Contents

Introduction

This report documents a proposed technologically enhanced learning environment, using virtual reality (VR) to assist the teaching of first aid.

Background

As an estimated 6.3 million working days were lost to non-fatal workplace injuries in 2022 (Arco Ltd., 2021); effective first aid could have a high economic benefit. Additionally, out of the 2,230,414 A&E attendances in April 2024, only 544,113 were emergency admissions (Evert K., 2024). This suggests that not enough people have adequate first aid training in the UK.

Historically, teaching is done through experience-based learning in a hands-on environment. While this allows first-hand experience with any equipment the first aider would need, it relies on that equipment being present. Volunteers (like St John Ambulance and British Red Cross) offer courses to teach people the necessary skills, but those that cannot travel to the course or work from home do not get the same experience, relying solely on books or online media. The courses offered sometimes differ based on the location these at may be impractical to get to and the courses also cost £60 minimum (St John Ambulance, 2024). When trying to learn a range of first aid procedures, a large upfront cost is required.

Online resources are available (https://www.redcross.org.uk/first-aid/learn-first-aid) but these do not all offer the same information. St John Ambulance offers CPR training and certification (St John Ambulance (2024)) but give little information online about it, while providing in-depth online instruction on other injuries like "severe bleeding". British Red Cross provide basic information and videos on CPR but offer sparce information regarding other injuries ("bleeding heavily").

Practical experience allows the first aider to gain confidence in their skills and ask questions in a pressure insensitive environment.

Some apps are available (British Red Cross (2024)), but these largely follow the same style as the online materials.

There are many reasons why the public don't use 'hands-on' first aid training, including:

- High cost for each course, with additional courses needed for things like defibrillator use
- Not wanting to leave the house
- Being too busy or not having the time

VR is a possible solution to many of these reasons. The cost of a VR headset is greater than the courses but can be used at any time and only one purchase is required. On top of this, the headset can be used to keep skills up to date or given to someone else to learn.

If a person doesn't want to or is unable to leave the house, they would still be able to learn first aid from their own home if there is enough space to.

As gaming consoles are made to be easily used and quick to start playing, there is little setup time required for a VR headset. This paired with how each accident/emergency is a separate task allows the learning environment to be used when time allows and for short periods of time if necessary.

Design & Development Process

User Profiles

To help with the design of the environment, some personas were made. As first aid is something everyone would benefit from knowing, a range of ages and professions were chosen:

- James Woodward, 20, University student
- Eric Brown, 42, Builder
- Sarah Dunsted, 33, IT Technician

The hazards each persona would face in their day-to-day lives differ, but their effects could be minimised with proper first aid training.

Theory and practicality have been considered when designing the learning environment.

Context

As a wide variety of people need to learn first aid, the environment should allow prospective users to learn from as wide a range of places as possible. To do this, a VR simulation was chosen.

The simulation could be used anywhere a VR headset could be used. As some headsets like the Meta Quest 2 (Meta (2024)) require no external cables and can have programs downloaded onto them, they could be used anywhere with enough space. This could be useful in settings such as a library or office, allowing anyone who wishes to use the simulation to learn or update their knowledge. Because learning wouldn't be confined to a computer, it would also make learning possible in remote areas such as the breakroom of a building site.

Prototyping

Story boarding was used to better understand how the environment could implement various learning techniques (Figure 1). Once these were identified, a low fidelity prototype was made.

The prototype allowed for a better understanding of how users interact with the learning environment. Given that this is for virtual reality, most elements were designed to be selected or have motions associated with them. One example of this is the equipment window on the right side of the user during any main first aid activity (Figure 3). This window will be able to be hidden or shown by clicking on it or by dragging or either side, a feature afforded by VR, to make the experience feel more natural and easier to use.

It is assumed that the environment has enough space to use the VR equipment and that the equipment is fully charged.

Low Fidelity Prototype

When opening the environment, the first screen the user will see is the injury selection screen.

A scrollable list of injuries will be shown, with more severe/advanced scenarios further down the list. To allow users to get used to the environment (preventing it from becoming a distraction) and learn or revisit simpler first aid procedures before attempting more dangerous or severe injuries. The colours of the injury on this list would be used to denote the severity, ranging from basic to life threatening. Each injury in the list will have a time and score associated with it to allow the user to keep track of their best times and scores, adding a gamification element to the environment, allowing the user to compete with themselves and others.

After selecting an injury, the user will be prompted to "learn" what first aid is needed. This will give them a step-by-step guide on how to attend to the injury selected. If they have already learnt the relevant first aid, the user will then be prompted to select one of three options:

- Learn
- Practice
- Test

"Learn" will take them to the same step-by-step guide mentioned above; this option is always available for the user to refresh their skills.

"Practice" will put the user in the same environment as the "learn" option, only without the step-by-step guide (Figure 3). There is an option to watch a video of someone completing the task as well as a checklist for the user to look at (Figure 4). Additional hints can be toggled at the bottom of the user's view. Any equipment the user has been exposed to, from previous injuries, is available for use in the selection panel on the right of their view. This panel can be moved and hidden or shown by clicking or dragging the window. Any items can be dragged out of the panel and into the environment to then be used.

"Test" allows the user to see how quickly and effectively they can complete the first aid. Without hints (including the video and checklist). Upon completion, a score is given based on accuracy and performance, as well as a time (Figure 5). Their best times and scores can be seen from the injury selection screen.

Prototype Testing

Not all elements of the prototype map to the proposed VR environment (for example bandaging) as they would require the environment to respond to the motions the user would make. Because of this, only the following menu navigation testing could be completed:

- Selecting an injury
- Opening the checklist
- Opening the video (and checklist)
- Interacting with the equipment window
- Hiding and showing any hints

Theory to Design

This learning environment utilised several traditional learning philosophies with the prototype being created with elements of Cognitivism, Constructivism and Behaviourism. On top of this, gamification and various motivation techniques are used.

Neuroscience

VR allows for a practical learning style; the interactions with the environment allow the user to practice various techniques and build muscle memory. The physicality of VR allows for better oxygenation of the brain, leading to improved attention spans and memory formation (Tokuhama-Espinosa, T. (2010)). Mind, brain, and education science: A comprehensive guide to the new brain-based teaching.).

Cognitivism

"Cognitivism offers insight into how our minds process information and convert it into knowledge" (Kurt, S. (2023)).

As a lot of vital information needs to be portrayed, where possible, the information will be broken down, as proposed by Mayer, R.E. (2005). However, the video examples will include subtitles.

Even though this is extraneous information (as a greater cognitive load is required), subtitles increase accessibility for the hearing impaired. As the video outlines each step, the task gets added to the checklist, making it easier for the user to understand the most important parts of each video.

As new emergencies build on prior knowledge, connections can easily be made between the preexisting information and new information, increasing the efficiency of learning.

Constructivism

Constructivism is "an approach to learning that holds that people actively construct or make their own knowledge and that reality is determined by the experiences of the learner" (Elliott et al., 2000, p. 256)

Starting with simple accidents (applying a plaster) and progressing to life threatening emergencies (major bleeding) allows for the "Zone of Proximal Development" principle (Vygotsky, L.S. (1978))

The user should find the first few tasks (like applying a plaster) simple, though some may be slightly challenging, making these tasks belong in the "what I do on my own" zone. To start, the user would likely find the life-threatening emergencies difficult and stressful, placing them in the "I cannot do" zone. As the user progresses onto new tasks, they are given assistance (instructional videos, a checklist and hints), meaning that all users should be able to complete a task, given they have completed the previous tasks, putting most new tasks in their "I can do it with help" zone. As the user progresses through the tasks, and more is learnt, the tasks that were originally beyond their reach should become completable.

Gamification (with Behaviourism)

This learning environment implements operant learning through gamification. Tasks can be compared to the levels of a game (with checklists being the objectives for that level). After the user completes a task's "test", they are given positive reinforcement is the form of a time and score. This gamification offers a reward for the user completing the tasks quickly and to a high standard. Scores and times can be shared and compared, introducing competition with those around you (Gartner Report, 2012).

Gamification offers other benefits such as the ability to take risks with few consequences, allowing for "performance before competence" (Gee, J.P. (2007)). This principal reverses the normal learning model of building competence before allowing the student to perform the action; the student is allowed to learn through the successes and failures of their own actions. The ability to retry any task affords this to the user of this learning environment (Gee, J.P. (2005)).

Motivation

There are many different reasons as to why someone might want to learn first aid using this environment. These motivations can be split into intrinsic (learning something because of a desire to gain that knowledge) and extrinsic (learning something because of what that knowledge affords). An example would be that some users might have an intrinsic motivation for learning the different first aid techniques from a desire to help someone in an emergency, while some may want to learn due to an extrinsic factor such as a higher pay rate or the avoidance of negative consequences because of not helping the person in need.

As users learn in the environment, the feelings of competence and autonomy help to improve their intrinsic motivation (Ryan and Deci, 2000). Where possible, Keller's ARCS (Keller, 2012) model has been considered. The VR platform aids in attention retention and relevance due to the amount the participation and the first-hand experience gained. Being able to learn

techniques as much as they like allows the user to gain experience and confidence. The user would also experience satisfaction from successfully administering the required first aid.

The challenge of applying new first aid techniques helps with individual intrinsic motivation, while the competition afforded by gamification aids interpersonal motivation (Malone & Lepper).

Innovative Interactions

This prototype affords innovation due to the hardware it's designed for. VR allows the user to gain muscle memory and related motor skills to improve their confidence and performance during an actual emergency.

This prototype offers an alternative to traditional in-person hands-on learning by allowing users to learn whenever they wish to and for as much time as they would like, rather than meeting at a pre-agreed upon time at a set location.

On top of offering time and locational flexibility, gamification allows users to learn through failure without serious repercussions, allowing them the freedom to take their time and fully understand the material. A virtual space also reduces any pressure from learning in a group while still allowing competition through gamification.

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Appendix

Appendix 1 – Personas

Name: James Woodward

Age: 20

Profession: Student

Background: Recently started university (studying geology) but has little previous experience living on their own. They are into computer games and have a VR headset in their room. Due to a mixture of being clumsy and distracted with university work and a lack of confidence and knowledge, some of their kitchen practices are unsafe.

Existing knowledge: They have very little knowledge of first aid.

Name: Eric Brown

Age: 42

Profession: Builder

Background: They have worked on a building site since they were 18 and have been exposed to many of the associated dangers. They have a family with 2 children, one in college, the other in secondary school.

Existing knowledge: Has dealt with a coworker's heavy bleeding (applied pressure and called an ambulance). They know how to apply basic first aid.

Name: Sarah Dunsted

Age: 33

Profession: IT Technician

Background: Works with a large amount of electrical equipment. Dismantles and fixes various electrical components, sometimes forgetting to first disconnect the power.

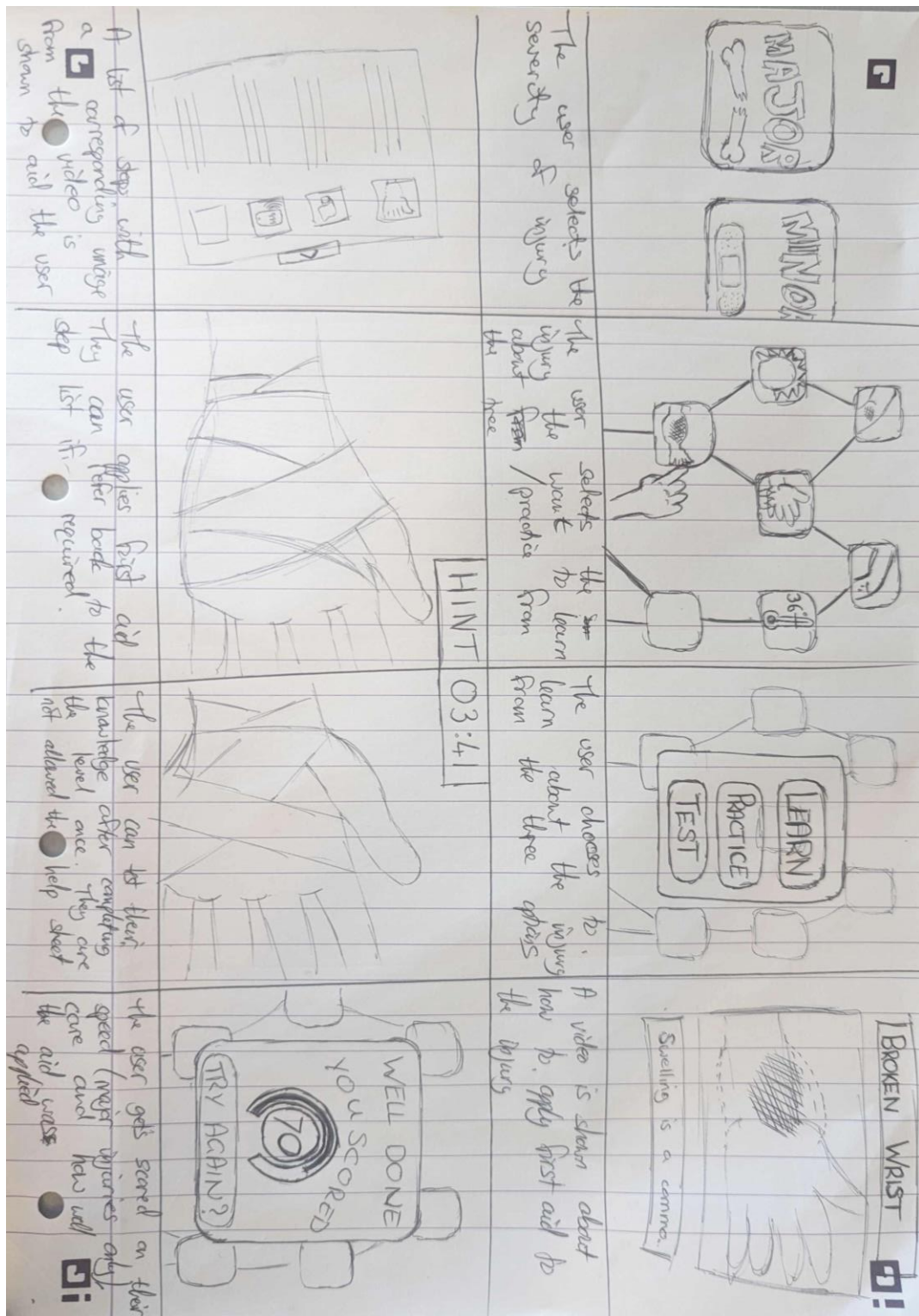Existing knowledge: Basic first aid knowledge

Appendix 2 – Story Board

Figure 1 - Initial Story board

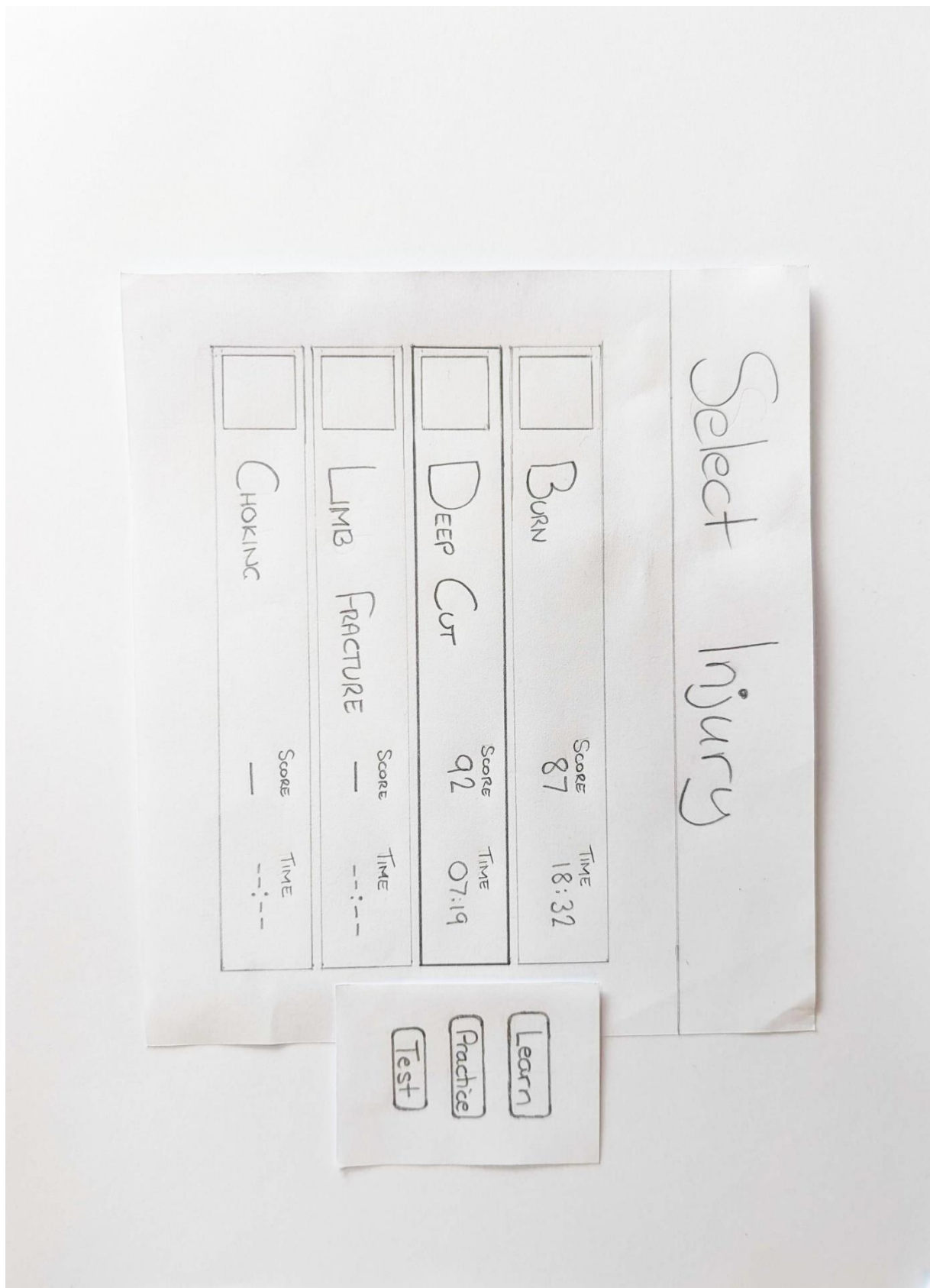# Appendix 3 – Low Fidelity Prototype
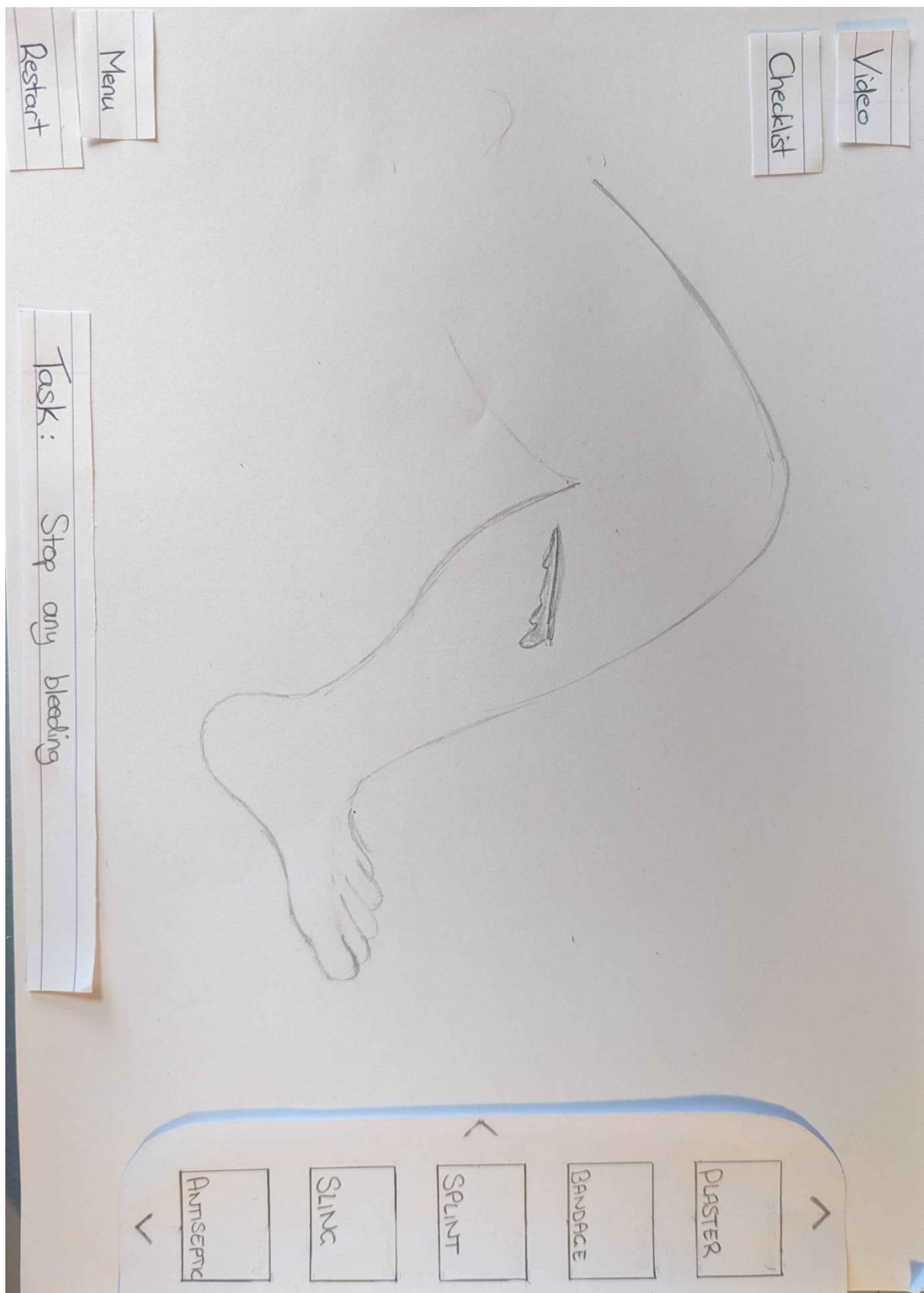

Figure 2 - Injury Selection Screen.

Figure 3 - Main Activity – Deep cut to the leg.

Menu

Restart

Task: Stop any bleeding

Demonstration Video

Subtitles

Checklist

☐ Wear gloves if possible to prevent spread of disease

☐ Apply pressure with sterile dressing or non-fluffy cloth if dressing unavailable

☐ Call 999, if possible get a helper to do this so you can maintain pressure

☐ Secure the dressing with a bandage

☐ Check circulation beyond the bandage

☐ Lay them down, raising the injury, to prevent shock.

Figure 4 - Instructional Video and Checklist
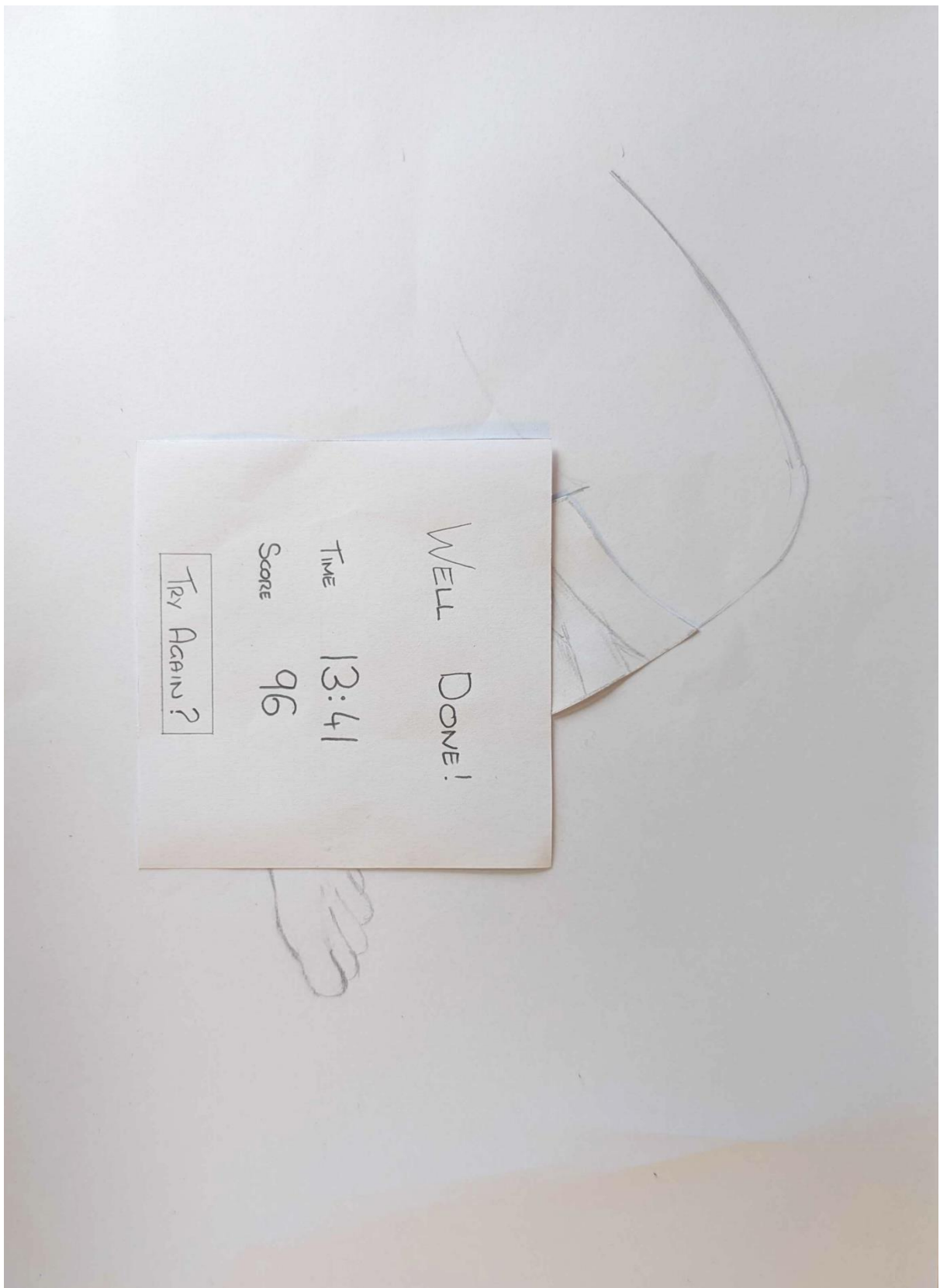
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Figure 5 - Activity Completion Window.

Journal: What makes learning meaningful?

Entry 1: Describe your own meaningful learning experience

Your first entry should describe a meaningful learning experience that you have personally had in the past. You should describe one positive experience in detail.

When becoming a PADI rescue diver, a large amount of information is required to ensure the safety of yourself, and the person being rescued. When I took this course, the content was taught in a way that was enjoyable to learn and easy to understand. The course was split into 3 sections.

For the first section, I had to read a book and complete a series of "knowledge reviews" based on the information in the book.

The second section started by going through the answers of the knowledge review, making sure everyone understood them, and ended in a classroom-based practice of the content (including techniques like CPR).

The final section was a practical session in a lake, employing the techniques in a similar situation as they would be used in.

Entry 2: Assumptions about learning

Your second entry is a simple one: given whatever you have described in the first entry, what assumptions have been made (implicitly or explicitly) about how people learn?

Being a diving qualification, much of the information was to do with safety and technique in the water, allowing prior information to be referenced. The underlying assumption is that incorporating past knowledge helps new learning, whether through references or use of previous techniques.

Much of the information was technique based. For these points, the technique was practiced a few times (both in and out of the water). The base assumption for this is that it is best to practice techniques several times to help build muscle memory.

Most of the water-based learning was first done in the classroom, allowing the techniques to be practiced before any environmental risks were introduced. The assumption for this is that learning in an environment with fewer consequences to risk taking allows people to feel more confident in their abilities before trying them out in their usual environment.

Entry 3: Theories of learning

Your third entry should focus on theories of learning (behaviourism, cognitivism, constructivism, or any other theories that you research independently).

The learning was mainly a combination of cognitivism and cognitivism. Having hands-on experience and being able to ask questions when learning techniques allowed me to have an active role in the learning.

There were elements of cognitivism as having to learn the various techniques, understand why each could be used and apply the most effective one requires more than stimulus response. The best techniques changes based on various factor (e.g. a current).

The knowledge reviews, practical exercises and reason for the course helped to focus my attention on the content being taught, making it more memorable.

Entry 4: Theories of motivation

Your fourth entry should focus on theories of motivation, for example, the Lepper and Malone model, the ARCS model developed by Keller and Suzuki, intrinsic and extrinsic motivation as covered in Deci and Ryan's Self Determination Theory, or any other theories of motivation that you have researched.

The main intrinsic motivation is the ability to help someone in trouble.

*This learning experience implemented Keller's ARCS model completely. Being a dangerous sport, the **relevance** of what was being taught was ever-present, more-so with the in-water practice/teaching section. These practice sessions also aided in **confidence**. As much of the information was already known (through previous first aid courses and diving experience), being able to tie new learning to prior knowledge reduced the perceived difficulty of the information. Participation and a conversational teaching style throughout helped me maintain **attention**, so that when practicing the various techniques, there was **satisfaction** when completing them properly.*

Entry 5: From real to digital

Your fifth, and final entry is about the move from "real" to digital. Your learning experience is likely to have taken place in a face-to-face environment, but don't worry if that's not the case. The key here is to think about those features of the experience that made it meaningful: what were they, and how could you recreate them when designing a technology-enhanced learning experience? This is a very important step in the design process: when designing technology for learning, many of us simply copy what we're used to. However, much of the technology-enhanced learning that is out there isn't particularly inspiring, motivating, or well designed. It's not always clear that the designers have thought long and hard about how to best engage and motivate their learners. So, it's up to you to break the cycle!

As other people's lives potentially depend upon the knowledge and abilities this course provides teaches, an instructor should always be there to make sure the student can safely and affectively implement any knowledge gained during this course. Because of this, an instructor should be present for all in-water practice and to check any on-land skills before moving to the water. As a result, the only parts where a technologically enhanced learning environment would be safe are learning and practicing the skills (before showing the instructor) and the knowledge the skills use and is checked in the knowledge reviews.

Gamification of the knowledge reviews may help students remain engaged for the length of the content. A mixture of videos as well as text may also aid in the understanding of various techniques presented, and scoring (before an in-person session) would provide instant feedback and let the learner better understand the areas they performed poorly at. As most divers are above 40, over gamification would reduce the motivation for many. The lack of interactable content, however, makes the reading of information boring, greatly reducing motivation, leading to some of the more vital pieces of information to be skim read.

The learning environment prototype developed for this module implements various gamification elements through scores and times. Scores allow people to be competitive with both themselves and others and allow people to see how their performance improves over time. The prototype allows people to practice and relearn any previously completed "level", allowing for skills to be updated or relearnt if necessary, this is another affordance of gamification that this scenario would benefit from.

Brainstorming

Activity: consider a variety of subjects / topics / concepts / skills for your prototype and complete the table below (minimum of 10 ideas). Include the completed table in the appendix to your report.

You do not need to be an 'expert' in your chosen area, but *some* prior experience would be preferable. There are very few constraints on the topic or the audience - it does not *need* to be traditionally academic and can be designed for any learner e.g. regardless of age or context. If you're struggling to think of ideas, please contact your practical tutor as soon as possible.

Remember that you will be working on this project for the entire term, so choose ideas that you will find interesting and fun. In the next practical you will discuss these ideas with your group and select one to move forward with (you *can* select a wholly new idea after receiving feedback but it should be finalised as soon as possible after the Week 3 practical).

Please note, you should not describe *how* your TELE will teach these ideas (e.g. specific technologies). For entries in the 'Why?' column, a couple of sentences will suffice.

Week 2 Practical activity: brainstorming	
What? **(topic / target audience / context)**	**Why?** **(what is interesting about this idea)**
Archery People learning archery To help people learn technique	Can be hard to learn technique and people can develop bad habits that make it harder to get better
Language learning (accents) People learning a new language It can be hard to understand people in another language without being familiar with that accent	Accents change how different languages are said and can be hard to understand for people who are not native speakers. E.g. Scottish accents sound very different from a welsh accent
Learning to code People who are learning to code Coding can be hard to learn and the experience changes with different environments	There are different learning tools but many are either block code-based (put blocks together rather than type the code) or rely on websites like geeksforgeeks
Exercise – learning proper form People looking to start going to the gym Incorrect form can injure you	Many people go the gyms and use improper techniques and they may get injured
Card games People looking to learn new card games Some games have complicated rules, others share rules	Card games are a good way to pass the time and are good for all age groups

Algebra School kids Many kids find it hard to learn algebra	Algebra is used in everyday life without people knowing it but they struggle when it is presented the way it is in schools
Camouflage Identification Military personnel Being able to recognise people based on their camouflage can be quicker than possibly glimpsing their national flag	Being able to identify friend from foe can save lives
Ride a bike adults learning to ride a bike Most people learn how to ride a bike young but some don't and may find it embarrassing to learn	Some who never learnt to ride a bike young may want to learn after they have grown up
Grammar School kids Improper grammar can make it hard to understand someone	It can also be used to help people
Cooking People learning to cook Many people go to university not being able to cook for themselves.	It would let people feed themselves and live more healthily

Appendix 6 - TELE Practical Activity: Week 3

Understanding and specifying the context of use

Activity: Describe the context(s) in which learning of your topic currently takes place and complete the table and persona template below. Include the persona in the appendix to your report.

In HCI last term, your understanding of 'context of use' would have been derived from interviewing your peers. However, that's not practical on this module, so you will be exploring this via online research. Try to explore a wide range of materials but consider the authority of the source e.g. if you're considering topics for school children then the National Curriculum and online lesson plans would be a good place to start etc. This activity will provide content for the 'introduction' section of your report, as well as guide your design process through the project.

Step 1: selecting your topic.

After discussion with your feedback group and tutor, you should select your most promising three ideas. For each idea, spend approximately 20 minutes exploring online resources that help you answer the questions in the step 2. Once you have a good idea of how much information is available for each, select the topic you wish to move forward with. (Justification of your design decisions will be a major factor when marking, so consider this when selecting e.g. are there sufficient materials available to inform your process and reference in the report, and do you see opportunity and necessity of improvement?)

Step 2: understanding context

Week 3 Practical activity: Understanding the context of use	
Question	Response
What is the topic?	First aid
In what settings are the topic taught?	In person – hands on
How is the topic currently taught?	Hands on – person showing then then they copy/try
What are the problems with the way the topic is currently taught?	You have to travel to somewhere to learn it
Who are the audience for the topic?	People learning first aid – secondary school children
What are their general characteristics?	Come in contact with potential dangers often
What is their prior knowledge of the topic?	Basic first aid
What are their motivations for learning the topic?	Want to be able to help in an emegency

Week 3 Practical activity: Understanding the context of use	
Question	Response
What is the topic?	Learning accents
In what settings are the topic taught?	It is not
How is the topic currently taught?	
What are the problems with the way the topic is currently taught?	It isn't. Language aids don't usually teach speech (only listening). Couldn't find any that teach accents
Who are the audience for the topic?	Adults learning new languages / moving to new places / actors learning new accents
What are their general characteristics?	They can speak
What is their prior knowledge of the topic?	
What are their motivations for learning the topic?	Moved/planning to move house to another country/area with different accent. People going on holiday

Week 3 Practical activity: Understanding the context of use	
Question	Response
What is the topic?	Archery
In what settings are the topic taught?	In person – in a hall/range. Usually many people – being around more experienced people may make people nervous
How is the topic currently taught?	One on one – shoot arrows with technique in mind, get verbal feedback from the coach about how to change
What are the problems with the way the topic is currently taught?	Relies on the student going to the club every week/session and the club having equipment – cannot do it at home
Who are the audience for the topic?	Adults learning archery
What are their general characteristics?	They can use their arms
What is their prior knowledge of the topic?	
What are their motivations for learning the topic?	

Specify the User Requirements

Activity: Write a context scenario describing your persona's typical interactions with your TELE. Include this in the appendix to your report.

The nature of this module means your ideas will likely evolve considerably as the project progresses e.g. after new concepts are introduced in the seminars. Therefore, we only ask you to define the user requirements using a context scenario – a full requirements specification would not be an efficient use of your time.

Step 1: selecting your technology.

Briefly review the academic papers describing the TELEs that (I believe) make effective and justified use of innovative technologies. Consider the advantages and disadvantages that these technologies might bring to the learning of that topic.

Now, for the topic you have chosen, select a technology that you believe may help resolve some, or all, of the problems you previously identified with the current teaching methods.

Remember – when marking, we will be considering the appropriateness of your technology, not the novelty! There will be no additional marks for designing an Augmented Reality interface compared to a more conventional desktop/tablet etc.

Step 2: justify your decision.

(please note, depending on your project, Q2 may not be relevant to you – just ignore it.)

Question	Response
What technology have you selected to use?	VR – it allows the user to interact and learn first aid in an environment it can be used in. It is also easiest to learn through physical application and VR will allow this anywhere
If there is no change in technology between current teaching methods and your proposal (e.g. desktop in both) then what is the innovation?	
Why do you think this technology / innovation will improve on the way things are currently taught?	It allows people to learn first aid from anywhere, rather than travelling to a workshop/course to learn it in person. It allows more people to access life-saving techniques. If used in workshops, allows everyone to learn at the same time - often not enough equipment for everyone or the person leading the workshop is busy teaching an individual

Step 3: write your context scenario.

Write a brief (300-400 words) narrative description of your persona interacting with your TELE.

Those of you that studied HCI last term will remember: a context scenario tells the story of a particular user persona, with various motivations, needs, and goals, using the future version of your product in the way that is most typical for that persona. Context scenarios should be broad and relatively shallow in scope. Example questions to answer within the narrative: In what setting(s) will the product be used? What user goal is accomplished in the scenario? What primary activities does the persona need to perform to meet their goals? What is the expected end result of using the product?

The user is in their bedroom room with a VR headset on. After loading the program, they select the severity of the injury they wish to learn about or get a random scenario with an injured person to treat. After selecting minor injury, the user is shown a screen where they choose the type of minor injury and if they want to practice or learn it. The different injuries are shown in a progression tree with completed injuries in green, new/learnable injuries in yellow/gold and ones that cannot be learnt yet in grey.

After the user selects a gold injury (in this case broken wrist) the user is told/shown how to identify a broken wrist. After this is closed, they are shown a short video on how to bandage and sling a broken wrist. After this is finished, they have to opportunity to watch it again if they need to. A list of steps to take and corresponding images (from the video) is given for the user to refer back to at any point in time.

After the user has completed the learning phase of the scenario, they can choose to progress to the exam phase. In this, the user has to do first aid on the injury in the scenario but without any aid (not allowed to see the video or look at the cheat sheet of steps).

Once the scenario has been passed, the user gets taken back to the injury tree seen before with a score based on the speed and care taken during the exam phase. The user can go back to redo the exam, practice or relearn the injury whenever they wish if they want to get a better score or to refresh their knowledge. The injury is now green in the tree and the next grey injury(s) in the tree is now available (yellow).