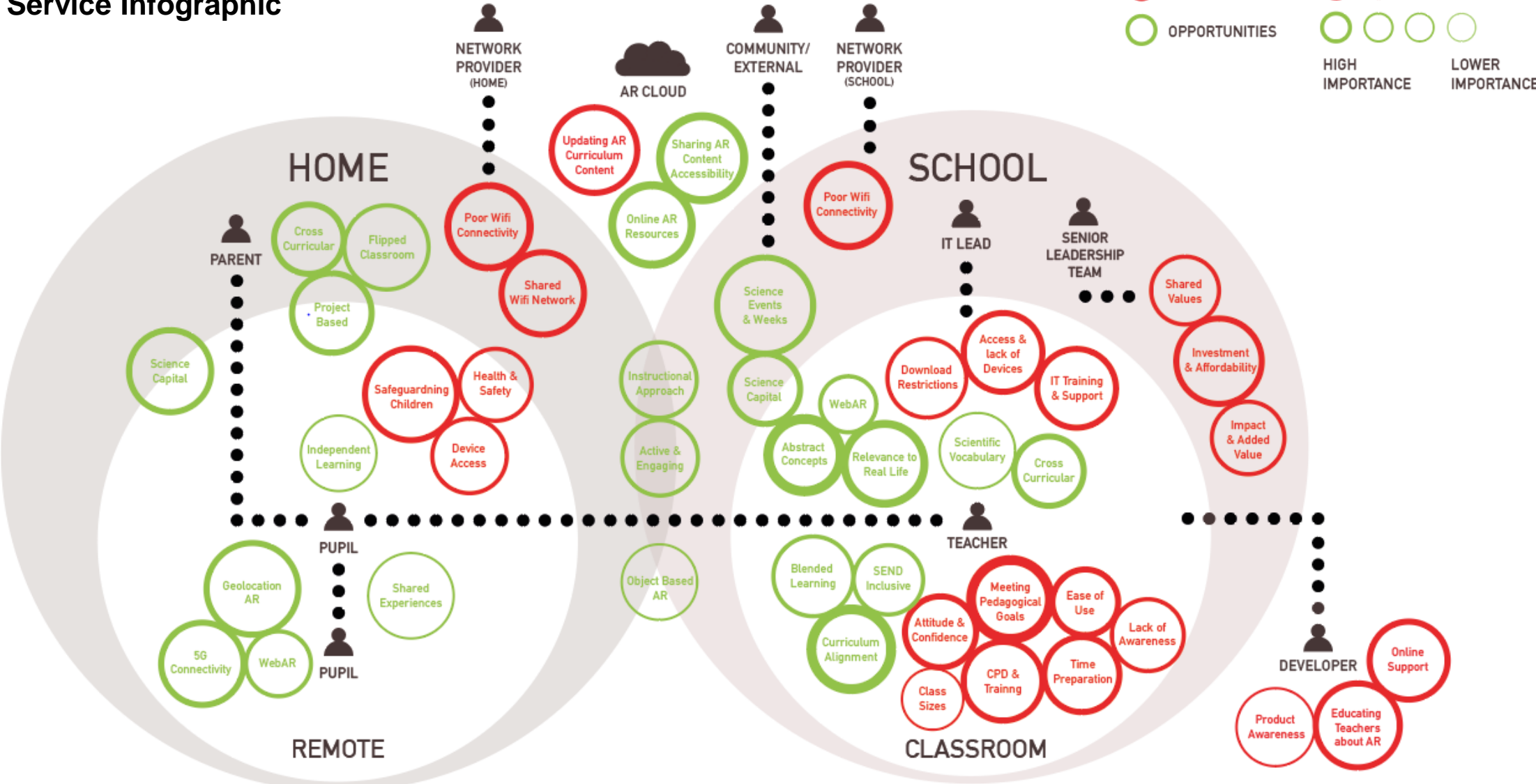
Exploration:

Service Infographic

KEY:

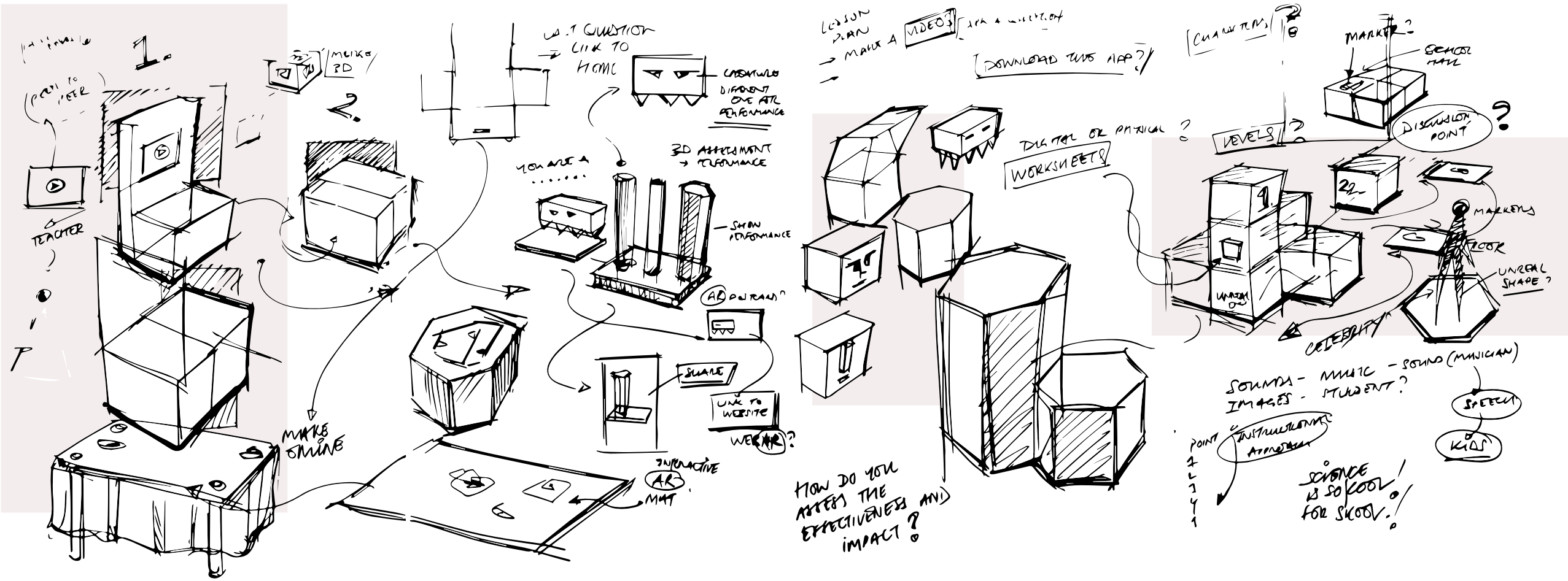
- BARRIERS
- OPPORTUNITIES

○ ○ ○ ○ HIGH IMPORTANCE
○ ○ ○ ○ LOWER IMPORTANCE



Creation:

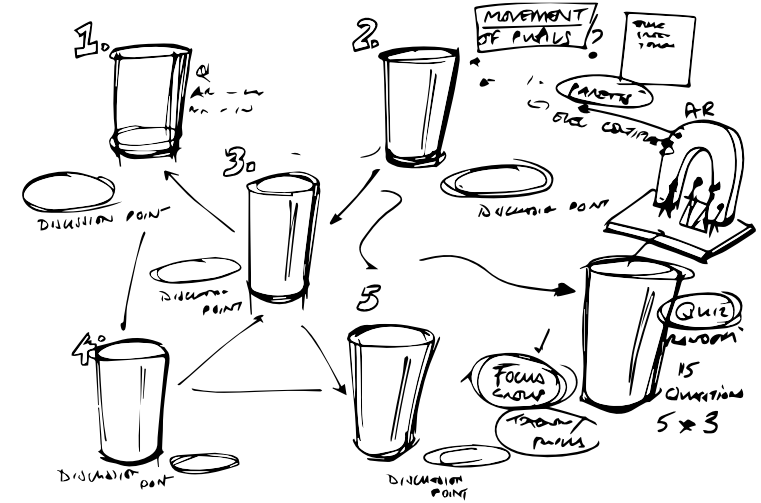
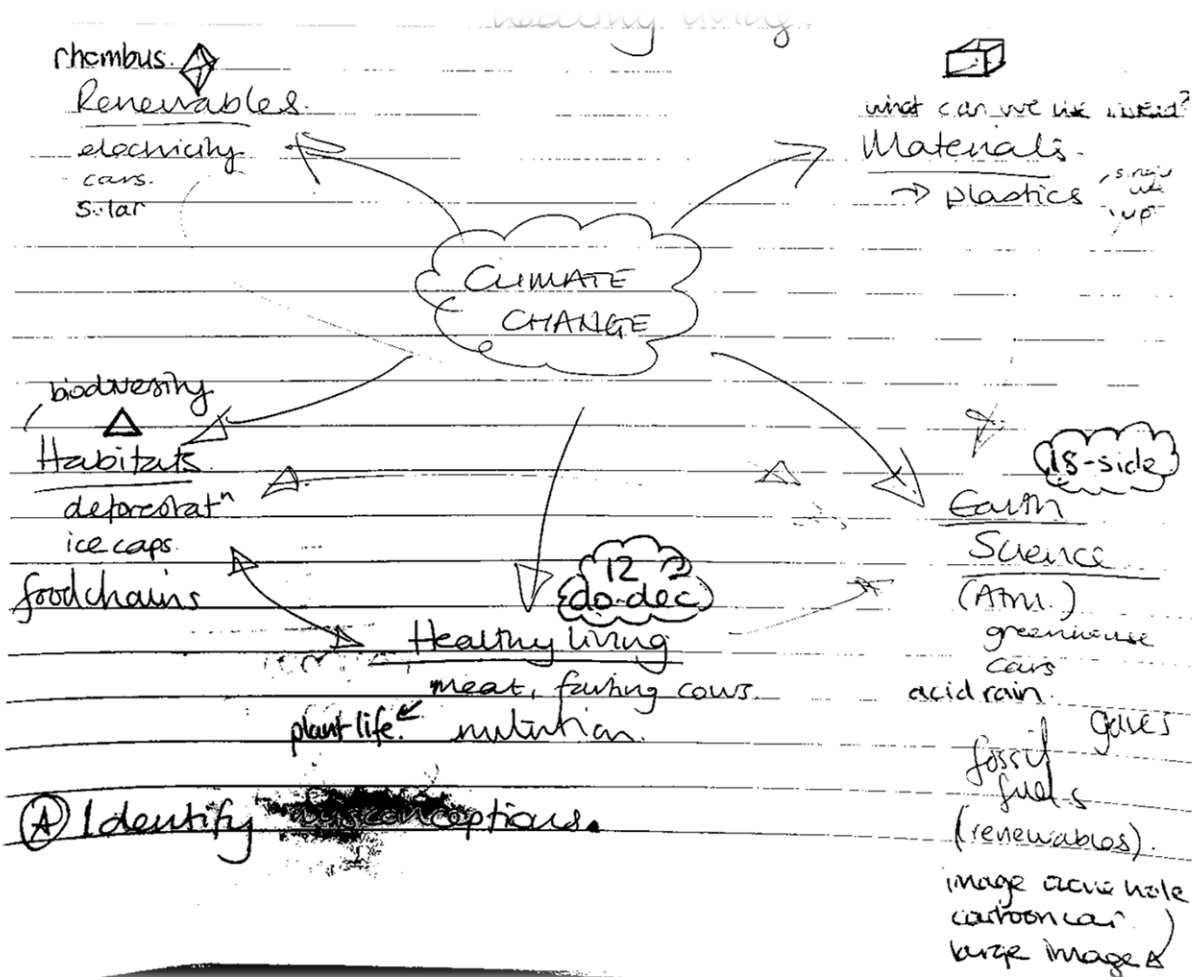
AR Science Exhibition



Introducing AR / Change Content (Cloud-based) / Image-Based Recognition / Group Work / Themed

Creation:

Customer Journey Mapping / Teacher Focus Group



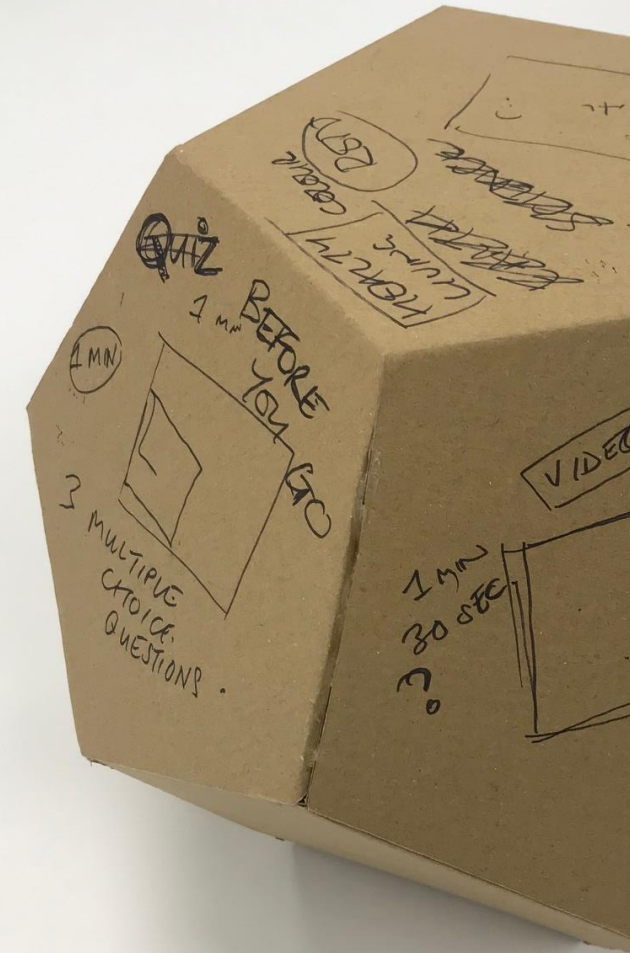
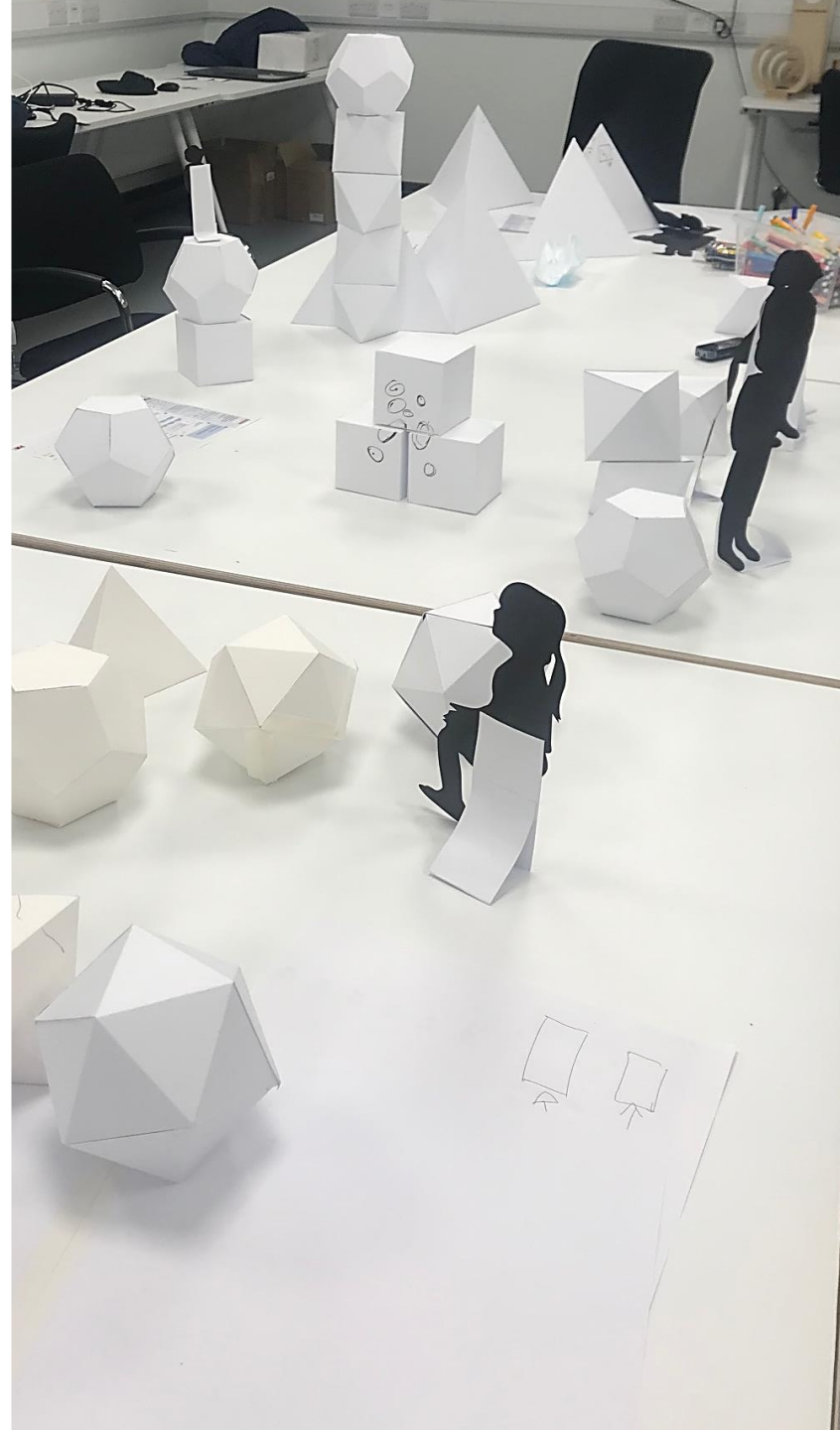
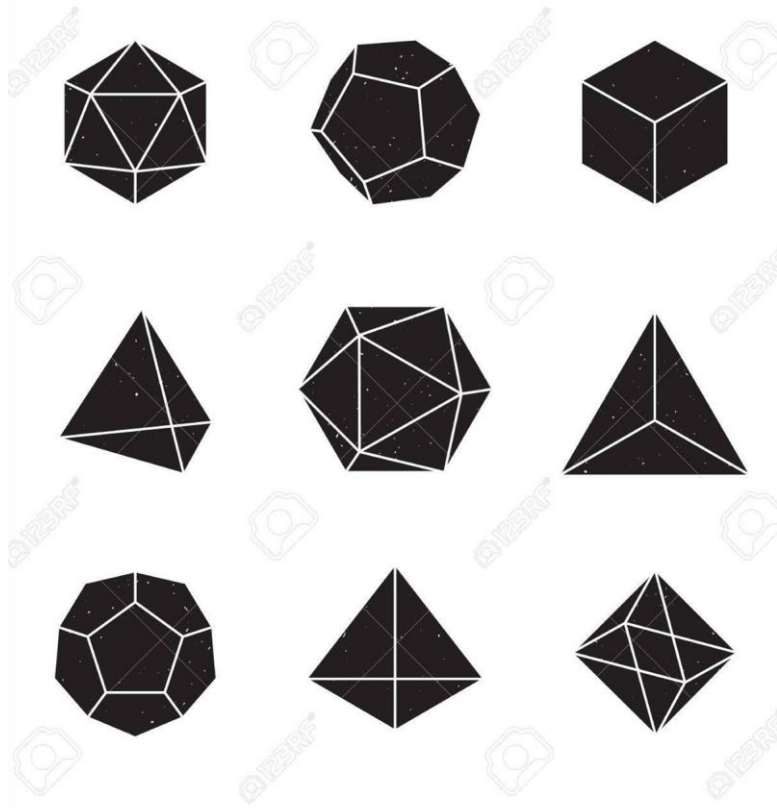
Theme: Climate Change

5 Stations: Healthy Living, Materials, Renewables, Climate, Habitats.

1. Questions
2. Video
3. AR Experience
4. AR Interactive
5. Quiz

Creation:

Roleplaying



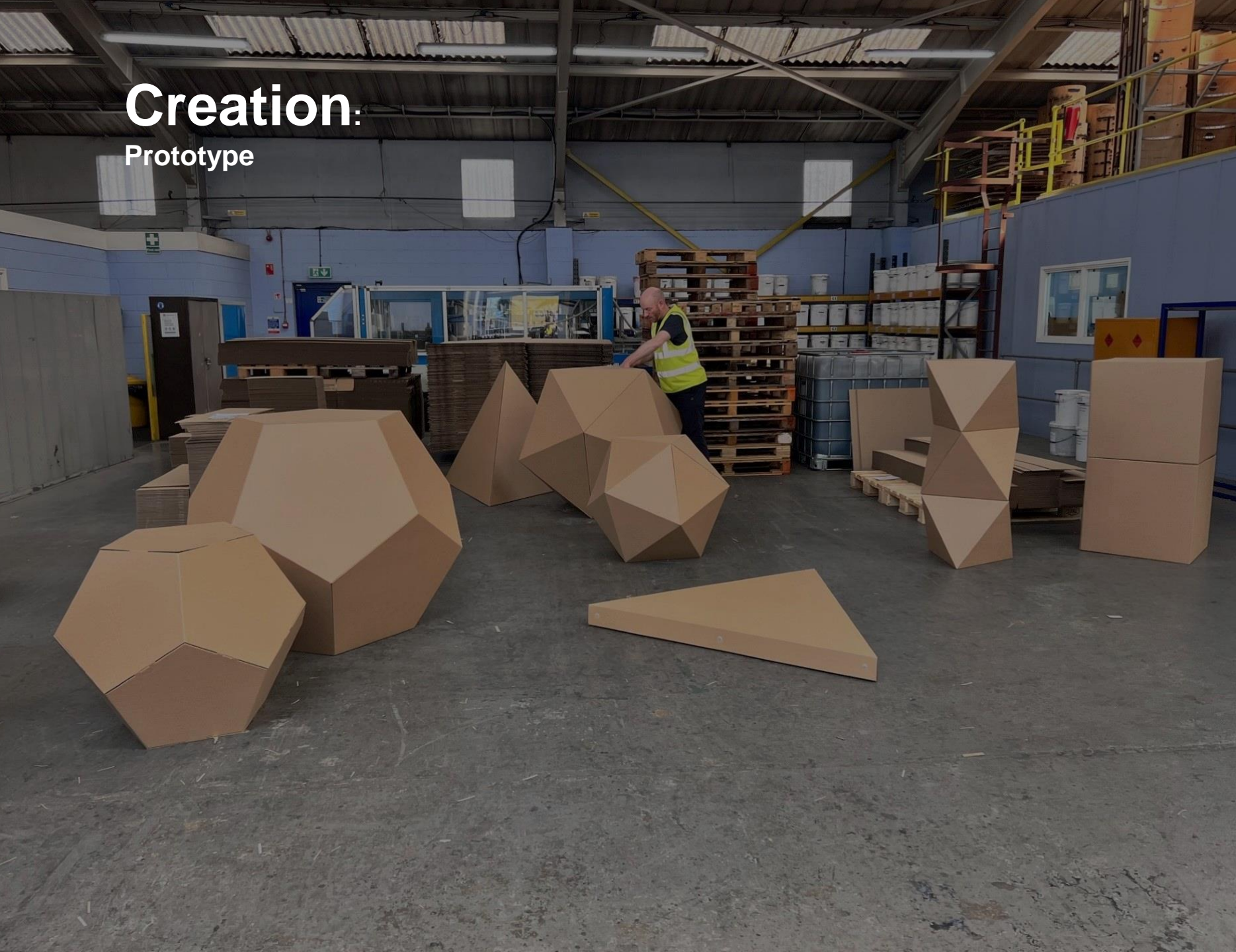
Creation:

Visualise



Creation:

Prototype



Creation:

Reflect / Visualise

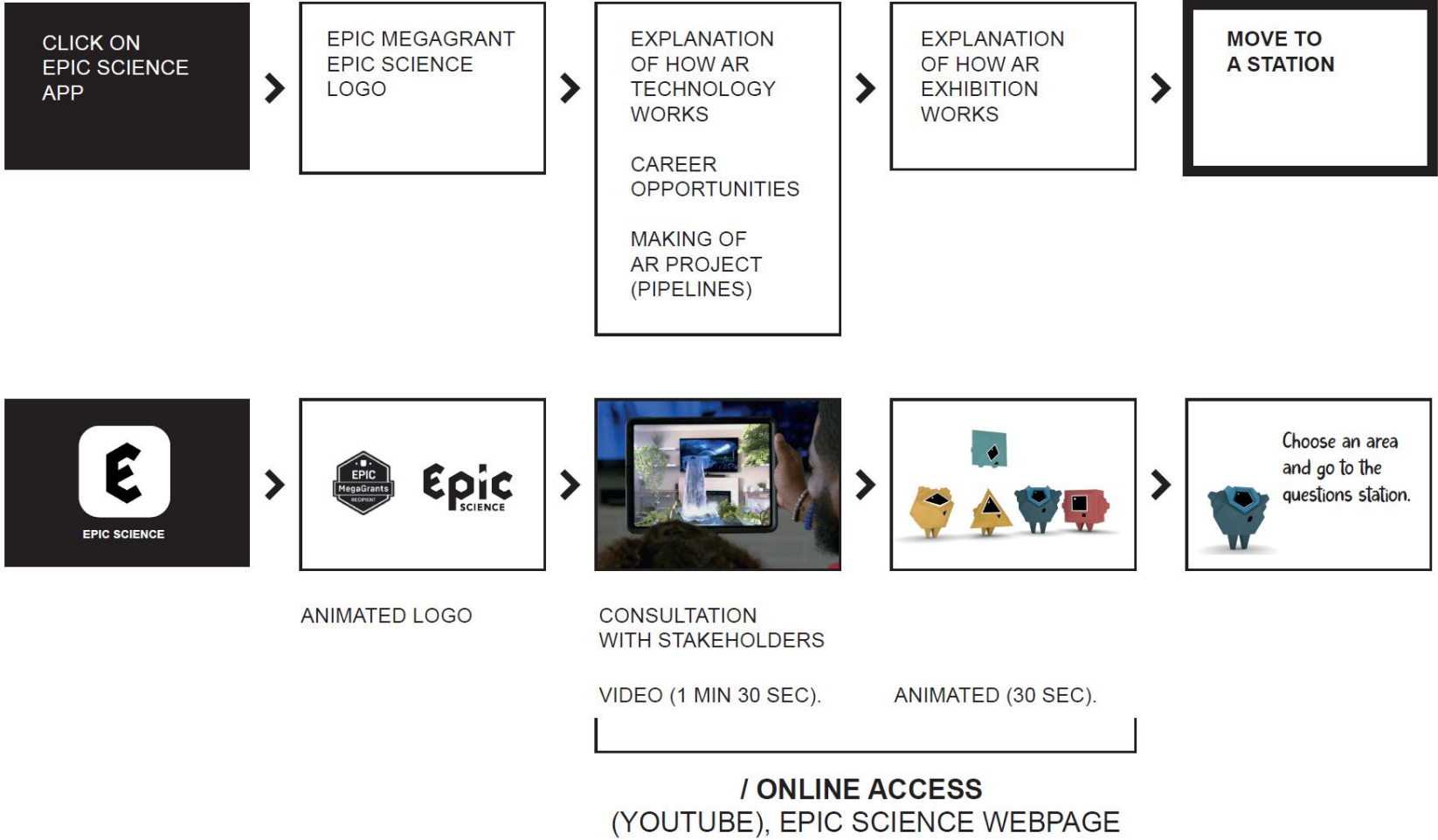
Epic
SCIENCE





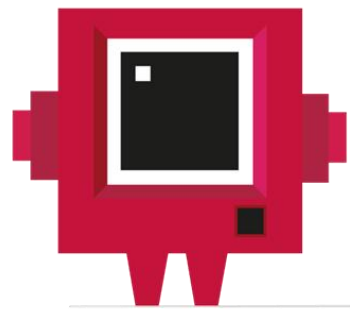
Creation:

Customer Journey Mapping

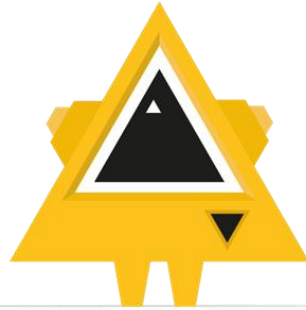


Creation:

Character Design



HEX



TETA



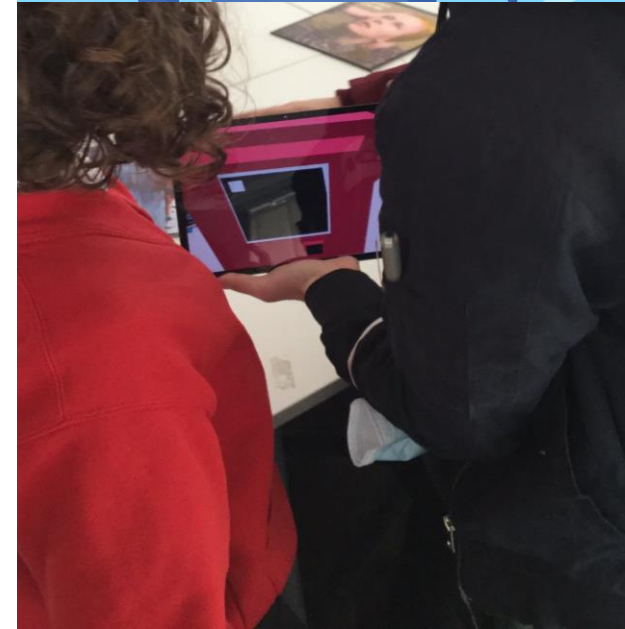
IOO



DODA



OCTO



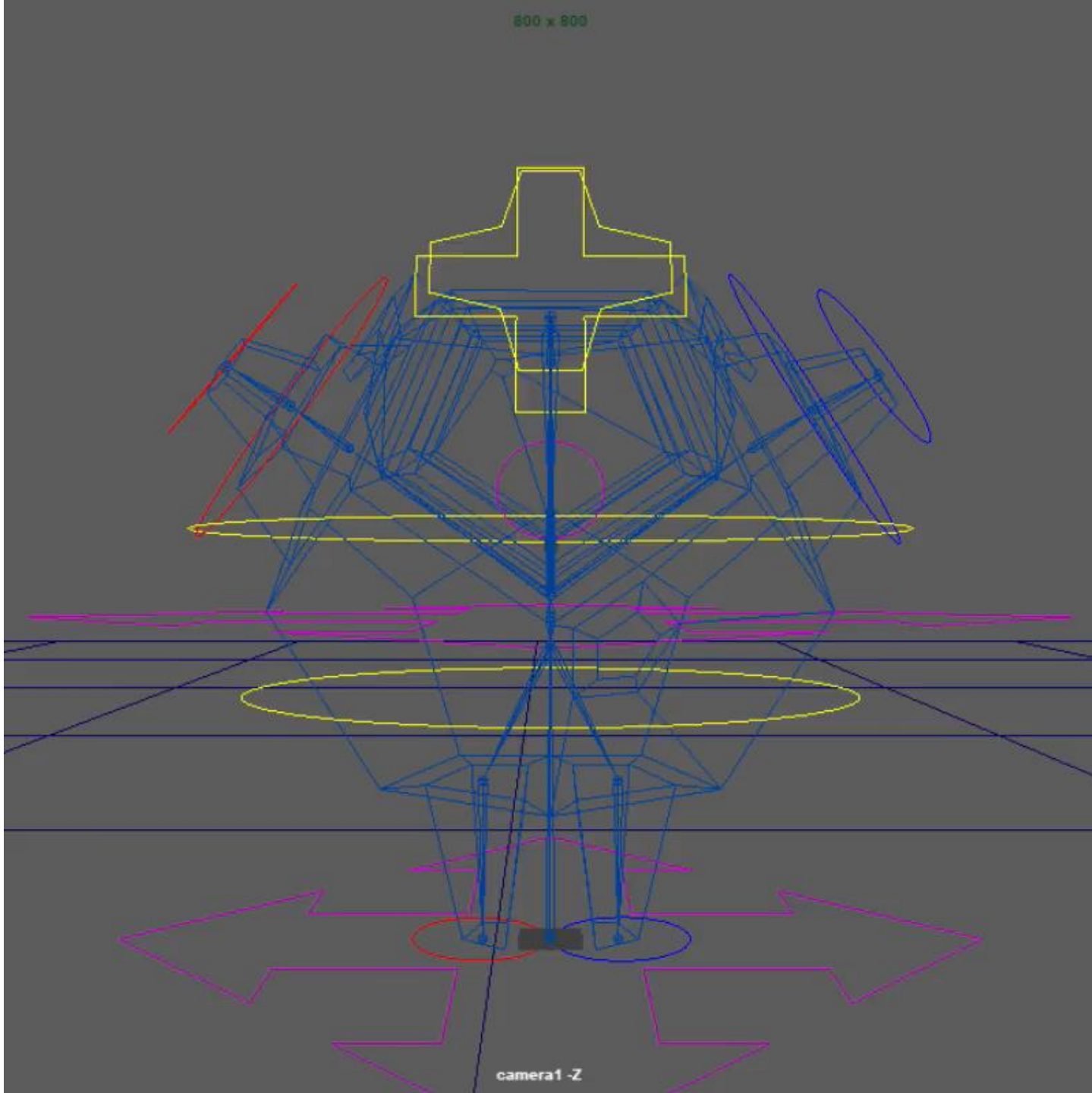
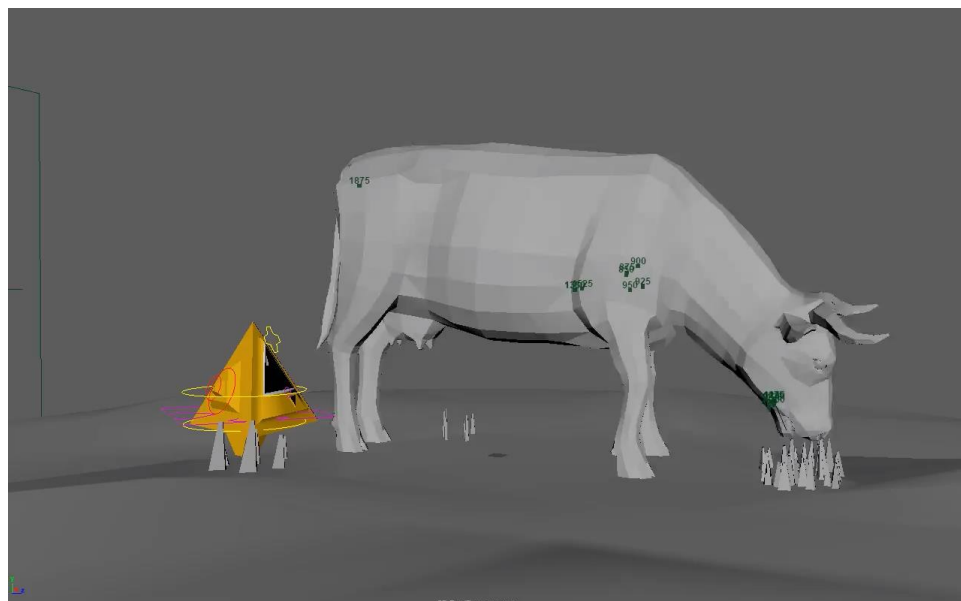
Creation:

Animation



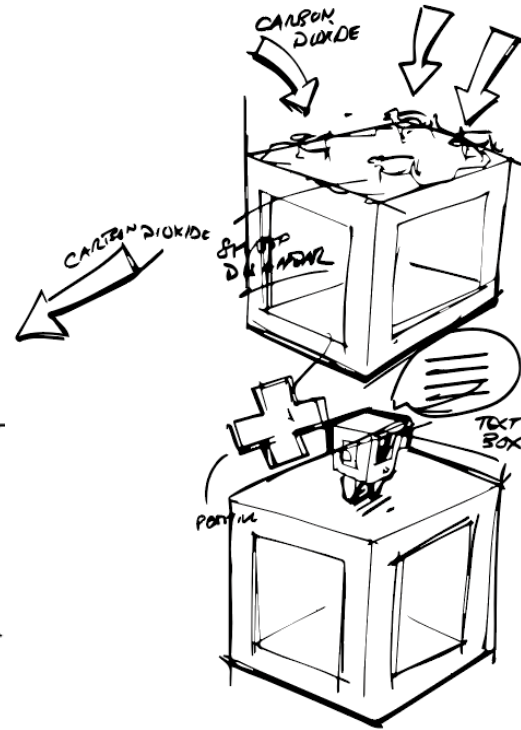
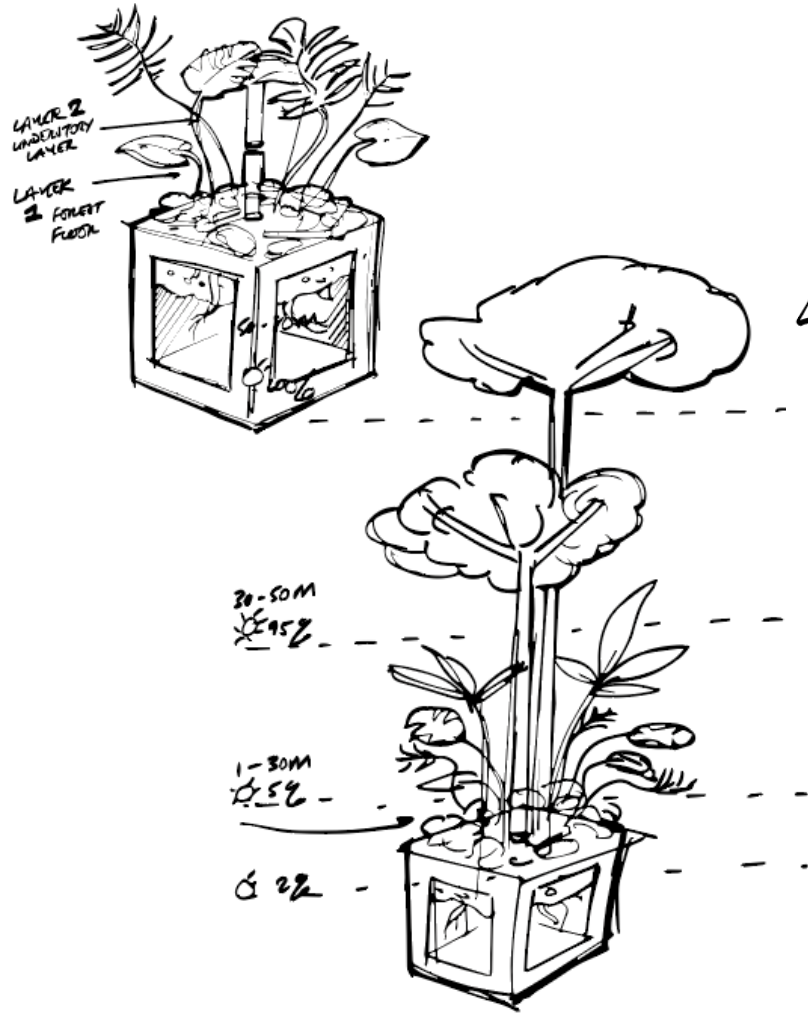
Dean Finnegan

Animation Lead,
Character Rigging
Ubisoft
Sydney



Creation:

Storyboarding



3.

Narration:

(12 Seconds)

Located above the forest floor is the understory layer. Small shrubs and trees can grow here. Understory plants often produce flowers that are large and easy to see.

FRAMES
1525 - 1825

(Animate the visibility of each layer)

(12 Seconds)

The canopy layer forms a dense network of leaves and branches as a roof over the two remaining layers. With so much food available, more animals live in the canopy than any other layer in the rainforest.

FRAMES
1825 - 2125

(11 Seconds)

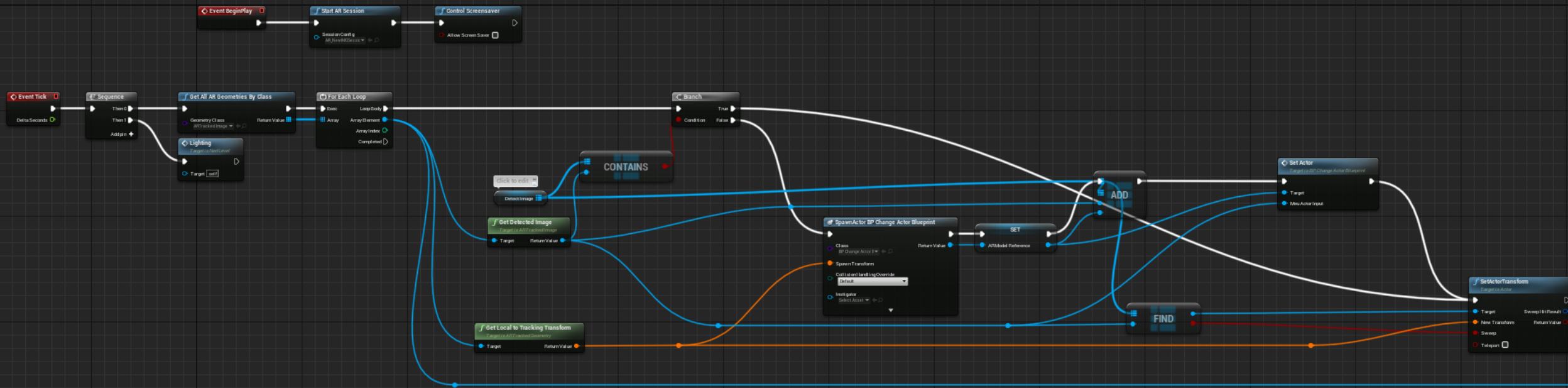
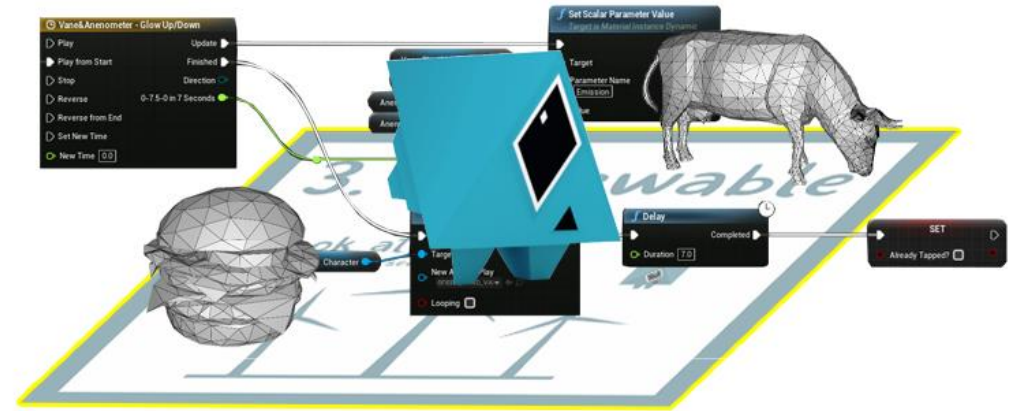
The top layer of the rainforest is the emergent layer, where trees can grow up to 60 metres tall due to larger amounts of sunlight. Here, you will find living bats, butterflies and awaiting predators such as hawks and eagles.

FRAMES
2125 - 2400

Creation: Coding (Blueprint)

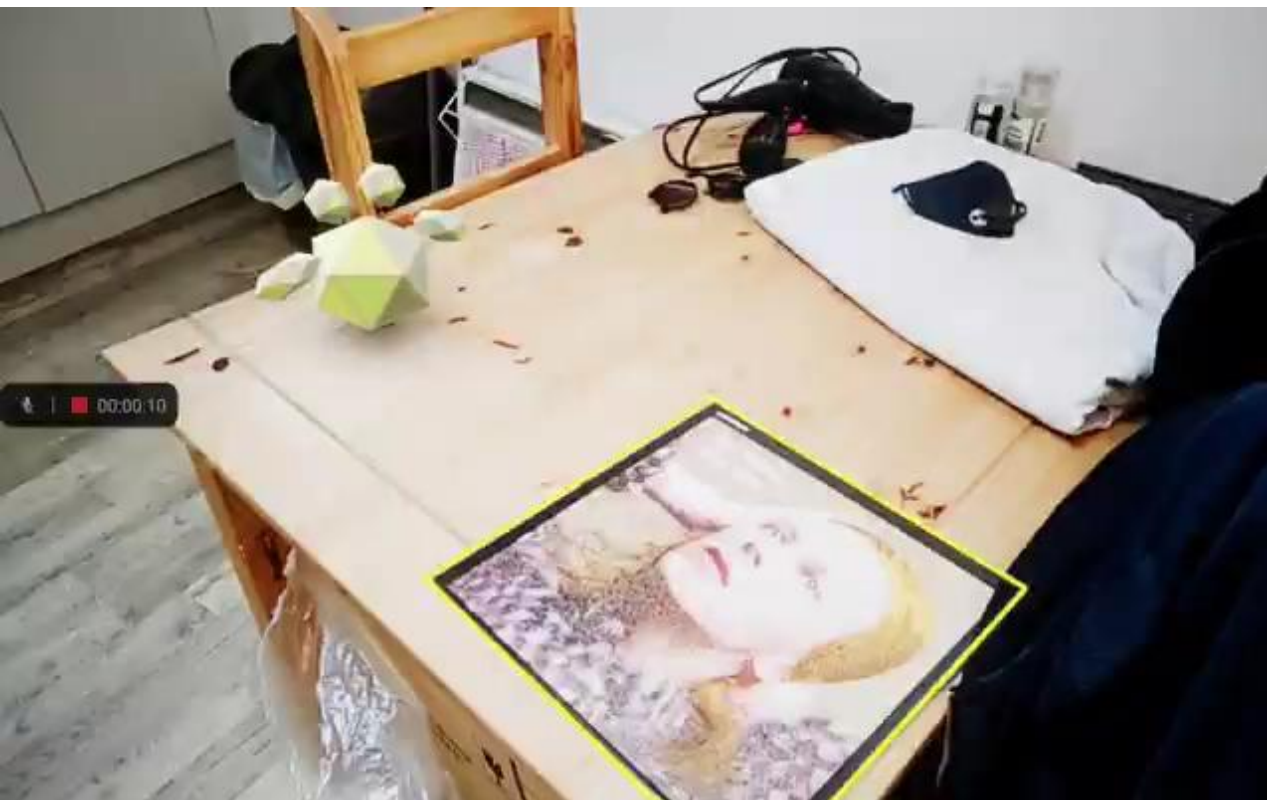


Jonathan Bardwell
Director and Head of
Immersive Development at
GDXR
Plymouth
UK



Creation:

AR Testing



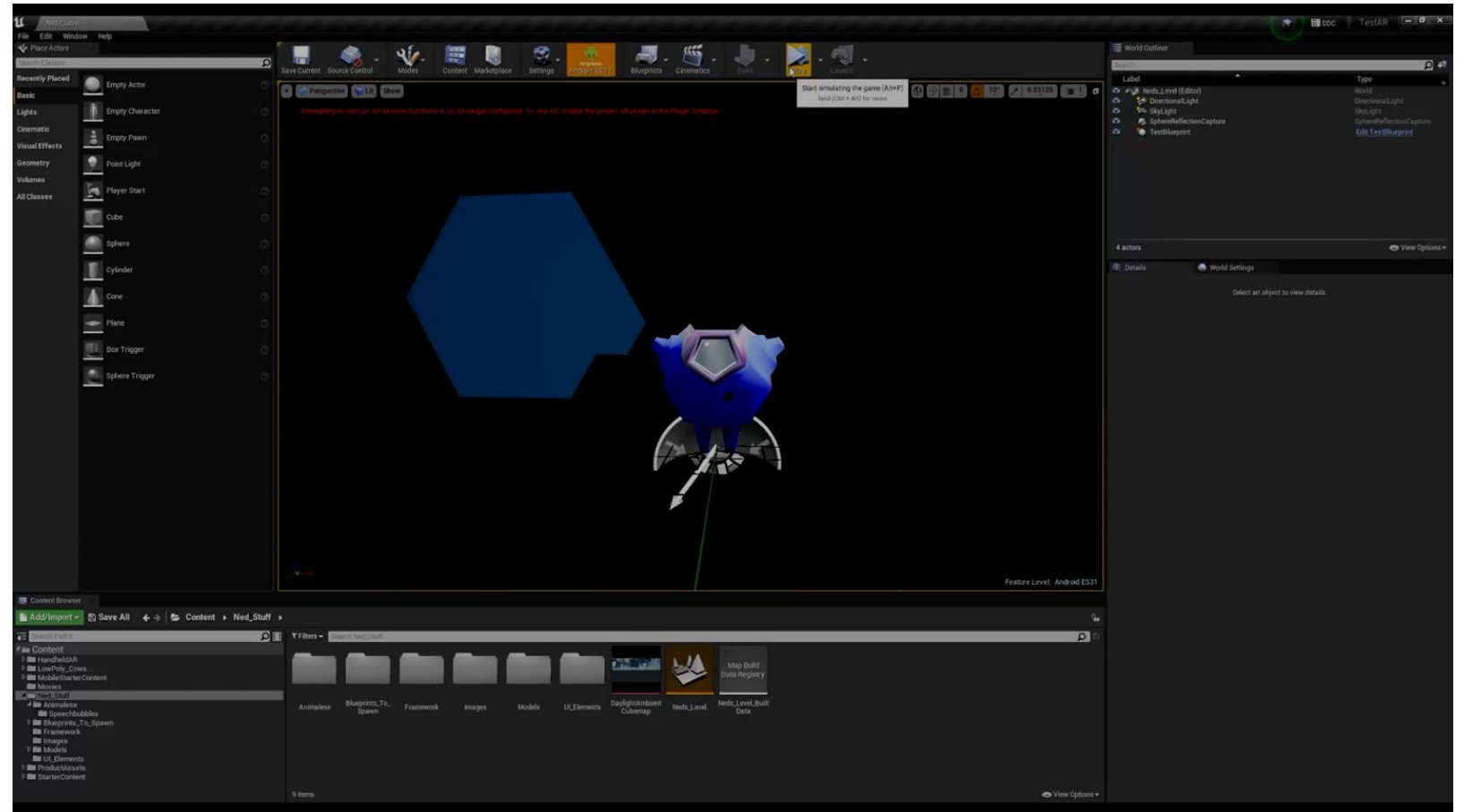
Creation: Sound

Eleven Labs



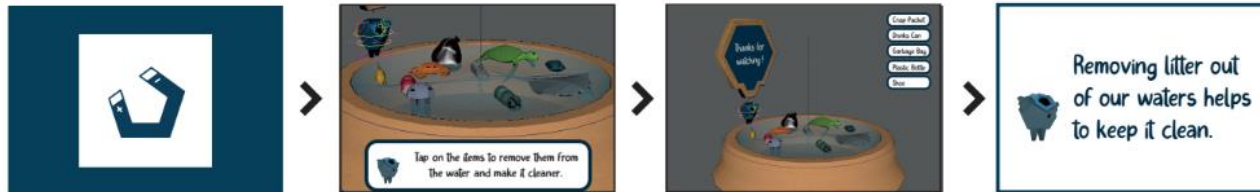
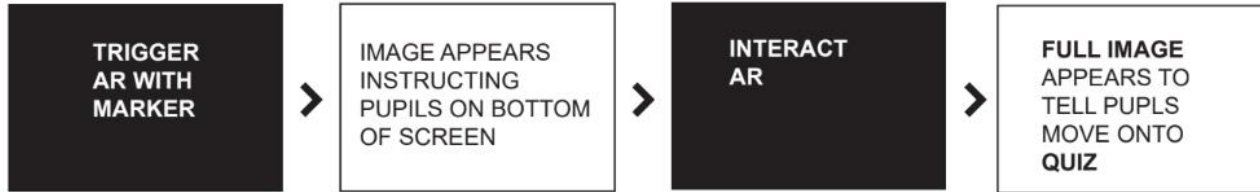
John Ricketts

Audio Engineer
Music Production (YSJ Graduate)
Sonas Audio Services
School of the Arts
York St John University
UK



Implementation:

User Interface



TEXT & TYPE ANIMATE UPWARDS TO INSTRUCT PUPILS WHAT TO DO.

ANIMATED CHARACTER (UNREAL FLIPBOOK)

GUI DRIVEN (MOB/TABLET)

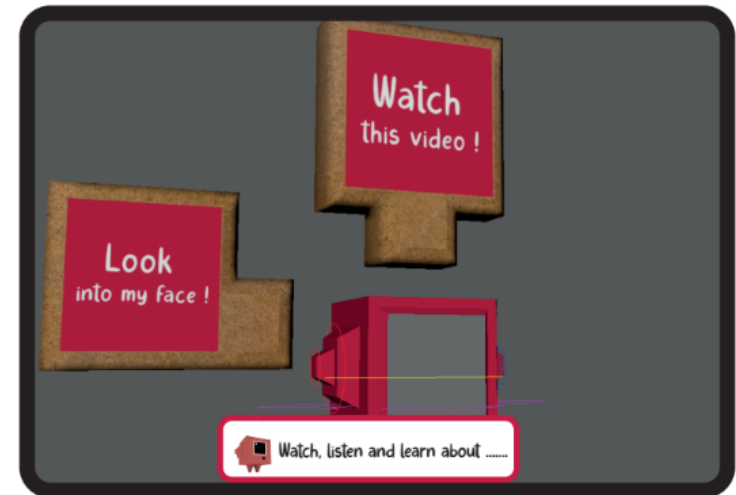
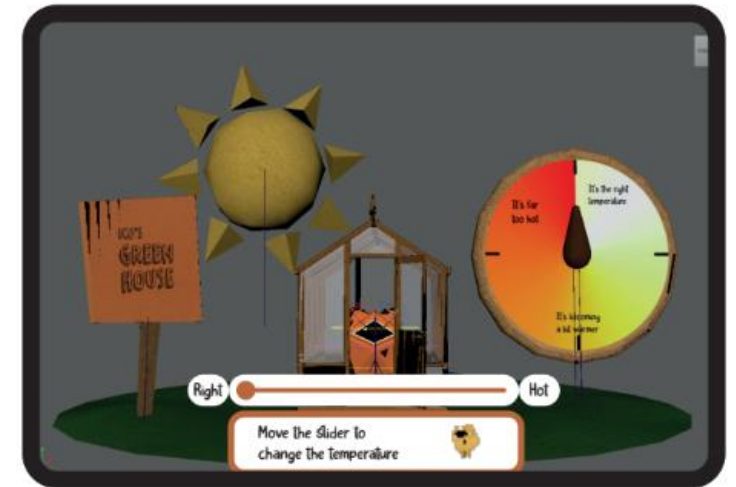
QUICK INTERMITTENT CHANGES

LABEL ON SCREEN WHAT HAS BEEN REMOVED.

10 SECS TIMER

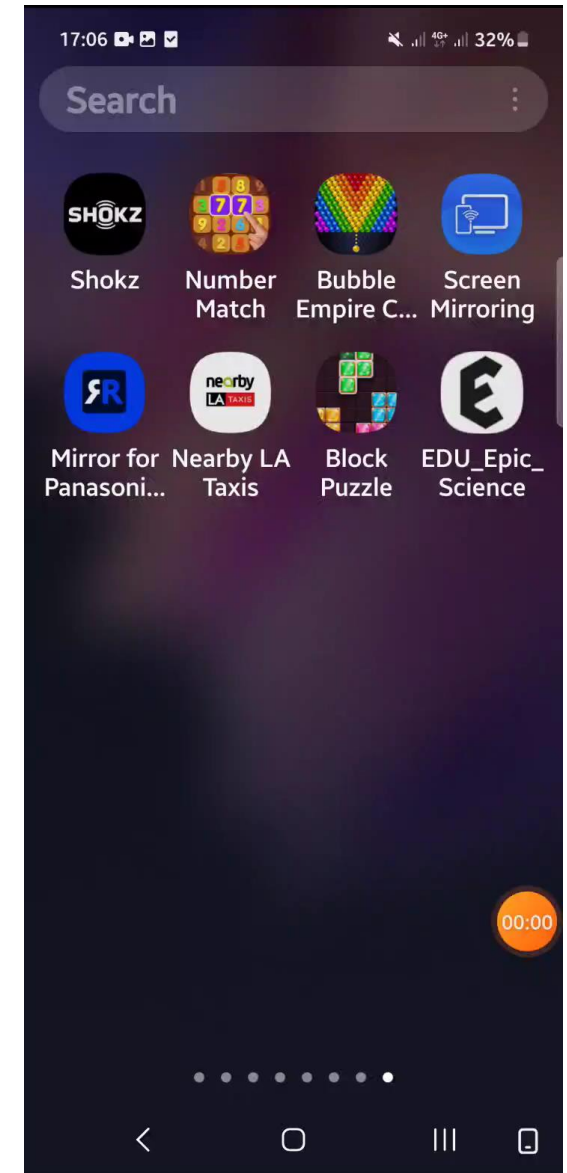
DELETE THE ACTOR 25 COUNTER / INTEGER (UNREAL BLUEPRINT)

MOVE ONTO THE QUIZ.



Implementation:

User Interface



Implementation: Schools



Implementation:

Focus Groups / In-Depth Interviews

9 Schools (Ebor Academy Trust)

Usage Frequency: Teachers advocated intermittent use to maintain pupil engagement without overexposure.

Rental Model Preference: Teachers preferred a rental model for AR technology managed at the academy trust level:

Circulation across schools enhances accessibility and sustainability.

Shared setup spaces, like school halls, enable reuse for various science topics.

**Senior Leadership Team (SLT)
Influence:**

Budget Constraints

Broader Buy-In for AR

Safeguarding Pupils

Group Dynamics

Career Opportunities

CPD

Active Learning

Abstract Concepts

Experiential Learning

Parental Engagement

Implementation:

Focus Groups / In-Depth Interviews

I think just the way it was laid out, and the shapes and the way it was presented, was really engaging

"cool," "epic," "amazing," "creative," "mind-boggling," and "fantastic."

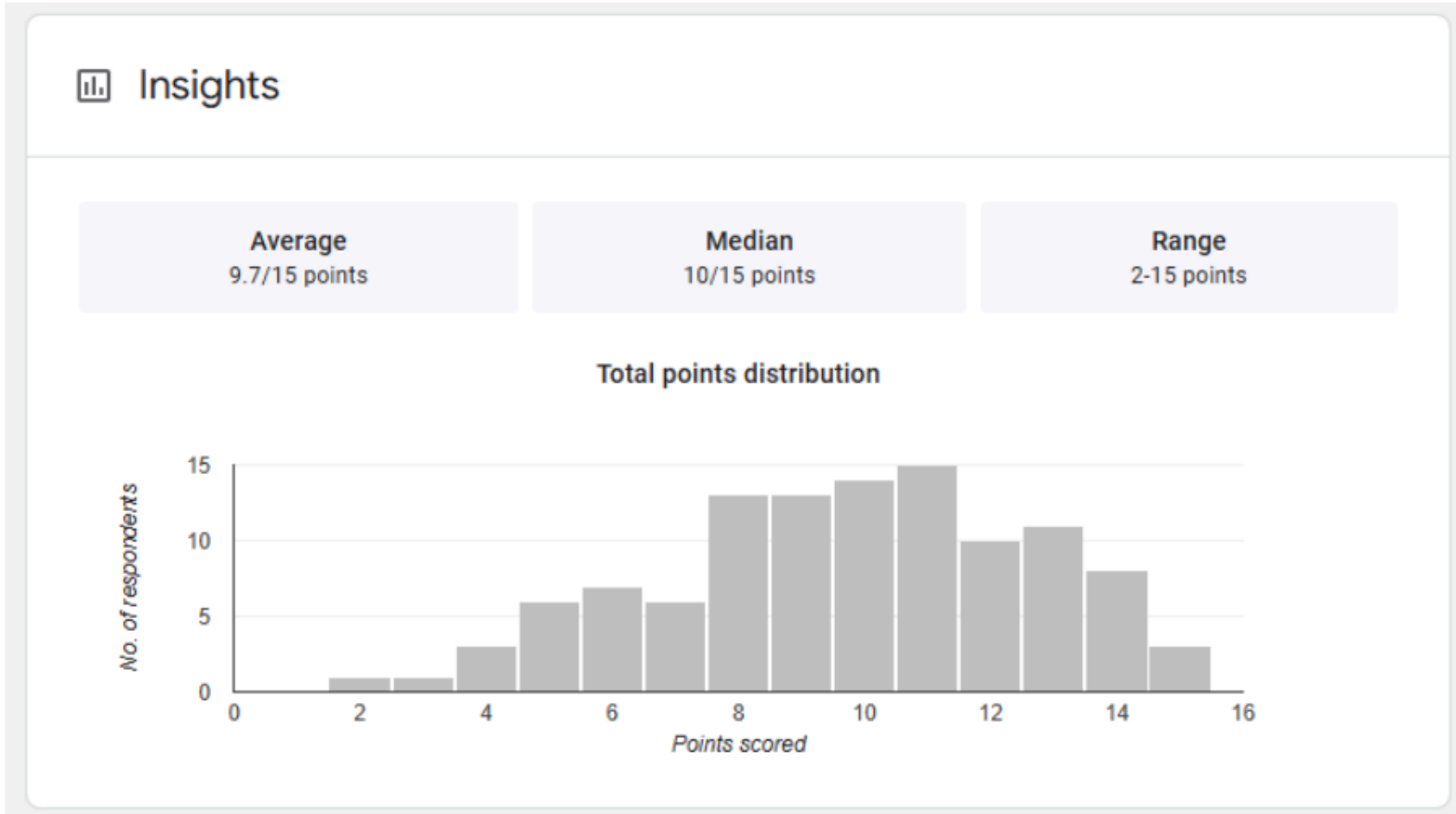
I already loved science, but this was amazing, and it was fun—not something we would do every day

My pupils had nothing but positive things to say about it; they were amazed when they came into the hall, excited and genuinely interested.”

Even if it is at the end or beginning of a unit, the AR exhibition can help to build upon what has been explained to pupils

Implementation:

Multiple Choice Science Quiz (15 Questions)



111 Pupil Responses

Average - 9.7/15

shows an average score of more than half (65%)

Median - 10/15

shows a median answer of more than half (67%)

Range - 2-15

a large range shows differences in levels of ability/knowledge retention between children.

Implementation:

STEM Learning Centre



Thank you.

For more information.

Warren Fearn,
Associate Professor, Design
York St John University

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EPIC Science
Augmented Reality Project

www.epic-science.com

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