Un-layering the Anthropos

An Augmented Reality experience of human remains

Final project for the "Digital Heritage and Multimedia" course held by Simona Caraceni and Sofia Pescarin, as part of the Digital Humanities and Digital Knowledge (DHDK) Master Degree program of the Alma Mater Studiorum – University of Bologna

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Acknowledgments

We would like to thank the Museo/Collezione di Antropologia of the University of Bologna's staff, collaborators and head, Dr. Maria Giovanna Belcastro, for having granted us the occasion to discuss with them on the collection's history, **goals** and **problematics** – both in its **museological** and **scientific** aspects – as an entry point to our group project work for the Digital Heritage and Multimedia course.

This privileged meeting and rich discussion we had with M.G. Belcastro, Teresa Nicolosi and Giselle Luzzati on the 26th of May – as well as a guided tour by the latter two, and multiple academic papers sent by the former – allowed us to inscribe our project work in a design approach concerned with solving the main **issues** that the collection and institution faces, and with the **enhancement** of the overall experience of the museum's community and public.

Departing from the reality of their **constraints** and of their **vision** of the collection's goals, we hope that our project work will inspire them in approaching their main aims and help solve certain issues they have told us about, through **the layering and un-layering potentiality of the digital**, applied to their specific **cultural heritage** context of human remains.

Abstract

This design brief concerns the proposed **development** of an **Augmented Reality (AR)** application for the Museo di Antropologia, of Sistema Museale di Ateneo (SMA) of the Alma Mater Studiorum - Università di Bologna. This **on-site application**, to be applied on the museum's rich collection of **human remains**, is primarily concerned with the valorization of these items – in all of their **anthropological significance and cultural diversity** – where the added digital layer encourages better **reflexivity** on the arbitrary boundary we habitually draw between the "anatomical" and the "cultural", promoting as such these items as truthful and **meaningful** cultural heritage objects. Supporting the anthological field's recent evolutions in promoting **perspective-taking** and **care** for cultures pertaining to different times and places, our digital tool project aims to un-layer the human dimensions from their conceived isolations from each other, as well as **virtually animate human remains**, in such a way to provoke better **engagement** of the public with these singular objects that we believe, if well supported by the virtual, can better fulfill their **mind-changing** and **empathic** potentials.

Introduction

Context

The Anthropological Collection belongs to the Sistema Museale di Ateneo (SMA), a network of 15 museums, collections and a digital museum belonging to the University of Bologna. As stated on its website, "SMA is an independent, self-governing institution aimed at promoting the fundamental cultural value underpinning the University heritage", and "its diverse collections were born as a result of teaching and scientific research activities carried out since its foundation".[1] The collection thus belongs to a broader **cultural heritage**, as well as **scientific institutional goa**l of the University of Bologna.

[1] https://sma.unibo.it/en/about-us

The Anthropological Collection itself houses a rich collection divided into four sections: paleoanthropology and prehistory; anthropometric instruments of historical and scientific interest; face casts, plaster busts and colored tables; skeleton biology and bioarcheology.[2] The **skeletons** hosted by the collection were collected by Prof. Fabio Frassetto, Chair of Anthropology and founder, director of the Institute of Anthropology of the University of Bologna from 1908 to 1953, and by his successor Prof. Elsa Graffi Benassi, who headed the Institute until 1971 (The History and Composition of the Identified Human Skeletal Collection of the Certosa Cemetery paper). The institute and museum of anthropology were founded in parallel in 1908 and moved to its current location in 1933, in the main university campus of the University of Bologna (Via Selmi, 3 - 40126 Bologna), place in which the digital experience will take place as an **on-site experience**.

Figure 1: A skeleton displayed in the same way it was found and excavated

As described to us by Dr. Maria Giovanna Belcastro, in a meeting we had with her and two other collaborators of the museum, on the 26th of May 2022 (M.G. Belcastro has been in charge of the Anthropological Collection since 2005, as well as head of the Master in Skeletal and Forensic Anthropology and Paleopathology): the collection is a **scientific** one but also includes diverse **cultural instruments**. The collection as such stands at once between the "natural sciences" and the "social sciences" – with an often-blurred boundary between the two. Its main goal, explained by M.G. Belcastro, is to display and valorize "**anthropological human variability**" and evolution through space and time, both in its biological features and its cultural practices. Another goal is to transmit the history of the **physical anthropology discipline** and its **methodology** (including skeletal excavation, anatomy reconstruction, …).

[2] https://sma.unibo.it/en/the-university-museum-network/anthropological-collection

Figure 2: The sandpit used in "laboratory" sessions with kids, to make them practice skeletal excavation

Figure 3: The "classroom" used to transmit the history and methods of the Anthropological science

With **more than a thousand skeletons**, all of which have **demographic information** associated with them, the collection principally welcomes a public spanning from kindergarten to high school classes during the week, and families with kids during the weekends (during which some "laboratories sessions" are organized). There are just a few tourists that visit the collection, and in regards to university students, it spans from students in the natural sciences to students in Humanities and the social sciences, though they do not constitute the main public of the collection.

Considering this, **our main target audience** are **university students**, coming from the "**natural sciences**" and **the Humanities** alike. Indeed, our project aims to encourage more university students to come and engage with the collection – a potential public that could grow for the University's museum that could, in turn, be better in touch with its mission to serve the university community. University students would be as such better encouraged to reflect on their own **academic discipline** through our app, making use of

their **motivation to broaden their knowledge and understanding** in their studies, their **capability to reflect critically** and their **possession and practice of smartphone devices** (for most of them).

Concept

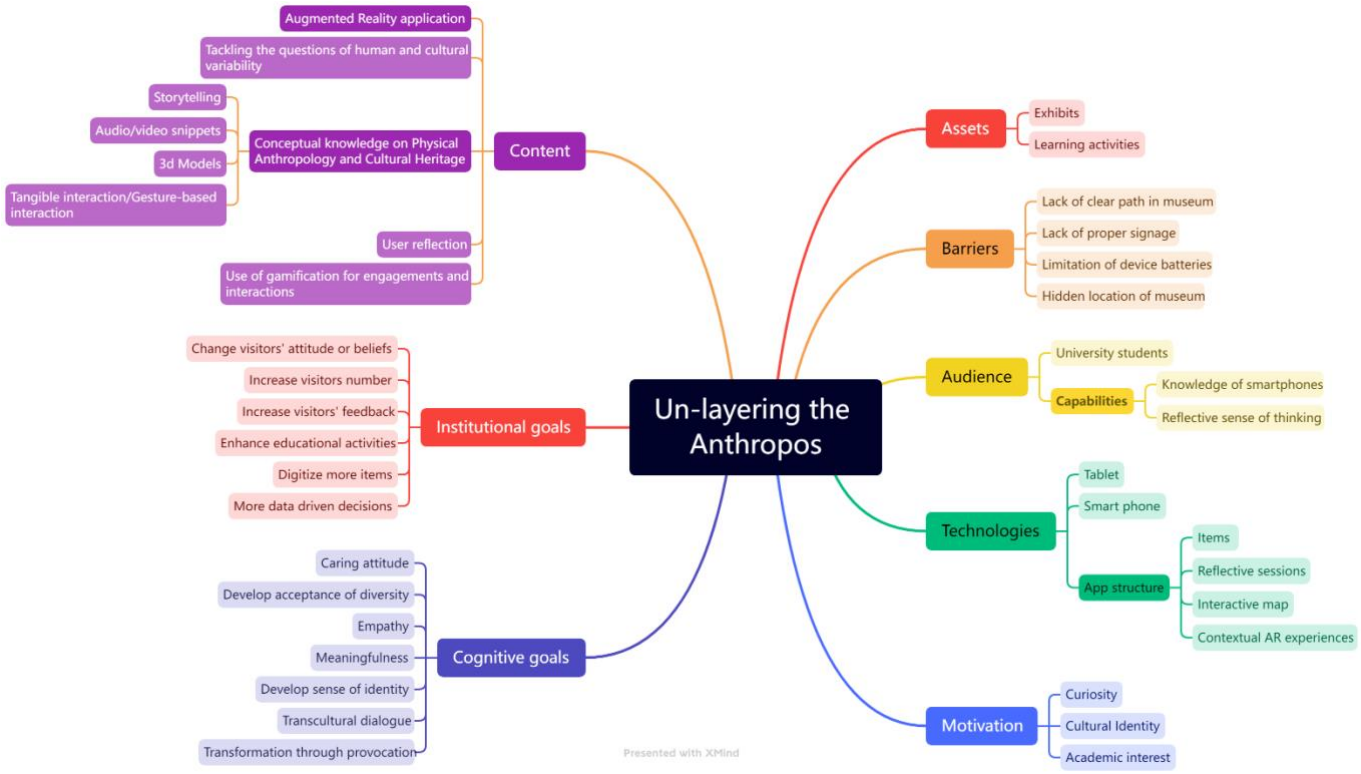

Figure 4: The conceptual map

The main question that came out of our interview with Maria Giovanna Belcastro – which derives from one of their main concern in order to realize their mission – could be stated as such: **Which kind of digital tool or virtual layer could help in valorizing the human remains items already there in the collection, in all of their anthropological and cultural significance as well as diversity?** A subsidiary question to this one, related to a broader anthropological concern as a discipline, is to what extent this digital addition to the museum can, through its **added information**, **interactive features and reflexive questions asked to its users**, help in the **decolonization** of anthropological museums?

Our digital prototype should as such be one that better reveals the blurry frontier between the anatomical and the cultural (the former being influenced by the latter, for instance through specific burial practices), and that better raises **awareness** of the collection's public on human evolution and **variability** in space and time – without instantiating, even insidiously, a hierarchy in between these varieties. At the same time, as an anthropological goal, the project should reveal how, underlying these variabilities, the anatomical and cultural items displayed in the museums express a **unifying trend** and peculiarity in the human species, in its relation to **nature** and **death**.

Considering all of these problematics and goals, as well the **financial constraints** of the collection and the fact that no one is employed there specifically in full-time mode, it seemed to us that the most appropriate **digital supplement** to the museum would be an augmented reality application, helping in **guiding** the public through the museum, **adding a layer of information** on some of the collection's items, as well as **adding a layer of digital visualization** on some of the items. An important part of the application would

also consist of **questions asked to the users** of the app, both relating the collection and museological experience in general and relating to specific items.

As such our **museological approach**, as informed by professor Simona Caraceni's taxonomy of virtual museums, can be said to be in the category "D" of S. Caraceni's table below (open interaction, open space that **does not have a specific path**, with **visitors contributions being allowed**), except that it would not consist of virtual with real but rather **real with virtual**, in the idea of valorizing the items that are already there **on-site**, through the digital layers of the augmented reality application.

CATEGORY	NEED TO BE ENHANCED	INTERACTION (open/closed)	SPACE (open/closed)	CONTENT	VIRTUAL/ REAL	VISITOR CONTRIBUTIONS (allowed/not allowed)
A	MARKETING	Open	Closed	Selected objects	Virtual on real, virtual with real	Not allowed
B	EDUCATION	Closed	Closed	Selected objects	Virtual on real	Not allowed
C	EXHIBITION	Open	Closed	Selected objects	Real with virtual	Not allowed
D	COLLECTIONS	Open	Open	All collection	Virtual with real	Not allowed/Allowed (*)
E	INTERPRETATION	Open	Open	Selected works/ all collection	Virtual with virtual	Allowed
F	EXPERIMENTATION/ COMPLEX MUSEUM IDENTITIES	Open	Open	Selected works/ all collection	Virtual with real	Allowed

Figure 5: "Toward a taxonomy of Virtual Museum" - slide from professor Simona Caraceni

Experience Design

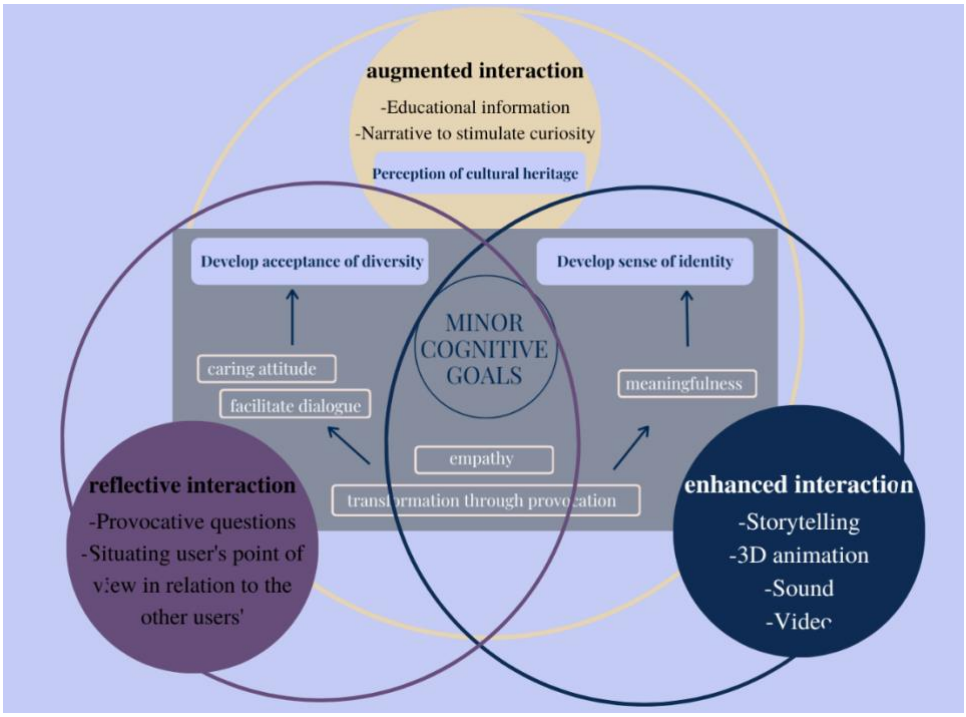

Figure 6: User experience design diagram

Cultural Heritage Topic

The specific cultural heritage topic we have selected as our case study are **skeletons and human remains**, which have been best informed in their cultural heritage significance by papers sent to us by M.G. Belcastro (see the bibliography section).

More importantly, we selected these specific items for **the surprising significance and meaningfulness** we saw in them in our visit of the collection. What do we talk about when we talk about human remains? We talk about ourselves, we talk about our bodies and about how or why they changed during the course of our life. We talk about our **identity** and about how we **experience** the world through our body, how we walk through life in our unique, precious, situated **embodied** experience.

Few things are left behind when we are gone. We know about tangible artifacts and exteriorized memories. But we often forget that the ground we walk is kneaded with the bones of those who walked before us. Our bones tell a **story** - more precisely, they prove to us that culture is embodied, that **our cultural heritage shapes our bodily forms that can in turn incarnate stories about these cultures.**

Human remains are as such an inestimable kind of cultural heritage items, that stand as a bridge **between the natural and the cultural**, asking the complex question of the extent to which these two are intertwined in between each other, as well **raising ethical concerns**, or even controversies in considering such items as proper cultural heritage. These reasons brought us to focalize on these largely misunderstood, but immensely complex items.

Cognitive focus

The chosen cognitive focus of our project, on the other hand, is **meaningfulness, emotions and empathy**. Indeed, these cognitive qualities are all interwoven with the **sense of identity**, as well as that of **cultural diversity**, that we aim to convey better through our digital application. This also goes hand in hand with the collection's goal, formulated by M.G. Belcastro as that of displaying the story of the **human species** in general, as much as that of its **variability** through geographical space and the time of its evolution.

Goal

Our main goal is to encourage **reflexivity** and **empathy,** in the engagement of the public with the collection's items. As suggested above, these cognitive and emotional goals are interlinked to the collection's display and valorization of the human identity, both in its general biological and cultural patterns and in its diversification through geographical space and through the time of its evolution.

Through our project and digital application, we want to better encourage **perspective taking** for our public - that is, a certain "relativization" of their own culture - a prerequisite for a sense of care for the diversity of the "anthropos." Our project should develop the public's **sense of belonging** to its broader anthropological history, as well as develop their own **sense of identity and singularity**, in the tree of human evolution and diversification.

Concerning our target audience of university students, we want to increase their **interest** and **curiosity**, as well as stimulate their **reflection** about what cultural heritage is and in what ways human remains can contribute to it, as well as to their own academic discipline.

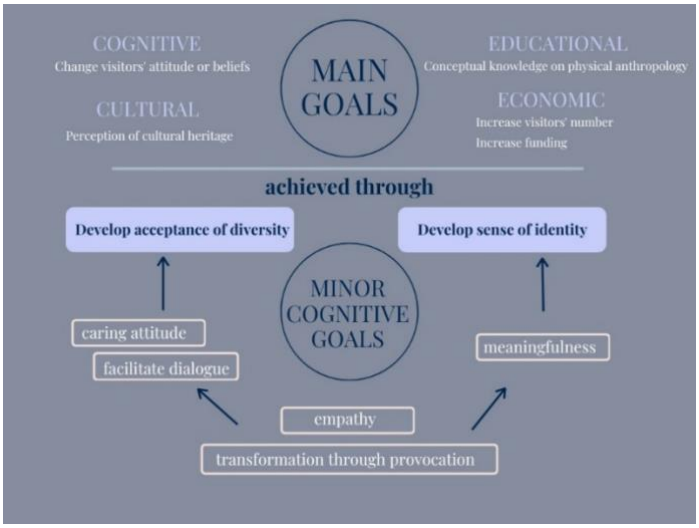

Figure 7: Our goals' map

Through **empathy** and **provocation**, we want to encourage change in our visitors' attitude and beliefs (cognitive goals), their perception of cultural heritage (cultural goal), as well as their conceptual knowledge on physical anthropology (educational goal). In the process, the goal is also to boost the number of visitors of the collection, especially university student visitors, and draw more attention of the public administration to the value of the collection to eventually increase the funding it gives to it (economic goal). These main goals are to be achieved through empathy and provocation in that these ("minor") cognitive goals develop as much a sense of identity as a sense of acceptance for human and cultural diversity - notably through the facilitation of **dialogue**, **care** and **meaningfulness**.

A subsidiary goal to our project, which concerns the broader institutional goals of the global scientific, as well as museologic community working on human remains, is **to gather data and knowledge** on ethical and educational concerns, from the public of the collection. Their perspective needs to be taken into account on these topics, and the digital can offer an opportunity for the scientific and museologic community to receive the **contribution of their public** regarding their **scientific methodologies** and their **ethical standards**. This **contributory** aspect goes hand in hand with the direction of **participatory science** and **citizen inclusion** in the museological process.

Requirements

Our **augmented reality (AR) technology**, through the form of an application, will require the connection of tangible objects of the museums to digital layers and experiences of these items. We will need to develop a **device-based interaction**, which includes a **gesture-based** one according to the movements seen from the front camera, from a **smartphone** or **tablet**, required from the public for the AR experience.

As already mentioned above, this digital supplement to the museum would require:

- An **interactive map**, guiding the public through the museum to the chosen items
- An **augmented interaction**, taking the form of a layer of information on top of some of the collection's items
- An **enhanced interaction**, taking the form of a layer of 3D visualization and animation of some of the collection's items

- An **interactive questionnaire**, both relating to the collection and museological experience in general and relating to specific items, with open-ended and closed-ended questions, and with responsive output showing what others replied.

Development

Our project is developed in order to satisfy to the **institutional goals** and **cognitive goals** we want to achieve. In order to do that we propose an **interactive Augmented Reality (AR) application**. This application could be used by the museum, where the public/users would be able to **experience** and **reflect** on the multiple cultural heritage items present in the museum.

This application can be used on both android and iOS devices. The museum would need to have a set of tablets which would already have this application pre-installed, but the public would also be given an option to install the application, using a **QR code** at the entrance of the museum. All the **instructions** to use the app would also be provided at the entrance, for the public user to be able to reach the most optimal experience of the application and visit.

Story

By means of Twine, we developed an **interactive nonlinear narrative** to better describe how *Anthropos un-layered* can be experienced, from the very beginning to the end. We based this narrative on **concretely observed, researched or recounted dynamics and problems of the Anthropological collection**, including from some of its public we had the occasion to interview there.

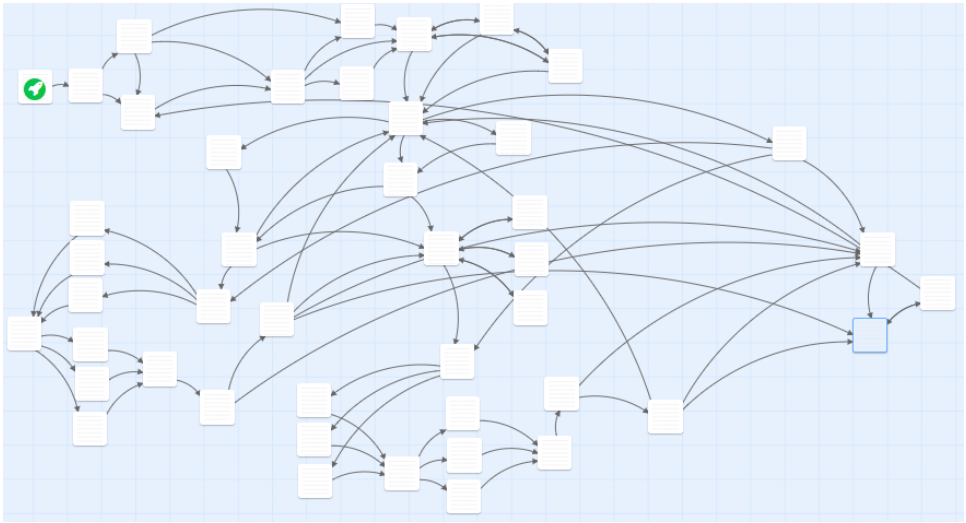

Figure 8: Twine story structure

You can try our Twine interactive narrative using this link
https://maddagh.github.io/twine/

First of all, in our narrative, our **persona user** is a male visitor of 20 years old, currently attending the History degree course at the University of Bologna. He is visiting the museum with his partner who is also living in Bologna, during a vacation day, so they have quite some time to spend inside the museum and they are not in a rush. He only has a vague idea about what he will find inside the museum, but he knows the museum includes different collections, and he is looking forward to **learning** new things during his visit.

Secondly, our narrative integrates the concern of **the architecture of the museum**, which is an environment of three floors with different collections on each floor. The anthropological collection is situated on the third floor, from which we can presuppose that it is usually the last step on a visitor's path – thus, it is likely that a visitor, unless he or she is specifically interested in it, might skip it, or walk through it with a lower level of **attention**. For this reason we decided to include an **interactive signage panel at the very entrance** of the museum in our narrative, because of the importance of **catching visitors' curiosity** and encourage them to try out our AR experience at the Anthropological collection on the third floor.

Finally, as we have come to learn during our visit of the collection, the items displayed in it have not been changed since they were first arranged in 1933, and the descriptions available to a visitor are only written in Italian and hardly up to date, some of them even incorrect. This is a problematic of which the museum's staff is aware but which cannot be easily resolved, due to the lack of funding and the lack of attention from the institution for the collection. Furthermore, some of the items displayed – such as babies' skeletons exhumed from the Certosa cemetery – can be considered controversial and this could raise **ethical concerns** among visitors. For these reasons, we implemented our AR experience in a way that the information delivered could, on the one hand, integrate and **overlay the already present written descriptions** and, on the other hand, **offer a place of reflection and debate about human remains**, both in terms of them being considered as proper cultural heritage and in terms of the ethical concerns they raise.

User interaction

In order to better explain the **interaction between a user and the application**, we have provided **wireframes** of how the application and its use would look like.

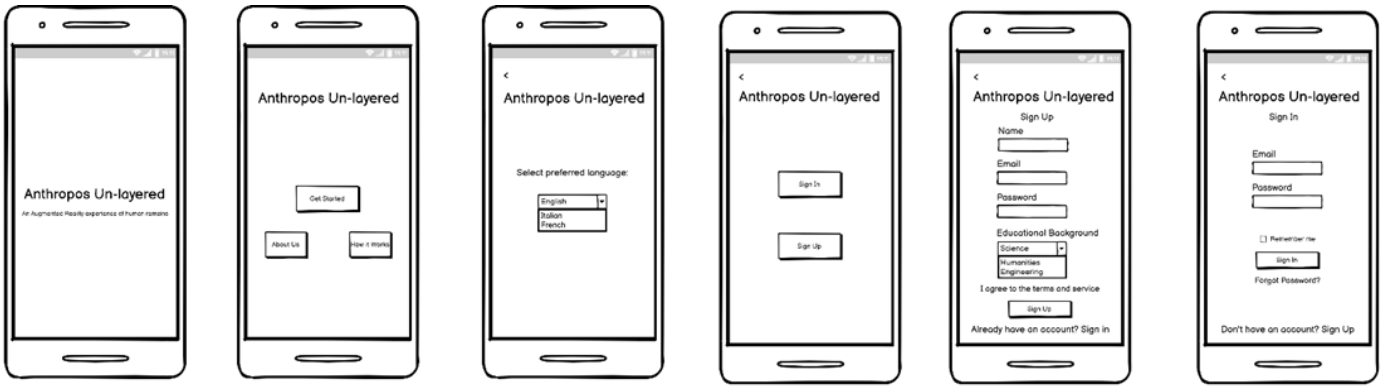

Figure 9: Start of App

The app would start with a splash screen with its logo and tagline. Then it would go to the **Home Page**. This page would have a button where users can have instructions on how to use the app. It would also have an **about us button** that would give descriptions about the museum itself and the reason behind why the app was developed. The last button can be chosen when the user is ready to start their experience. This would first take them to a page where they could select the language they prefer to use.

Since this would be a digital experience, **language would not be a barrier anymore for the museum**, with the interaction presented in multiple languages. Once a language is selected, users can either sign in if they already have an account or sign up. This is an important step as it would further help the museum to get to know the number of people visiting, as well as **save some information** about them, like educational background, which the application would use in order to **adapt the experience** of the user.

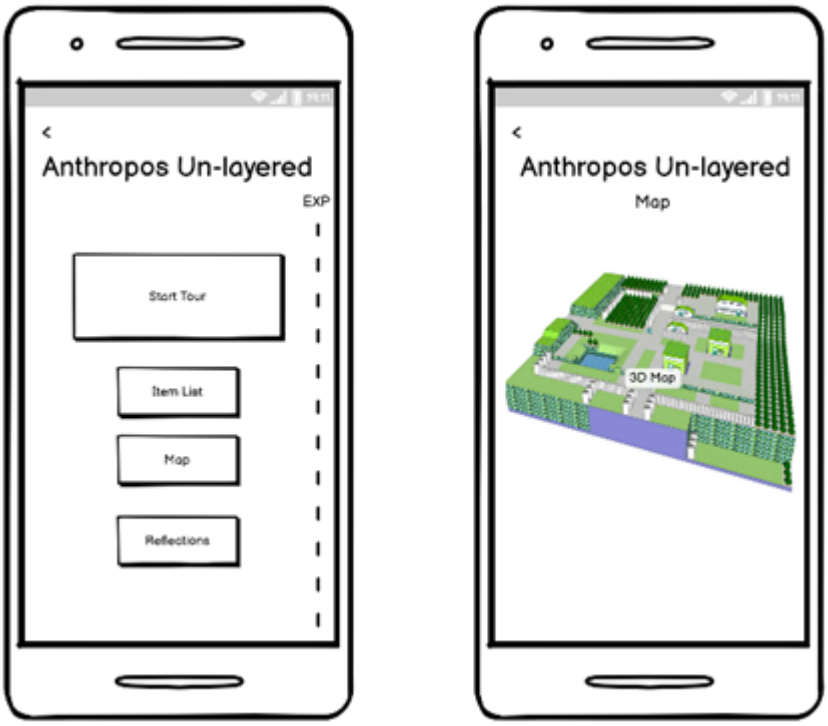

Figure 10: Main Screen and Map

Once a user has signed into the application, they will be directed towards the home screen. The home screen consists of 4 buttons and **an experience points bar**. The map button leads them to an **interactive 3D map of the museum** so that they are able to see the entire structure of the museum as well as all the items present, with their labels on the map.

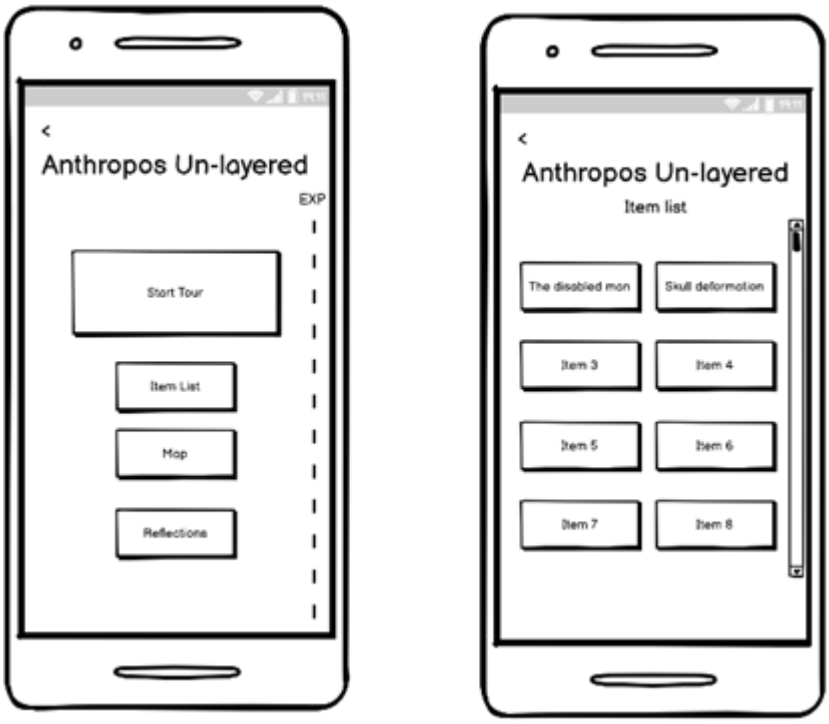

Figure 11: Main Screen and Item list

The **item list button** would lead the users to a screen with each of the items of the museum listed down.

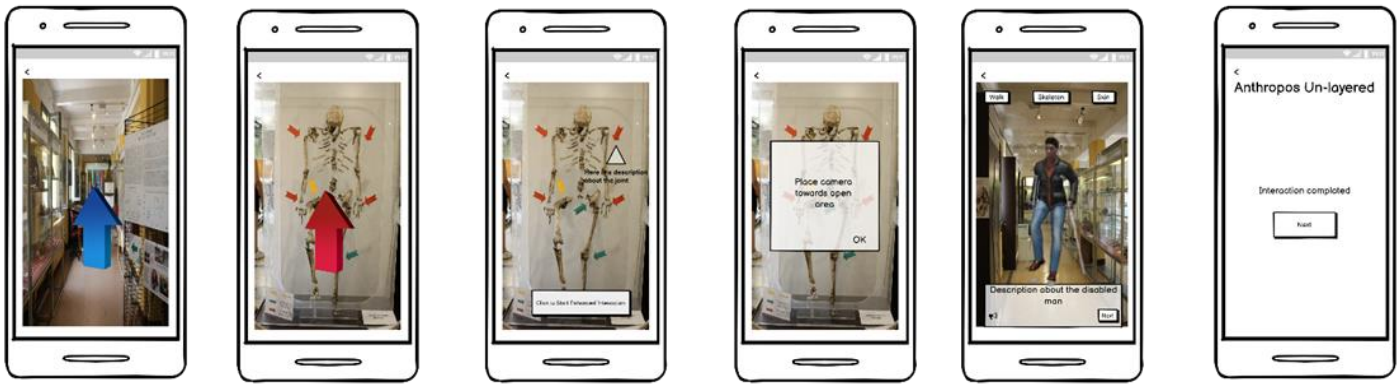

Figure 12: AR navigator and Item Interaction

Once a user selects an item or they select the '*Start Tour*' button from the main screen, **an AR navigator** would start. This would make appear **the augmentation of an arrow navigator** which would lead the users to their specific item. The arrow would appear in a cold blue color which goes to the hotter red, as the users would get closer to the item. Once they reach the item, they would be able to see "augmented interactions" and information over the item, as well as a button to start the "enhanced interaction" of that item.

The **augmented interactions** and the **enhanced interactions** are each catered to the different items present in the museum (in the next sections, we will further talk about two items in particular, in order to better explain how the interaction should happen).

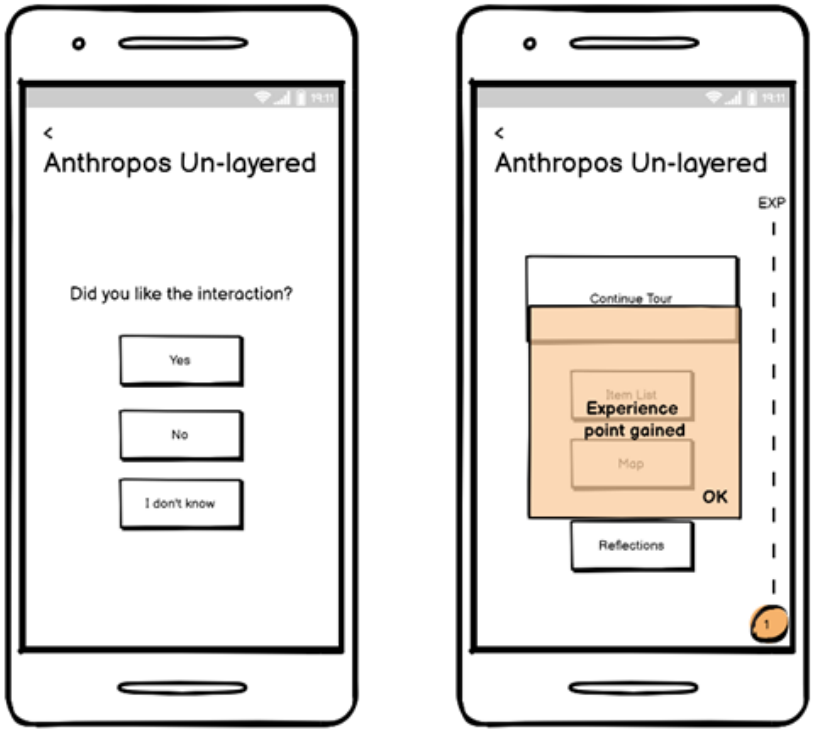

Figure 13: Reflective session and experience point

Once the users are finished with their interaction, **they would be guided towards a reflective session** where they would be asked some **closed and open-ended questions** related to that particular item.

Once this reflective session is completed, the users would be guided back to the main screen where **they would be prompted about gaining experience points**. At the experience point bar at the right-hand side, users would be able to see an item's enhanced experience unlocked. This enhanced experience would be freely usable outside the tour. This experience point bar would progress and would be completed when the tour has been completed.

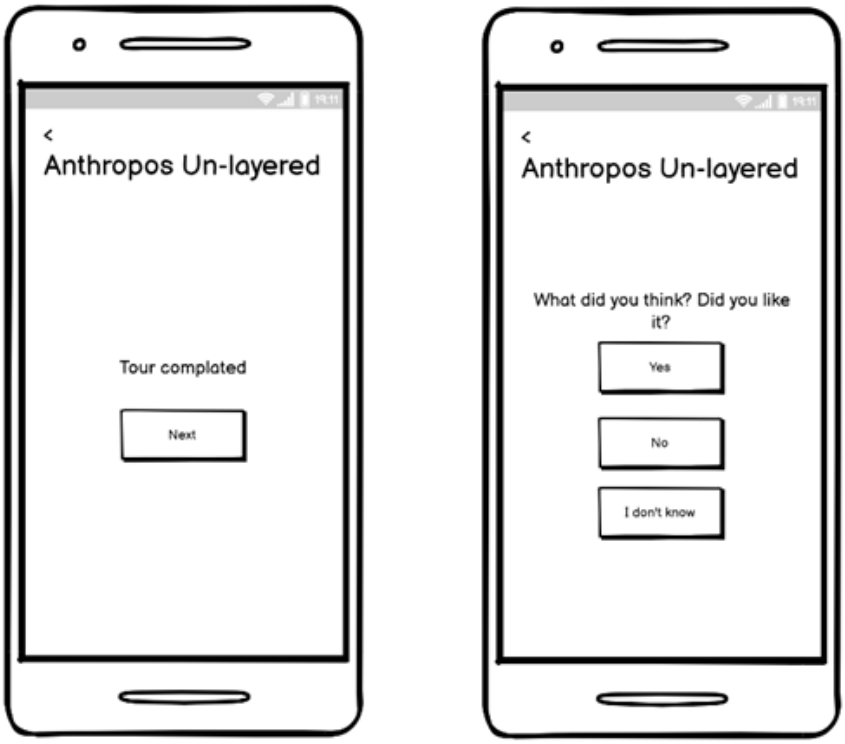

Figure 14: End of tour and final reflections

Once the tour has been completed, the user would be guided towards the **final reflective session which will touch on some general points** that the museum wants to make its audience reflect about or know from them.

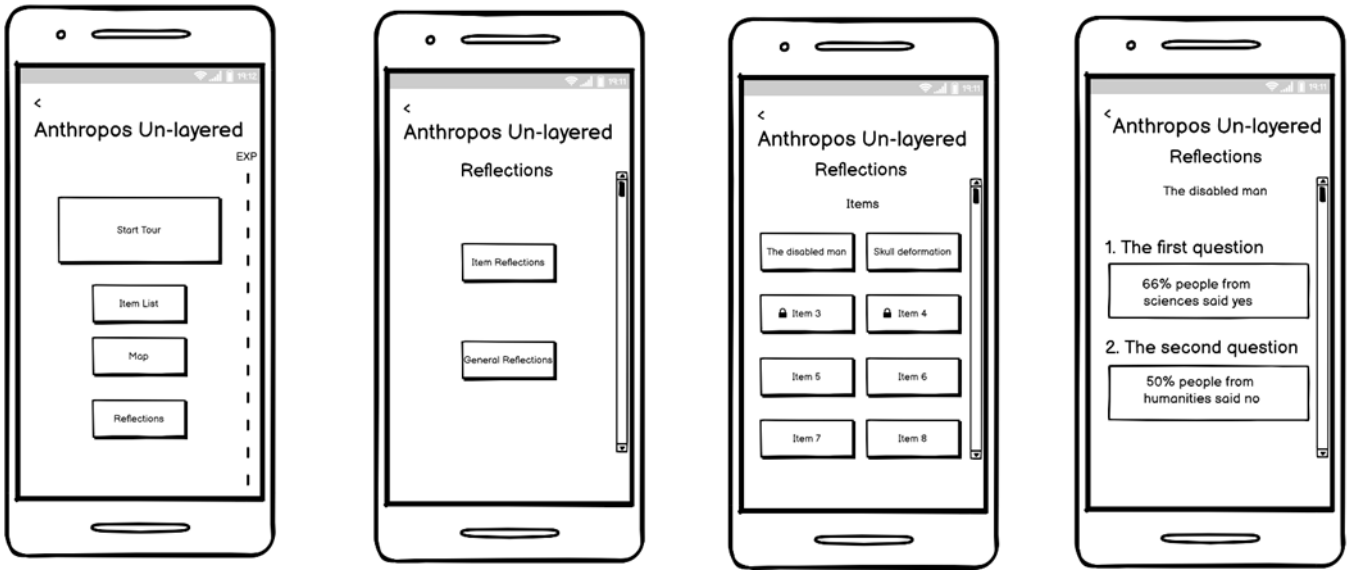

Figure 15: Reflections

The last button from the home screen called *Reflection* would take the users to the **results that have been gathered by the museum from different users' reflections**. This concerns both the items' reflections and the general reflections. When the users go to the item reflections, they would be able to see the reflection results from other individuals, about the items which they would have already experienced and provided a reflection on.

Below is the **interaction diagram** of the entire flow:

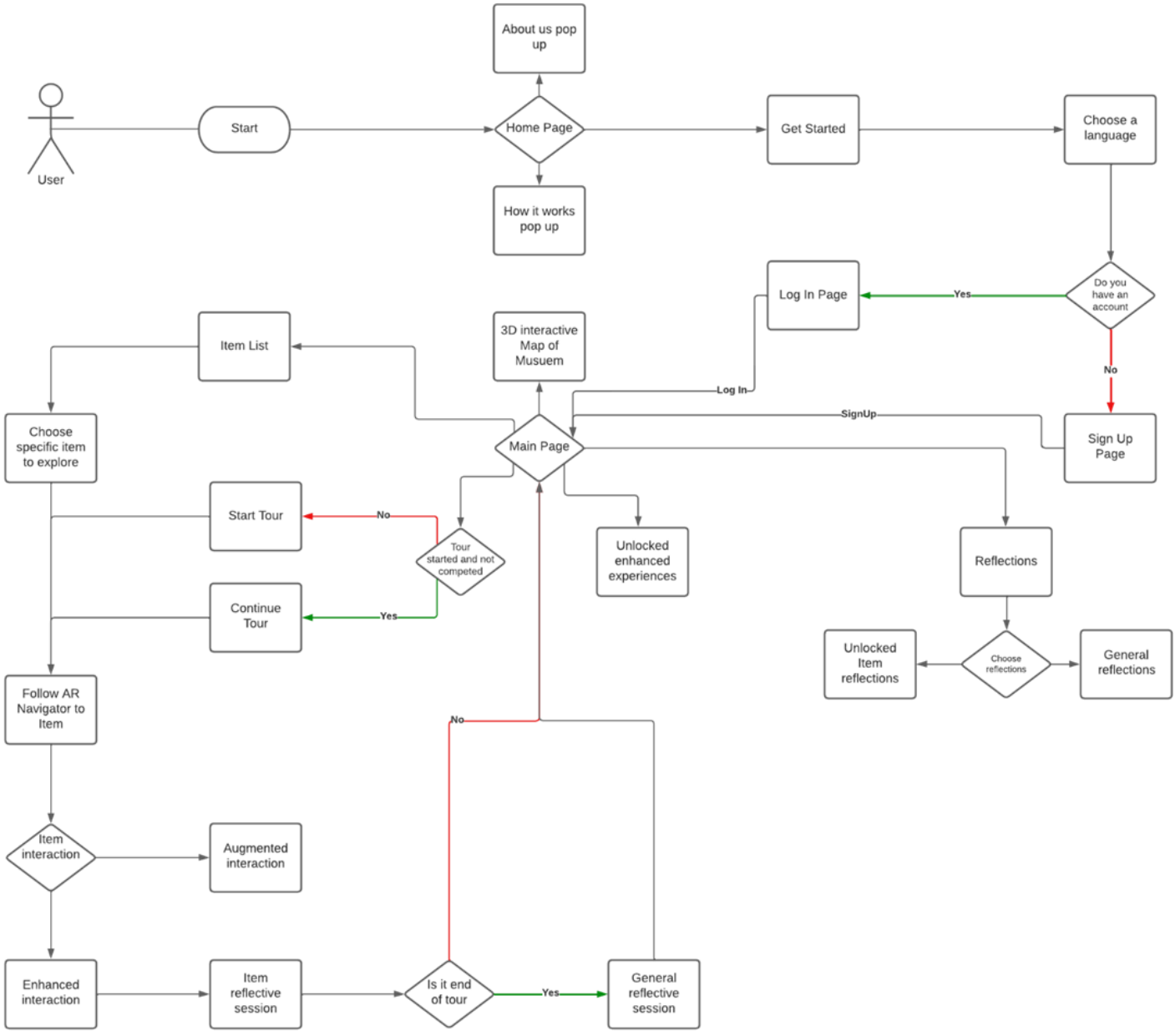

Figure 16: Interaction Diagram

Reaching the cognitive focus

As defined above, our main cognitive focus is meaningfulness, emotions and empathy. The use of our application should be able to provoke these cognitive and emotional qualities, by **giving users an**

immersive and interactive experience. They should be able, not only to understand **the cultural and historic context of the items** at hand, but also, to **reflect on their own experiences.**

For each of the items used in the museum, the application would use a guided AR map. This would help the user to **not get distracted and lost in space and stay focused at the item at hand**. Once they reach an item, they would be able to better interact with it. The interactions would be made in such a way that users would develop more **care** for these items. A user interacts with an item in three ways, namely augmented interaction, enhanced interaction and the reflective session.

Below is an illustration of a use case, and the ways in which we would try to reach our desired cognitive focus:

Item:
The disabled man

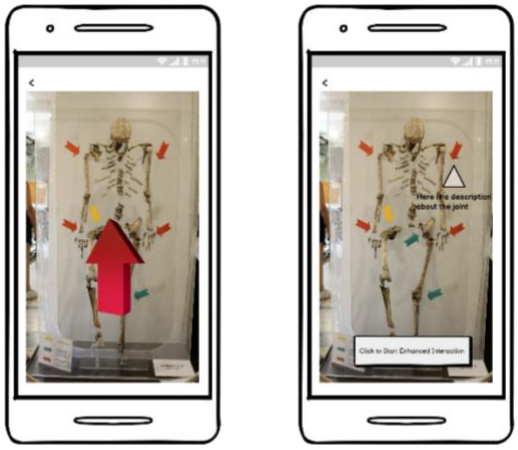

Figure 17: The disabled man

Augmented interaction:

Once the user reaches the item 'disabled man', **the application augments some information on the screen** for the user to interact with. These are **specifically designed to enforce the curiosity of the users**, and to explain better what they are seeing in front of them. The information also suggests to treat human remains not just as anatomical objects, but also as cultural heritage of which we need to care about.

For the 'disabled man' item, it will show all the joints and bones that this man had a disability in. It increases curiosity in users as it **provokes** the question of how this man survived, in that era and at his age.

Figure 18: The disabled man augmented interaction

Enhanced Interaction:

For each item, users also have a choice to experience the enhanced interaction. This is one of the most important steps in the application as it **contextualizes all the information and history about that item and aims to make users empathize and understand the identity, history and cultural aspect of that specific item, its heritage.**

In the case of the item at hand, a **3D augmented animation** would be placed on the screen, shown as if that man was standing right in front of the user. The user would be able to **control** if they want to see just the skeleton walking, just his bones or just the man with flesh. There will also be a **description box** below with **text and sound** that will **narrate** the history of this man such as where was he born, what was his culture at his time, how long did he live for, what kind of society did he live in, etc.

Figure 19: The disabled man enhanced experience

Reflective session:

This is the final interaction that a user goes through with an item. Here, **a series of carefully planned open and close ended questions are asked**. This is not just meant to be a survey to collect data and knowledge, rather, it is meant for users to more deeply reflect on the items they just observed, and to empathize more with its heritage. In other words, these questions are meant to **convey to the public/users the cultural importance of these human remains.**

For the disabled man, here is the reflection session that we developed, taken from our Twine narrative:

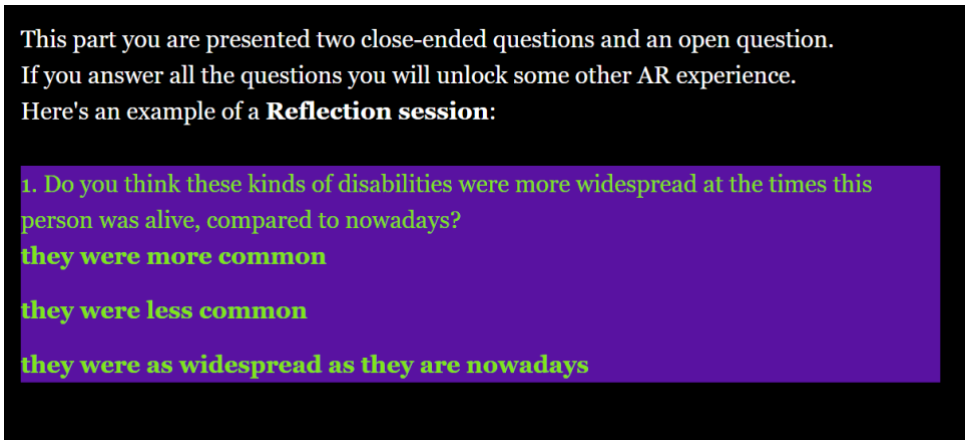

Figure 20a : The disabled man reflective session question 1

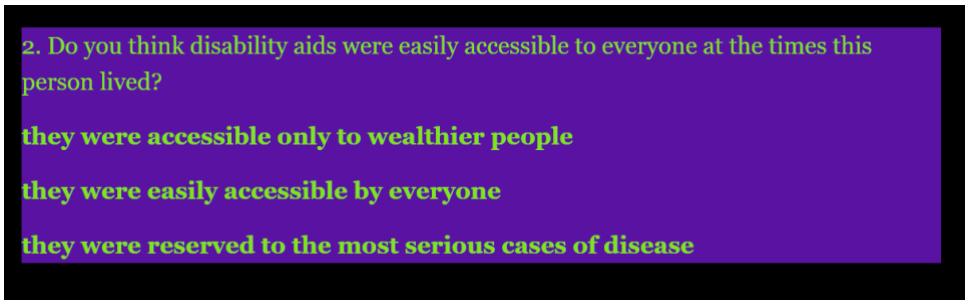

Figure 20b : The disabled man reflective session question 2

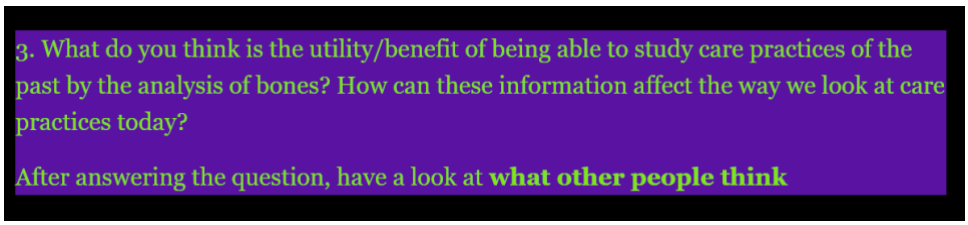

Figure 20c : The disabled man reflective session question 3

Once a user completes this session, he or she will also be able to see how other users of this application responded to the same questions. This would **help users better understand where their opinion stands in regards to others'**, potentially triggering an **emotional transformation and response** in their behavior and thinking process.

Foreseen workflow

The workflow in order to realize this project would be:

Professionals**:**

1. *Domain Experts*
   Domain experts in the field of physical anthropology will be required to **contextualize** each one of the cultural heritage items in the museum and to summarize the kind of interaction they want the users to have on them. They will also be responsible for coming up with some reflective questions/thoughts which they want the user to experience and contribute to. They will also be responsible for **moderating** open-ended questions, in order to make sure they stay relevant to the

item/question at hand. These experts could be the staff that works at or collaborates with the museum, as well as students and volunteers from a related field.

2. *Application and Interface designers*
   These people will be responsible for **developing** the application that would eventually be used by the museum. This would involve professionals experienced with android and iOS application development.

Software:

1. *Unity/Unreal Engine*
   This will be used to make augmented tags on the items at hand in the museum

2. *Android Development Studio*
   This will be used to make native android applications where AR component can be embedded

3. *Swift development software*
   This will be used to make native iOS applications AR component can be embedded as well.

4. *Blender/AutoCAD Maya*
   This will be used to design 3D objects wherever they may be required.

Hardware:

1. *Android Tablets/iPads*
   A few sets of tablets/iPads will be required for the museum so that they are able to provide them to users, with the application pre-installed.

2. *Smartphones*
   Smartphones (Android or iOS) can be used by visitors who will just have to scan a QR code and download the app

3. *3D scanners*
   For some items, in order for them to be better visualized, they need to be 3D-scanned. For this digitization process, 3D scanners will be needed. Professional 3D scanning equipment or even the photogrammetry process will be required to achieve this task

Further development

Our project mostly focuses on one aspect of the museum: how human remains can be considered as proper cultural heritage items. This project, however, can be further developed in such a way that it includes other aspects of the museum that we did not consider.

Our project is also a new and **immersive** way of interacting with museum's cultural heritages, whether they are human remains, animal remains, paintings or ancient relics. Through this type of **design thinking approach**, we believe that these type of institutions could truly progress in **making their target audience**

question, reflect and care about the items they interact with.

Maintenance issues

Once the application has been developed, there are very few aspects that need to be maintained. Firstly, we would need someone to moderate open-ended questions, so that they remain relevant to the topic at hand. We would also need an external application professional, available when necessary, that is in case there are some bugs in the application that need to be fixed.

The most important maintenance work would be to add the latest item to the application, along with its AR experience.

Team Roles

Victor Chaix – research on the institutional problematics and goals concerning human remains, development of the concept and museological approach, reflection, and justification of the project's goals

Ahsan Syed – development of the interaction diagram, of the prototype of the application and its wireframe, of the foreseen workflow and precision of the requirements.

Maddalena Ghiotto – development of the Twine interactive story, conceptual map, selection of the relevant cultural heritage assets and picture shooting, production of the experience design diagram

Supporting Material

1. Interactive story (through *Twine*)
2. Prototype of the application (*Balsamiq* for the wireframe and *Justinmind* for the working prototype)
3. Photographs from the Bologna University Museum of Anthropology

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