

Improving CPR Manikins and Training for Children

RESEARCH REPORT

FA/DESN2011
Designing For Human Interactions

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PROJECT OVERVIEW

1.1 PROJECT DESCRIPTION

1.2 EXPLORATION QUESTIONS

1.3 TARGET USERS

1.4 RESEARCH PLAN

1.5 RESEARCH METHOD

1.1 Project Description

"This semester's design challenge requires the application of your interaction design process, design knowledge and skills to design interactions with a child size manikin for children to learn the CPR (cardiopulmonary resuscitation) technique. The interactions with the manikin should be designed to support haptic feedback to facilitate the children's learning. You are required to design actions (haptic in this project) and reactions with the manikin. Lecture content will inform the weekly development of your design."

1.2 Exploration Questions

PERFORMING CPR

- What is the proper technique for performing CPR?
- When does CPR need to be performed? How can we tell?
- What unique challenges do children face when performing CPR on others?
- How do people stay calm during the CPR process?
- How does performing CPR in training differ from performing CPR in reality?
- How do the pressures of real life emergencies affect people as they perform CPR?
- What deterrents may prevent people/children from performing CPR on a casualty?

LEARNING CPR

- What mistakes do people make when first learning CPR?
Children, specifically?
- How real should the simulated training be?

TEACHING CPR

- How do instructors usually train people to do CPR?
- What challenges do instructors face when teaching CPR to children?
- What are the most important CPR aspects that should be emphasized to children?

CPR MANIKIN

- What are the components and characteristics of CPR manikins?
- What existing interfaces and tools are used to teach CPR?
- What are the problems with existing tools or interfaces?
- If you could redesign a manikin, what would you change/add/take away?

1.3 Target Users



Primary Users: children aged 10-13 who do not know First Aid/CPR

Secondary users: trainers, instructors, teachers who teach CPR to children

Tertiary users: parents who enroll their children in First Aid/CPR workshops

1.4 Research Plan

- 1 Research CPR technique, training, and manikins online
- 2 Contact stakeholders and conduct interviews
- 3 Compile insights from both primary and secondary research
- 4 Determine possible design directions

1.5 Research Method

PRIMARY RESEARCH

- Stakeholder interviews
- Personal experiences

SECONDARY RESEARCH

- Research CPR technique and training online
- View available CPR models & existing feedback devices
- Watch videos going through the CPR process

METHODOLOGIES

- Stakeholder mapping
- Topic mapping
- Affinity mapping
- Personas
- PACT

2

PACT ANALYSIS

2.1 PACT OVERVIEW

2.2 PEOPLE

2.3 ACTIVITIES

2.4 CONTEXT

2.5 TECHNOLOGY

2.1 PACT Overview



PEOPLE

RELEVANT USER CHARACTERISTICS & SKILLS



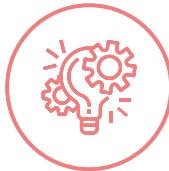
ACTIVITIES

HOW IS THE ACTIVITY CURRENTLY CARRIED OUT?
WHY? WHAT CAN BE IMPROVED?



CONTEXT

THE ENVIRONMENT OF THE ACTIVITY



TECHNOLOGIES

WHAT TOOLS ARE USED NOW, AND HOW MIGHT NEW DEVELOPMENTS BE USED?

2.2 People



PSYCHOLOGICAL

- Attention spans
- Cooperation level
- Memory
- Forming the right 'mental model'



PHYSIOLOGICAL

- Height, weight, and hand size
- Physical strength - ability to effectively compress chest
- Fine motor skills
- Special needs

2.3 Activities

TIME

- Lesson is the length of a standard CPR session
- (1-2 hours for a short class, 3 hours for a long class, 8 hours for a day-long workshop)
- Possibly regular practice sessions at home

COOPERATION

- One trainer to a group of students

COMPLEXITY

- Well-defined - step-by-step instructions

NATURE OF CONTENT

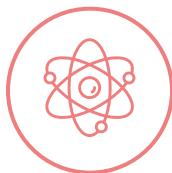
- Teach 10-13 year old children how to perform CPR
- Course material includes reading, writing, and hands on practice
- Explicit - may be hard for some individuals to process CPR scenarios

2.4 Context



SOCIAL CONTEXT

- Individual activity - asynchronous or synchronous video
- Group activity - class/workshop



PHYSICAL CONTEXT

- CPR training classroom
- School classroom
- Swimming lesson - poolside
- At home, with video conference or video tutorial
- Short class (e.g. 1-2 hours), long class (3 hours), or day-long workshop (8 hours)



PSYCHOLOGICAL CONTEXT

- Motivation level varies (some kids may be interested, some kids may not)
- Cognitive demands
- Level of energy varies (some kids may be hyperactive, others may be bored)

2.5 Technology

INPUT

- Breath responders - blowing in the right amount of air into the manikin
- Chest only rises when the head is tilted properly
- Instantaneous audio & visual feedback
- Realistic anatomical landmarks

OUTPUT / COMMUNICATION

- Clicking sound when compressions are done properly (2 to 2.4 inches)
- Combinations of lights to monitor speed
- Vibrations to indicate proper compressions

3

PRIMARY RESEARCH

3.1 OUR PROCESS

3.2 OBSERVATIONS FROM CPR TRAINING

3.3 STAKEHOLDERS

3.4 STAKEHOLDER CONTACTS

3.5 TOPIC MAPS

3.6 INTERVIEWS

3.7 AFFINITY DIAGRAMS

3.8 INTERVIEW INSIGHTS

3.1 Our Process

1

CONTACTS

We gathered a list of stakeholders we could potentially interview through our personal networks and online research. Then, we ranked the stakeholders based on priority.

2

REACHING OUT

The high-priority and medium-priority stakeholders were contacted through various platforms such as LinkedIn, email, and video call to share their personal experiences with CPR.

3

INTERVIEWS

During our interviews, we asked open-ended questions based on our topic maps and collected information regarding CPR training, manikins, real life emergencies, and teaching strategies.

4

INSIGHTS

Although each person had their own opinions, common and relevant responses were organized in affinity diagrams and have been compiled into the section **3.6 Insights by Category**.

3.2 Observations From CPR Training

JUSTIN

"You've got to break ribs"

Brayden, CPR instructor

- Mannequins were all males with a slim build - this could cause issues in real life when trying to landmark and perform compressions on women, children, or people who are overweight
- Scene survey, observing signs/symptoms, and calling for help are underemphasized
- I had the habit of landmarking incorrectly because I perceived the heart to be farther to the left
- I kept forgetting to count how many compressions I had done
- I kept forgetting steps other than the core 30/2 compressions and breaths

3.3 Stakeholders

PRIMARY

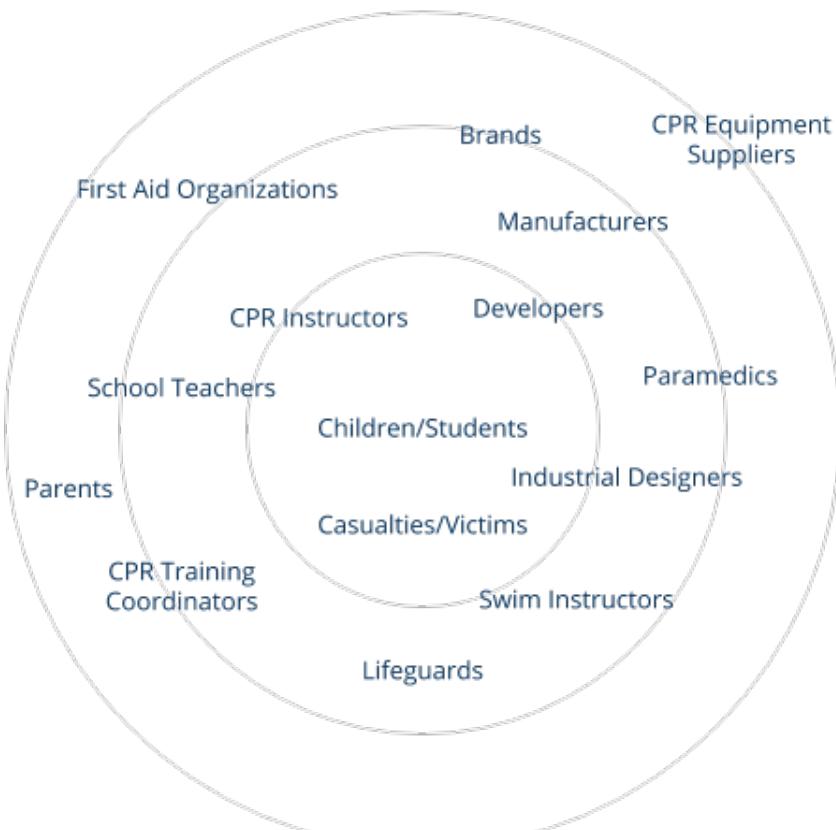
- Children

SECONDARY

- CPR Instructors
- Swim Instructors
- School Teachers

TERTIARY

- Parents
- CPR Training Coordinators
- Paramedics
- First Aid Organizations
- Casualties/Victims
- Lifeguards
- Kinesiology Experts
- Brands
- CPR Equipment Suppliers
- Manufacturers
- Developers
- Industrial Designers



3.4 Stakeholder Contacts*

HIGH PRIORITY

1. CPR INSTRUCTORS

- Rachel - York Instructor
- Brayden - St. John Ambulance Instructor
- Ja - Canadian Red Cross instructor
- Chris - Teaches CPR via Heart & Stroke

2. CPR TRAINING ORGANIZATIONS & COORDINATORS

- Brandon - Owner of CornerStone First Aid and CPR
- Chase - First Aid Training Partner at Red Cross
- Adrianna - CPR Program Coordinator
- Victoria - Vice President of SOS 4 Kids!
- Elise - Owner of Be Prepared

*All stakeholder names have been replaced with pseudonyms to maintain anonymity

MEDIUM PRIORITY

3. SCHOOL TEACHERS

- Maggie - School Teacher
- Carlos - School Teacher

4. PARAMEDICS

- Eliot - St. John Ambulance

5. SWIM INSTRUCTORS AND LIFEGUARDS

- Sarah - Swim Instructor
- Michael - Swim Instructor
- Denise - Swim Instructor/Lifeguard
- Sal - Lifeguard
- Danica - Lifeguard

6. CHILDREN

- Kayla - 13 year-old who has not learned CPR
- Larissa - 13 year-old Lifeguard-in-Training
- Kids - Justin's homeschool group

7. PARENTS

- Hailey's parents
- Parents - Justin's homeschool group

LOW PRIORITY

8. CPR EQUIPMENT SUPPLIERS

- First Aid Canada
- Canadian Safety Supplies
- AED4Life
- EMRN Medical Equipment
- Canadian Red Cross

9. BRANDS/MANUFACTURERS

- EngineeringCPR
- Biomedical Engineering interns at EngineeringCPR
- Nasco Healthcare, Ambu, Brayden, CPR Prompt,
- Laerdal, Ruth Lee, Life/form, Prestan

10. PEOPLE WHO PERFORMED/RECEIVED CPR IN REAL LIFE

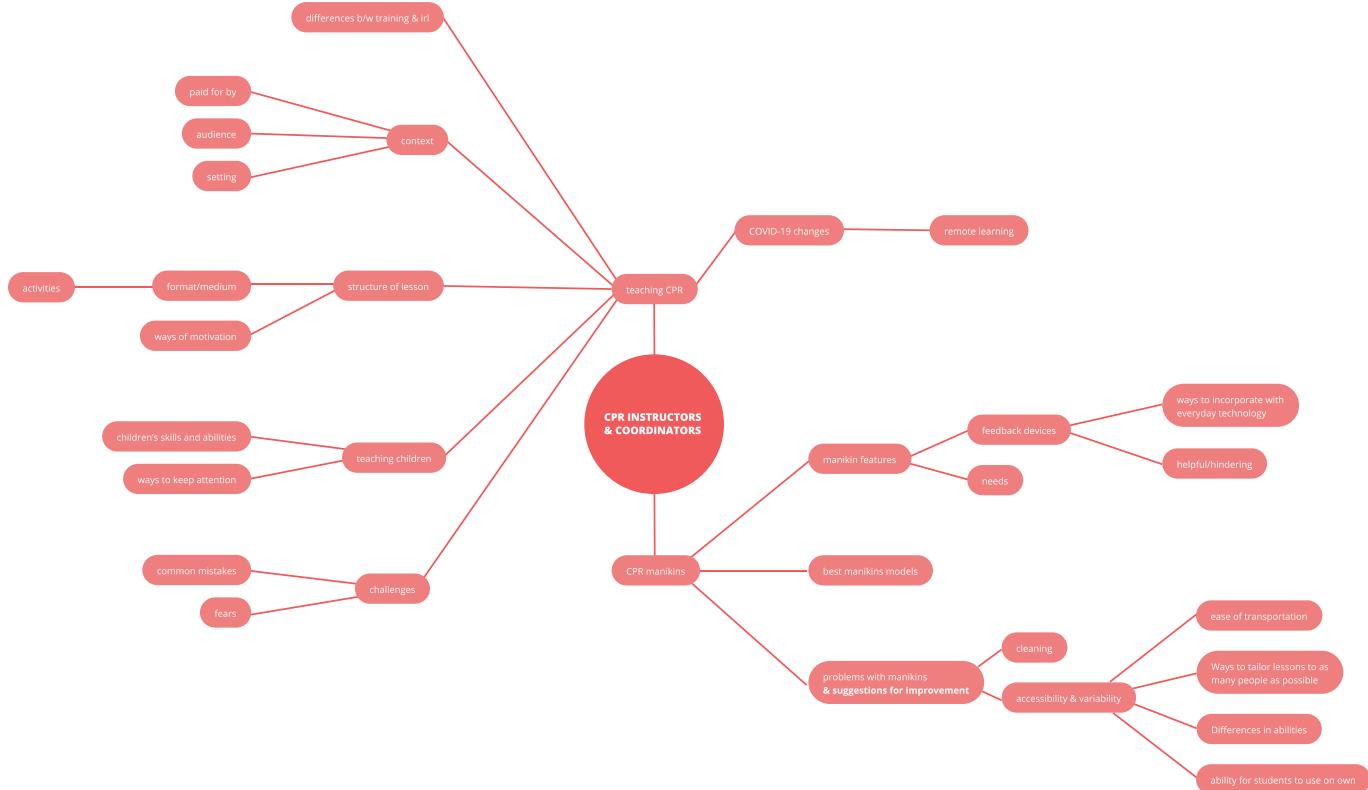
- Users on Reddit

11. KINESIOLOGY EXPERTS

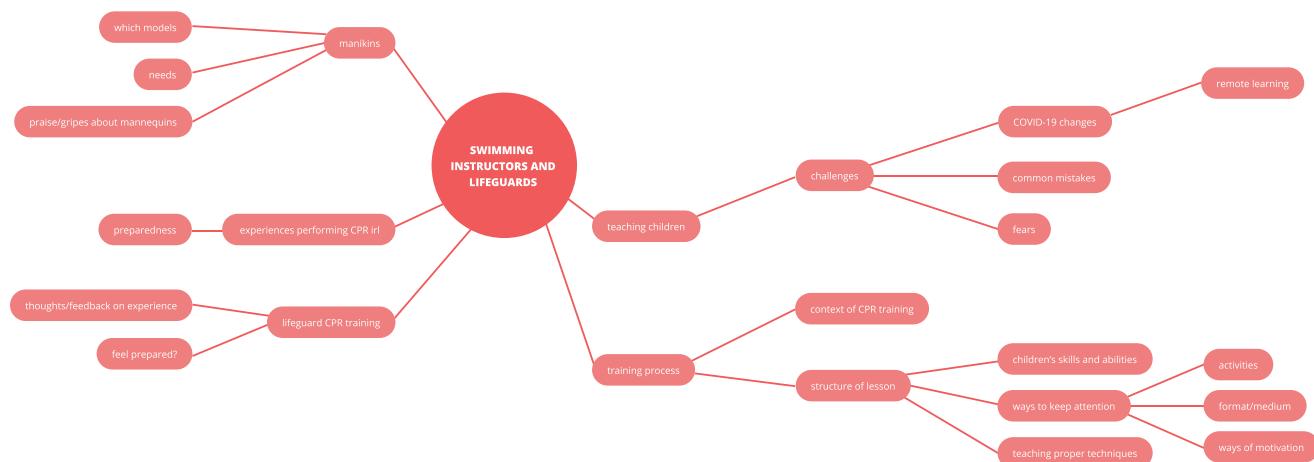
- Lee - Kinesiology Major

3.5 Topic Maps

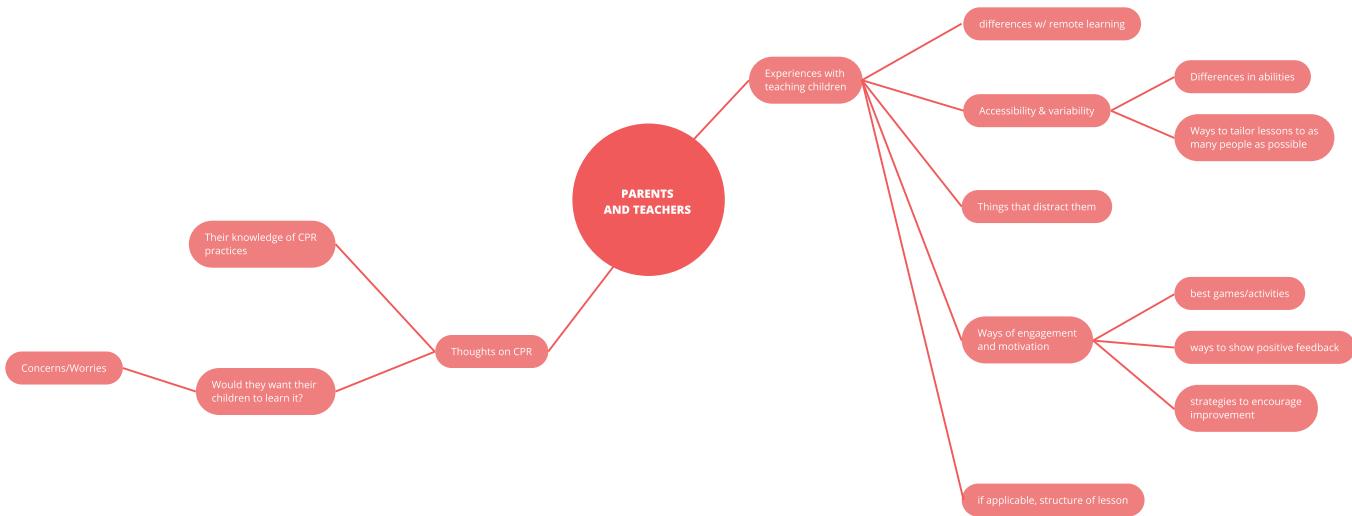
CPR INSTRUCTORS & COORDINATORS



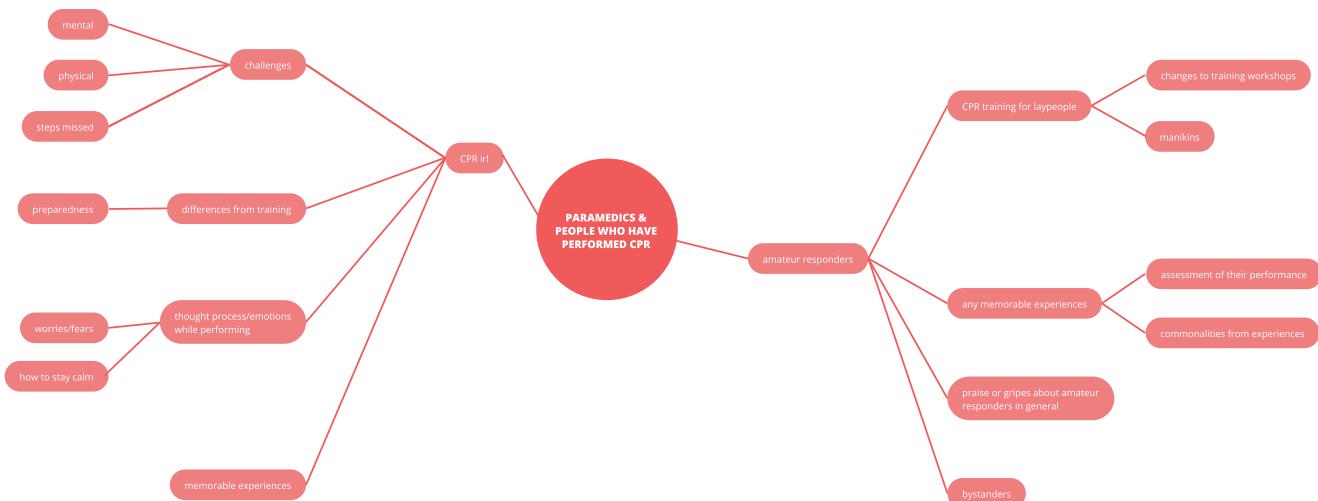
SWIMMING INSTRUCTORS & LIFEGUARDS



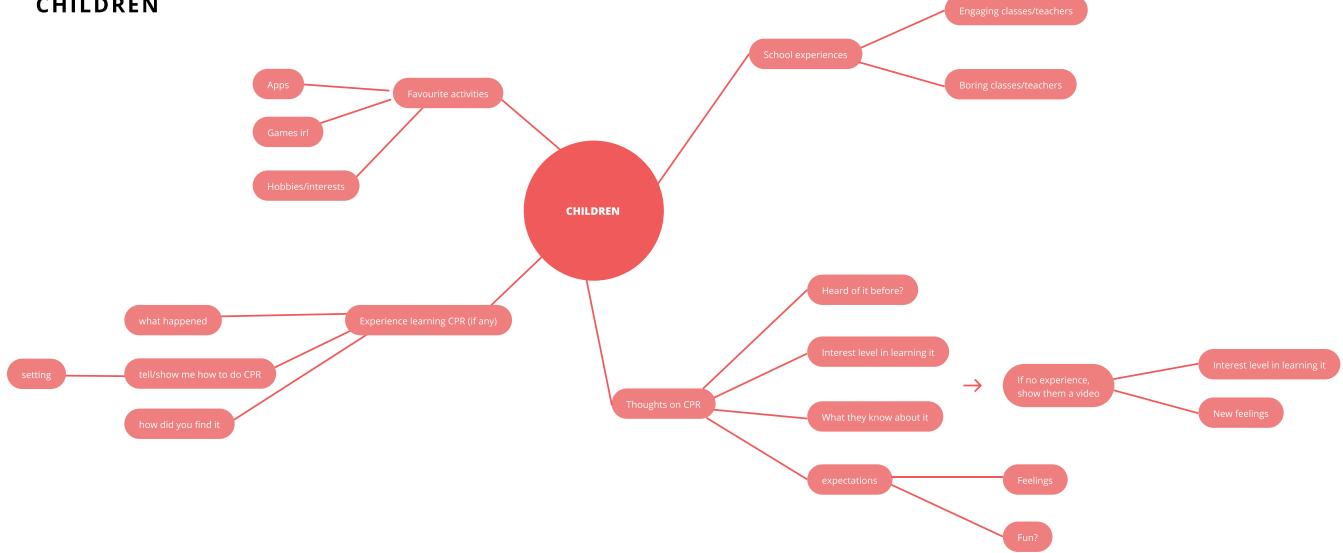
PARENTS & TEACHERS



PARAMEDICS & PEOPLE WHO HAVE PERFORMED CPR



CHILDREN



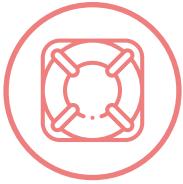
3.6 Interviews

RESPONDED

- Denise - Swimming Instructor
- Rachel - CPR Instructor
- Michael - Swimming Instructor
- Elise - CPR Instructor & Coordinator
- Larissa - 13 y/o Lifeguard-in-Training
- Adrianna - CPR Researcher & Coordinator
- Samantha - Swimming Instructor
- Chris - CPR Instructor & Nurse
- Lee - Kinesiology Major

DID NOT RESPOND

- Brayden - CPR Instructor
- Ja - CPR Instructor
- Brad - CPR Training Coordinator
- Victoria - CPR Training Coordinator
- Maggie - School Teacher
- Carlos - School Teacher
- Sal - Lifeguard
- Kids - Justin's homeschool group



DENISE

SWIMMING INSTRUCTOR & LIFEGUARD

Denise
Swim Instructor

Ways to engage kids: it's okay to make mistakes (e.g. try it this way instead), encourage when things are correct, balance between serious and fun

Denise is a Bronze Cross and Bronze Medallion-certified swimming instructor and lifeguard with experience teaching children swimming at different levels. She has taught first aid and CPR with a focus on water safety scenarios at the Bronze Cross and Bronze Medallion level.

Denise
Swim Instructor

Can tell if pushed down at enough pressure without feedback, but just an estimate; need to remind kids to apply enough pressure

Denise
Swim Instructor

Drawbacks of manikins: could be more human-like, not as effective in water training, too light when carrying

- Feedback devices should indicate whether enough pressure is being applied to the manikin, since her students have limited time to practice with accurate resistance—at all other times, students mime CPR on each other
- Emphasized positivity and open-mindedness as important attitudes for teaching and engaging with children
- Finds that a teaching method centered around scenario practice is very effective for training teenagers and children; limbs and accurate weight are important features for accurate simulation



RACHEL

ATHLETICS/RECREATION MANAGER & CPR INSTRUCTOR

Rachel is a manager for York University Athletics and Recreation who is dedicated to mentoring and supporting others. Having the opportunity to share the value of sport and recreation within a campus of over 50,000 students, she is passionate about implementing safety and inclusivity. She is also skilled at designing and organizing strategies for training, research, and planning.

Rachel
CPR Coordinator

Male with flat chest isn't an issue
- Keep it androgynous
- Boys might "titter" about chests (more difficult for them to focus)

Rachel
CPR Coordinator

Limbs make it heavy
- Don't add them
- Down to lower ribcage (show torso)

Rachel
CPR Coordinator

Easily sanitized since they come into contact with mouths (e.g. clean device with wipe)

Rachel
CPR Coordinator

Manikins: storables (especially for private trainers) & easy to transport

Rachel
CPR Coordinator

Repetition is important
- Each person needs their own manikin
- Lots and lots of practice

Rachel
CPR Coordinator

Some kids can't compress to right depth
- Manikins need to simulate resistance of human body

- As an instructor that travels often, Rachel emphasized the importance of developing a manikin that can be easily stored, assembled, cleaned, and carried. She spoke about having accessible batteries, components that can be replaced without hassle, and the ability to function in diverse environments.

- Having worked with children, she explained that they are often distracted by changing lights and can become discouraged when underperforming against their peers.
- Detailed various methods of technology that can be leveraged to enhance the CPR learning experience, such as through digital wristwatches, centralized devices, and interactive manikin sleeves.



MICHAEL
SWIMMING INSTRUCTOR

With experience working primarily with children in our target age group, Michael is a certified swimming instructor who also teaches short lessons in CPR.

- Stated that he seldom uses manikins for short CPR lessons because they are unwieldy, inconvenient, and require assembly
- Highlighted that children (and adults) can be frightened by the appearances of CPR manikins, which could be a deterrent.

Michael
Swim instructor

Too lazy to bring out the CPR dummies for the kids - I just have them do it on each other

Michael
Swim instructor

Kids are scared of the manikins. They look intimidating.

Michael
Swim instructor

Assembly of the CPR dummies takes too long for a short lesson of CPR

Michael
Swim instructor

Sometimes, I accidentally move into the space where the dummy's legs would have been.

Michael
Swim instructor

Manikins are hard to press and tiring to practice on



ELISE
CPR INSTRUCTOR & COORDINATOR

As the owner of Be Prepared First Aid Training, Elise is the organization's main instructor and has led sessions including First Aid & CPR Training, Babysitting, Home Alone Safety, as well as Health & Safety eLearning courses. In her free time, she has volunteered with a local Ski Patrol unit and hosted community events to teach emergency lifesaving measures.

Elise
CPR instructor - Be Prepared

Try to get them moving as much as possible (calling 911, doing compressions, moving the body etc.)

Elise
CPR instructor - Be Prepared

Adults aren't better than kids at learning CPR. Kids learn and acquire skills quickly.

Elise
CPR instructor - Be Prepared

Virtual babysitting classes: using bear/doll/plushie for compressions - lose out on pressure/depth feedback

Elise
CPR instructor - Be Prepared

Classroom setting - no adrenaline of real situation. Manikins don't need to simulate real pressure.

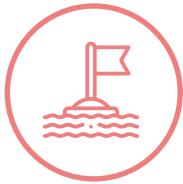
Elise
CPR instructor - Be Prepared

**Prepare for real situation:
be honest. Don't sugarcoat or scare (neither work)**

- Mentioned that adult manikins are too resistant for children to practice compressions. She explained that in a real life situation, the adrenaline would contribute to increasing the maximum amount of pressure they can apply on the victim.

• As a teacher of numerous courses, Elise described her ideal CPR manikin as being versatile to first aid situations, including having fake blood and blocked airways.

• She stressed the significance of teaching children to call for emergency help and retrieving any necessary equipment to assist the victim.



LARISSA

13 YEAR-OLD LIFEGUARD-IN-TRAINING

In addition to recently starting her first year of high school, Larissa is a 13-year-old lifeguard in training. She has completed CPR training and is planning to apply her newly developed skills to obtain a job at the community pool when she turns 16.

Larissa
Lifeguard in training (13)

Some pieces were broken or didn't fit properly

Larissa
Lifeguard in training (13)

Similar to everyday schooling system > material could be difficult

Larissa
Lifeguard in training (13)

Appreciated getting to use the manikins more than with peers

- Explained that although there were a few difficult concepts, a motivational instructor made CPR understandable and engaging.
- As they allowed her to repetitively perform compressions and apply real pressure, Larissa preferred practising CPR on manikins rather than on her peers.



ADRIANNA

CPR PROGRAM COORDINATOR & RESEARCHER

Adrianna is a Coordinator for Red Cross First Aid Program Development, specifically in the science and research-based department. Adrianna works alongside multiple teams both on national and international basis to re-develop existing programming material to teach individuals how to perform, as well as teach CPR.

Adrianna
First Aid Coordinator

Zoom challenges: difficult to help troubleshoot (esp. those who aren't as computer literate)

Adrianna
First Aid Coordinator

Instructors would have to teach participants how to interpret feedback devices or else it is useless.

Adrianna
First Aid Coordinator

Customizable feedback modalities (e.g. can turn off vibrations)

Adrianna
First Aid Coordinator

Set standard with camera quality, camera angles, internet strength

- Discussed popular manikins that many of their partners use such as Laerdal, Preston, and Brayden, but also clarifies that the Red Cross cannot be affiliated with a specific manikin distributor or manufacturer

Adrianna
First Aid Coordinator

Main thing with kids-- tap into different types of learners

- Emphasized cost and storage limitations as the main barriers to purchasing and using manikins with feedback devices, especially full-body manikins
- Highlighted the success of remote and blended CPR training but indicated drawbacks including technical issues and inability to gauge form; currently working on how to better develop and incorporate remote learning programs to better suit the needs of instructors today.



SARAH
SWIMMING INSTRUCTOR

Sarah is a certified children's swimming coach for Goldfish Swimming School and received the majority of her CPR training through the Bronze and Standard First Aid courses in the five years she has been teaching swimming.

- Have to modify teaching style to ensure each student is getting the most out of their lesson.
- Would like to have a light to indicate how deep the compressions are and if it's done correctly.
- Says that to keep the children engaged while learning CPR, play music to go align the beat of the compressions.

Samantha
Goldfish Swimming School Instructor

Same teaching style is not going to work for each kid, so you would have to modify what you are teaching to ensure each kid is learning.

Samantha
Goldfish Swimming School Instructor

Manikins don't give the best sense of an actual person

Samantha
Goldfish Swimming School Instructor

To keep the children engaged while learning CPR, play music to follow along the beat of the compressions



CHRIS

REGISTERED NURSE & CPR INSTRUCTOR

Chris is a Heart & Stroke CPR instructor for nursing and healthcare professionals. As a registered nurse himself, he has experience working in cardiac triage, critical care, and the catheterization laboratory.

- Pointed us to the Heart & Stroke CPR guidelines, as manikin feedback devices become mandatory in 2021
- Emphasized different modalities of feedback on the rate of compressions as a critical part of CPR manikins—even experienced healthcare professionals make mistakes by compressing the chest too quickly

Chris
CPR Instructor

Can do blended learning, but CPR is something that is physical (can't just read, watch videos)

Chris
CPR Instructor

someone dying/cardiac arrest can be sensitive to people under 16 or 18; try to encourage muscle memory

Chris
CPR Instructor

Early challenges:
Adrenaline is rushing, tend to do CPR much faster than we should (compressions are more shallow)

Chris
CPR Instructor

Don't need to teach breaths, emphasize hands-on & 911 instructions

- A maximum of 10 seconds between sets of compressions to maintain casualty's chance of survival; therefore, teaching hands-only CPR to the general public and to children may be more viable
- Described real-life CPR as stressful and adrenaline-inducing, but easier with practice; scenario training, including simulation labs is helpful for preparing healthcare professionals for these situations



LEE
KINESIOLOGY MAJOR

Lee is a fourth-year kinesiology student at York University, children's football coach, and Residence Life assistant for the past three years. Lee provided insight on how to keep children engaged and active while teaching them a new skillset. While Lee is certified in First Aid through York University's Red Cross training, he explained how he has not used these skills in real-life situations, although he remains confident that he would be able to assist in an emergency situation.

- Encourages involvement of more group activities which result in increased engagement, as everyone is participating in something.
- Says to focus lessons on fun and simple instructions.

Lee
Kinesiology Major/ Football Instructor/
Resident Assistant

**Focused lessons on fun
and simple intructions**

Lee
Kinesiology Major/ Football Instructor/
Resident Assistant

**more group actives, more
engagement - everyone
was doing something**

3.7 Affinity Diagrams

Digital sticky notes were created to record the interviewees' contributions, each one containing a unique idea or key point mentioned. Every interviewee received their own coloured sticky notes, which were later organized into general categories. Common topics included manikin features, feedback devices, advice to keep children engaged, and performing CPR in real life. Below are screenshots of our overall affinity diagram and some of our categories:

FIGMA LINK



3.8 Interview Insights



REMOTE/BLENDED LEARNING

INSIGHT

Remote CPR classes have been successful for the most part

- Main challenges involve troubleshooting technical issues, especially for those less computer literate

INSIGHT

Delivering CPR manikins and training equipment to learners is a challenge

- Elise said that for the babysitting course, participants practice on plushies—the obvious drawbacks being an inaccurate simulation of pressure and depth
- Red Cross ships manikin and other training equipment to participants
- In Adrianna's opinion, manikins are 100% necessary for CPR training—pillows do not work

INSIGHT

Teaching practical CPR skills is difficult in an online setting

- CPR is a physical skill (cannot be learned through just reading and watching videos)
- Many people avoid teaching practical CPR skills remotely altogether
- First Aid and CPR theory can be taught online effectively
- Adrianna stated that to address the challenge of visually gauging a learner's CPR performance remotely, standards for camera angles, quality, and internet strength have been established

APP-BASED LEARNING

- Should not rely on connectivity
- Educational
- Involve interaction with peers



ENGAGEMENT

INSIGHT

It is important to find ways to engage learners, especially kids

- Make it fun! Physical activity is good.
- Denise said that she tries to encouraging, even when kids make mistakes
- Make sure everyone is involved - group activities are good for this purpose

INSIGHT

Keep it simple when teaching kids

- Avoid confusing them with complicated concepts
- Give simple instructions

INSIGHT

Kids will get sidetracked in a variety of ways, for a variety of reasons

- Getting bored
- Being rambunctious or silly
- Not understanding the content

INSIGHT

Tap into different types of learners

- Sarah states that using the same teaching style is not going to work for every kid, so you would have to modify what you are teaching to ensure each kid is learning.



CPR TRAINING

INSIGHT

Kids are have a natural interest in learning CPR

- Multiple people pointed out that kids seem to be interested in learning CPR when given the chance.
- Elise said that kids can even acquire CPR skills as fast as adults

INSIGHT

Many kids learn CPR as part of a babysitting course

- Two CPR program coordinators told us about their babysitting course being the primary setting in which kids are introduced to CPR

INSIGHT

Repetitive hands-on practice is essential for learning CPR

- Four people mentioned the importance of practicing CPR repeatedly

INSIGHT

Theoretical scenarios are the preferred way to teach children, adults, and professionals to perform CPR in a variety of situations

- Three people mentioned using scenarios to teach and practice CPR
- Chris told us about simulation labs that where healthcare professionals are trained to respond to different situations involving CPR
- Elise emphasized the importance of getting learners to practice calling 911 and getting help

OTHER INSIGHTS

- Denise mentioned acronyms as a great way to teach CPR and first aid concepts
- Larissa said that it is more fun learning CPR with friends and a good instructor



MANIKINS

INSIGHT



Solely for CPR training, lightweight is preferred

- Needs to be usable in multiple environments
- Easy to transport and carry
- Storable (especially for private trainers)
- Danielle prefers heavy manikins to simulate body weight in water rescue + CPR scenario training

INSIGHT



Difficult assembly is a pain point and deters people from using manikins

- Manikins are delicate and components can be too loose and it is common for them to not fit together properly
- Dummy assemblage is time-consuming, which can cause kids to quickly lose interest

INSIGHT

It is important that manikins with feedback devices can be easily purchased and acquired

- Manikins with feedback devices are very costly
- Not all training partners have access to manikins with feedback devices
- Rachel emphasized the importance for each learner to have their own manikin to practice on

OTHER SUGGESTED FEATURES

- Fake blood and wounds
- Characterizing features such as tattoos
- Blocked airway
- Space for AED pad placement



MANIKINS

INSIGHT



Manikins look scary, not only for children

- Four people mentioned that children, and sometimes adults, find manikins unnerving and “creepy”, which may deter them from using it
- Manikins must be realistic but not so realistic that they scare the user

INSIGHT



The material should simulate skin but still be durable

- Some people criticized the lack of durability for foam,
- Others suggested foam or silicone over plastic because they are realistic materials

FULL BODY



PROPONENTS

Full body manikins are more realistic and versatile.

- Michael pointed out that he made the mistake of kneeling in the space where the manikin's legs would have been.
- Full-body manikins could be used to practise moving and rolling the casualty.
- Better suited for scenario training



OPPONENTS

Full body manikins are inconvenient, costly, and unnecessary.

- Two people said that having limbs make dummies heavy, difficult to store and transport, and generally unwieldy.
- Manikins are not accurate representations of real people anyway



MANIKINS

REALISTIC RESISTANCE



PROPONENTS

Simulated resistance is more realistic and better prepares learners for real life

- Many people valued realistic pressure simulation as a necessary characteristic for any CPR manikin
- Denise pointed out that sometimes there aren't a lot of manikins to share, so each learner only gets a short time to practice with the manikin and exert adequate force



OPPONENTS

Simulated resistance is unnecessary for the purposes of training children

- Kids have a hard time pushing on manikins tailored to adult learners
- Elise argues that adrenaline will give people the energy and make them push harder in real-life situations
- Prolonged practice of CPR on manikins with realistic resistance is tiring



TEACHING HANDS-ONLY CPR



PROPONENTS

- Hands-only CPR may be simpler and easier for the general public and for kids
- Chris told us about the maximum of 10 seconds a casualty can last between compressions without their chances of survival decreasing
- Concerns over potential for COVID-19 transmission, and complications involving masks



OPPONENTS

- Rachel said that compressions + ventilations is still more effective than hands-only CPR and both should be taught



FEEDBACK

INSIGHT



Feedback devices must be simple and intuitive

- Feedback should allow learners to self-correct and let the instructor know immediately if it is being done right
- The interface should be simple - calling for tech support should not be necessary
- Otherwise, instructors need to teach participants how to interpret the feedback, or else it is useless

INSIGHT



Feedback should measure compression depth, speed, and recoil.

- It is especially important for children to be encouraged to apply enough pressure.
- There should be immediate feedback to ensure compressions happen at the correct rate

INSIGHT



Feedback should come in multiple modalities

- Audio components, such as clicking sounds, visual feedback, such as lights and "blood flow" through major arteries, and vibrations
- Chris recommends having audio, visual, and tactile feedback
- Adrianna says that is preferable to have customizable feedback modalities that can be turned off if students are comfortable with their technique.



FEEDBACK

INSIGHT

Audio cues are the best



- Compressions could be set to the beat of a song, because children love music
- Multiple people said that audio feedback is helpful and limits distractions
- Many manikins have a clicking sound to guide the learner's compression rate

INSIGHT

Lights are not the best



- Multiple people criticized lights as distracting feedback, especially for kids
- Rachel explained that learners end up focusing on the lights instead of on pumping the chest

INSIGHT



App-based feedback interfaces work best in an ecosystem with a centralized device (the instructor's)

- Many people suggested having an separate interface for the instructor to see everyone's metrics at the same time
- Can allow instructor to monitor CPR performance remotely and allow for 100% remote CPR training
- However, app-based feedback can make CPR learning unnecessarily competitive

OTHER INSIGHTS

- Many people suggested having an separate interface for the instructor to see everyone's metrics at the same time
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- However, app-based feedback can make CPR learning unnecessarily competitive



CPR IN REAL LIFE

INSIGHT



Your instincts kick in

- Chris pointed out that when adrenaline is rushing, people tend to do CPR much faster and shallower than ideal
Adrenaline gives you extra stamina to push harder and do CPR for
 - longer
 - Real-life CPR is stressful at first, but becomes more manageable
 - with experience and practice

OTHER INSIGHTS

- Lee stated he would be hesitant but says he probably would be able to know what to do in an emergency situation. The main factor for doubt is his own confidence.
Elise stressed the importance of being
 - honest to learners about the real-life implications of CPR - sugarcoating or scaring does not work

4

SECONDARY RESEARCH

4.1 CPR: THE BASIC PROCESS

4.2 CHILDREN AND CPR

4.3 CHALLENGES

4.4 CPR MANIKINS AND DEVICES

4.1 CPR: The Basic Process

BEFORE CPR

- Check if casualty is conscious; if yes, ask if they need help
- Call 911 or ask bystander to call
- If possible, send someone to get AED
- With casualty lying on back, lift chin by tilting head backwards
- Check breathing by listening
- Proceed with next 2 steps in cycles until person can breathe again or medical assistance is available

30 COMPRESSIONS

- In centre of casualty's chest, place hands on top of each other
- Push hard and fast with body weight
- 2 inch depth & 100 compressions per minute

2 RESCUE BREATHS

- Tilt casualty's head & lift chin
- Pinch nose and place mouth over to form a seal
- Blow into casualty's mouth so the chest rises

4.2 Children And CPR

PERFORMING CPR ON AN INFANT OR CHILD

INFANT

- Perform CPR before calling 911
- Use two fingers for compressions
- 1.5" compressions depth
- Use cheeks to push rescue air, not lung force

CHILD

- Perform CPR before calling 911
- Use one or two hands depending on child's size
- 2" compressions depth
- Use the force of lungs to push air

CAN CHILDREN PERFORM CPR?

2009 STUDY: 90% OF CHILDREN PERFORMED CPR CORRECTLY, BUT ONLY 69% PERFORMED HEAD-TILT PROPERLY

- Emphasize staying calm and focus on calling 911 & compressions
- Use songs to teach children the tempo
- Children lack physical strength to effectively perform compressions with enough depth
- Children are unable to deliver breaths with enough volume
- Some sources believe that training children to do hands-only CPR should be prioritized

4.3 Challenges

REASONS PEOPLE AVOID PERFORMING CPR

- Fear of diseases or gross factor for rescue breaths (mouth-to-mouth)
- Lack of training
- Fear of messing up despite being trained
- Legal consequences

COMMON CPR MISTAKES

- Shallow/weak compressions
- Not enough recoil or pauses that are too long
- CPR tempo that is either too fast or too slow
- Over-inflating lungs on breaths
- Not tilting the head/chin enough

4.4 CPR Manikins And Devices

WHAT MAKES A GOOD MANIKIN?

A good CPR Manikin should offer **visual**, **auditory**, and **tactile** feedback to teach trainees concepts such as compression depth, pace, hand placement, recoil, and rescue breaths.

AUDIO FEEDBACK

- Good quality chest compressions are the most important part
- Built in clicking noise lets user know when the compressions are deep enough

TACTILE FEEDBACK

- Vibrations can indicate proper compressions

VISUAL FEEDBACK

- LED indicators show students real-time feedback on both compression depth and rate
- Correct anatomical structures help students find the proper location for compressions
- Chest rises when proper breaths are performed
- Manikins can be linked to devices to provide in-depth information to students and instructors

5

COMPETITIVE ANALYSIS

5.1 FEEDBACK DEVICES

5.2 FEEDBACK MODALITIES

5.3 MANIKIN MODELS

5.1 Feedback Devices



TICKER TAPE

Students can only pass if they have consistently perfect depth and timing. Rebecca mentioned that this decreases confidence as it discourages mistakes.



INTERACTIVE CPR WATCH

Interactive CPR watches measure compression depth and rate, however, they can be easily lost due to their size.



T-SHIRTS

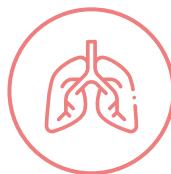
Rebecca suggested interactive t-shirts that can be used with old manikins. These are easier to sanitize and can function in both wet and dry environments.



APPS ON DEVICES

There are various manikin models that connect with apps app that allow instructors to monitor participants' activity

5.2 Feedback Modalities



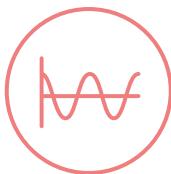
SIMULATED LUNGS

These can be inflated to measure rescue breaths, so students and instructors can view if enough air is being provided.



COMBINATION OF LIGHTS

Some manikins use a combination of lights to provide feedback on compression speed (too fast, too slow, or perfect).



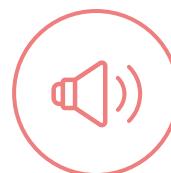
VIBRATIONS

Vibrations are used as a tactile modality to inform the students when they are correctly performing CPR.



CIRCULATION DISPLAY

Simulated blood circulation pathways show blood flow from the heart to the brain to emphasize the purpose of CPR.



CLICKING

This audio component signifies that the correct compression speed and depth have been achieved by the student.

5.3 Manikin Models

BIG RED



LIGHTSAVING MANIKIN

- Light system demonstrates blood flow from chest to brain
- Indicates proper compression, depth, rate, and recoil
- Vibrates when compressions are given at the correct tempo
- Realistic anatomical landmarks
- Clicker sounds when the correct compression depth is achieved
- Realistic chest rise when ventilations are performed properly
- Oral and nasal passages allow for pinching the manikin's nose
- Realistic head tilt and chin lift to unblock the airway

BRAYDEN



CPR MANIKIN

- Chest rises after proper nose-pinch, head tilt, and chin lift
- Lights show proper compression depth and blood circulation
- The clicker as an auditory modality can be turned on or off
- Anatomically correct and can be used with defibrillator pads

CPR PROMPT

TRAINING MANIKIN, ADULT/CHILD



- Chest rises after proper head tilt and chin lift
- Lightweight, cost-effective, and portable
- Landmarks for rib cage, chest notch, navel and carotid arteries
- Clicker indicates correct hand positioning and compression depth
- Compression piston can convert adult manikin into child manikin



PRESTAN

PROFESSIONAL ADULT SERIES 2000 MANIKINS

- Chest only rises when head is tilted properly
- Instantaneous audio & visual feedback
- Realistic anatomical landmarks
- The clicker shows when compressions are done properly
- Combinations of red, yellow, and green lights
- Connects to Prestan CPR Feedback app



LAERDAL

LITTLE ANNE QCPR

- Chest rises after proper nose-pinch, head tilt, and chin lift
- The clicker indicates the correct compression depth
- Disposable lungs and removable faces for easy maintenance
- Feedback on depth, rate and ventilations shown on QCPR app
- Provide scores out of 100% for students' performance

6

KEY FINDINGS

6.1 SUMMARY OF KEY FINDINGS

6.1 Summary Of Key Findings

Despite having numerous CPR manikins and feedback devices available on the market, very few are specialized towards teaching children the essential skill. These key findings highlight the factors that should be prioritized when developing a CPR manikin for children.

BASIC PROCESS

CPR is performed in cycles, alternating between 30 compressions and 2 rescue breaths. For children, it is especially important to emphasize calling 911 and performing compressions. As this is the case, the hands-only process may be a simpler way to introduce children to CPR.

CHALLENGES

Some of the main challenges children have performing CPR include compressing to the right depth, at the right rate, tilting the head enough, and delivering breaths with adequate volume.

MANIKIN FEATURES

Manikins and complementary CPR devices should have interfaces that are simple and easy to understand. Key considerations of manikin design include cost of each unit, transport, assembly, storage, waterproofing, aesthetics, and durability.

HAPTIC FEEDBACK

Through auditory, visual, and tactile feedback, manikins should indicate when compressions and ventilations are performed properly. Each child has their own learning style, so increasing the types of modalities will maximize accessibility.

REMOTE LEARNING

Completely remote training of practical CPR skills is currently very difficult - presently, there are no manikins or training equipment that address the unique challenges of an online learning environment.

ENGAGEMENT

Kids have a natural interest in learning CPR but may be sidetracked in the process - therefore, it is crucial to cater to children's diverse learning needs to ensure that they are engaged, motivated, and understanding the content.

TEACHING STRATEGIES

To help students memorize the CPR process, effective training involves repetitive, hands-on practice. Scenario training is a great way to expand on basic CPR skills and demonstrate how it exists in the context of emergency situations.

7

NEXT STEPS

7.1 DESIGN PROBLEMS & DIRECTIONS

7.1 Design Problems & Directions

OVERVIEW

From the insights, solutions were brainstormed to address the common challenges that were identified. Below, three unique directions for each group member have been outlined.



PORATABILITY

A LIGHTWEIGHT CPR MANIKIN THAT PRIORITIZES TRANSPORTATION AND STORAGE.

- Produced from light materials (possibly hollow plastic, rubber, or foam)
- Waterproof and versatile to function in various environments
- Components are customizable and can be disassembled
- Ideal for teaching in schools, community sessions, and remote areas

TO RESEARCH:

- Best waterproof and lightweight materials
- Customizable manikins on the market
- Possible methods of non-electronic feedback



ACCESSIBILITY

AN ADD-ON THAT CAN PROVIDE CPR FEEDBACK IN ACCOMPANIMENT WITH AT-HOME OBJECTS.

- Can be used to monitor compression techniques on dolls, pillows, and stuffed animals
- Cost-efficient and easily deliverable to remote learners
- Allows students to understand and apply feedback on their own

TO RESEARCH:

- Existing CPR feedback add-ons
- Cost-efficient technologies available
- Methods that students can use to measure their own progress



CONNECTIVITY

AN APPLICATION THAT CONNECTS STUDENTS AND INSTRUCTORS WHILE REMOTE LEARNING.

- Provides the opportunity for instructors to monitor student progress from afar
- Can be used for synchronous lessons or to provide asynchronous feedback
- Integrated video calling function and linked resources

TO RESEARCH:

- Apps that are currently available for learning CPR
- Interfaces that appeal to children
- Methods that students can use to measure their own progress

8

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8.1 RESEARCH

8.2 IMAGES

8.3 GRAPHICS

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8.3 Graphics

Icons by Freepik, Pixel perfect, Smashicons, and Swifticons
from Flaticon.com