Title	Q-Be : tangible augmented reality media to facilitate parents-children career-related conversation
Sub Title	
Author	Gunawan, Elvaretta Angelina(Ōkawa, Keiko) 大川, 恵子
Publisher	慶應義塾大学大学院メディアデザイン研究科
Publication year	2020
Jtitle	
JaLC DOI	
Abstract	
Notes	修士学位論文. 2020年度メディアデザイン学 第798号
Genre	Thesis or Dissertation
URL	https://koara.lib.keio.ac.jp/xoonips/modules/xoonips/detail.php?koara_id=KO40001001-00002020-0798

Master's Thesis
Academic Year 2020

Q-Be: Tangible Augmented Reality Media to
Facilitate Parents-Children Career-Related
Conversation

Keio University
Graduate School of Media Design

Elvaretta Angelina Gunawan

A Master's Thesis
submitted to Keio University Graduate School of Media Design
in partial fulfillment of the requirements for the degree of
Master of Media Design

Elvaretta Angelina Gunawan

Master's Thesis Advisory Committee:
        Professor Keiko Okawa   (Main Research Supervisor)
        Dr. MHD Yamen Saraiji   (Sub Research Supervisor)

Master's Thesis Review Committee:
        Professor Keiko Okawa   (Chair)
        Professor Kazunori Sugiura   (Co-Reviewer)
        Dr. MHD Yamen Saraiji   (Co-Reviewer)

Q-Be: Tangible Augmented Reality Media to Facilitate Parents-Children Career-Related Conversation

Category: Design

Summary

Career development started at an early age, often supported by educators and family. In practice, career development in the early lifespan has received little attention. Research has shown that having intentional discussions about career, which include occupational knowledge and interest, can provide the foundation in later years. In Indonesia, for a family with working parents who have limited time with their children, discussion about occupation-related topics rarely came up in conversation and there might be some definitional issues where parents and children have different contexts and understanding. Other than that, not every parent is an adequate role model for their children and not all of them have the privilege to let their child have hands-on experience.

To deal with this issue, this research proposed a tangible Augmented Reality media named Q-Be to facilitate parent's and children's career-related conversations. In this case, it is limited to discussion about occupations. Tangible Augmented Reality could provide information about occupation while encouraging social interaction, which could promote parent's and children's joint engagement in career-related conversation. Implementing the family-learning approach where parents and children are actively engaged, Q-Be has three main design components; which are (1) Occupational knowledge, (2) Questions, (3) Challenges. By using Q-Be as ground referents in conversations, parents and children are able to be actively engaged in the career-related conversation and have a deeper understanding of occupations.

Keywords:

Career education, Tangible Augmented Reality, Joint Media Engagement, Career-Related Conversation, Parents-Children Conversation

Keio University Graduate School of Media Design

Elvaretta Angelina Gunawan

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Chapter 1

Introduction

1.1. Career Education

It's Better to Start Early

Jobs in the digital age and the skills or capabilities required to do them are transforming at an unprecedented rate. The decisions that young people make in elementary years will have a big impact on their lives, affecting not only their further education but also their career journey[1]. Children begin to have preferences and develop interest early in their lives, as well as occupational aspirations. Instead of career advice, career education programs in the elementary level should be focused on career-related learning which shows children the vast range of possibilities open to them [2]. It is not only to prepare students to earn for living but also to develop a way for them to learn [3].

Career development is often supported and shaped by educators and family. Aside from school as an educational institution, parents serve as a major influence on their children's career development and education. Career education programs have been researched and applied to support children's career development and many stated the importance of engaging parents in the process. However, in families of poverty in developing economies, livelihood concerns can severely restrict adults from playing their parental roles. Parents may work long hours on all days of the week, which sometimes resulted in little time or energy to engage

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1   https://pssfw.myskills.gov.au/media/1754/career-education-why-is-it-important.pdf

2   https://www.educationandemployers.org/career-related-primary/

3   http://career.iresearchnet.com/career-development/career-education/

in parenting [1].

According to the World Bank's latest report, 45 percent of Indonesia's population, or approximately 115 million Indonesians, have yet to attain economic security and the lifestyle of the middle class. Working parents have less time at home with their children and discussion about occupation-related topics rarely comes up in conversation. Interviews with four Indonesian families in Bandung, Indonesia also shown that occupation-related topics rarely come up in their conversation, as parents and children mostly engage in conversation around school-related topics. On the other hand, studies have mentioned that having intentional discussions with children about occupational knowledge and interest can provide the foundation for a greater in-depth discussion in later years. It influences children's view of the world of work [2].

Moreover, not every parent is an adequate role model for their children and not all of them have the privilege to give their children hands-on experience. Other than that, there might be some definitional issues where parents and children have different contexts and understanding in career-related conversations.

Emerging Technologies in Education

Different kinds of technologies appear every year and many aspects of the world are experiencing huge changes, including education. The use of technologies in education has been proven to improve education experience, and Augmented Reality (AR) is one amongst them. AR has the potential to enhance learning experience in primary and secondary schools more than any other technology has done in the recent past. From an education perspective, AR environments could increase students' motivation and interest, which in turn may help them develop better investigation skills and gain more accurate knowledge on the topic [3]. It also has the capacity to make information available to learners at the exact time and place of need [4] [5].

Tangible AR enables ubiquitous, collaborative, and situated learning where it could enhance social interactivity when learners collaborate and naturally support face-to-face interactions while using the media [6] [4] as it allows users to monitor each other's gaze and thus interact more easily [7]. Thus, it provides the

possibility for joint media engagement between parents and children to happen. Using media as a conversation catalyst could offer a context and starting point for productive conversations between young children and adults, and could bring up deeper lessons by supporting children's ongoing construction and understanding of concepts and introduce ideas to them while engaging parents in the process [8] [9].

Therefore, this research proposes a solution to deliver occupational knowledge and facilitate the career-related conversation between parents and children utilizing tangible Augmented Reality media.

1.2. Research Goal and Question

This research is presented to find solutions to the previously cited problems. With that, came the following research questions:

- How does tangible AR media promotes parents and children joint engagement in career-related conversation?

- What components in tangible AR media trigger interaction between parents and children in career-related conversation?

1.3. Contribution

The contributions of this research are as follows:

- Creation of a media that provides occupational knowledge while engaging parents and children in career-related conversation

- Utilization of tangible Augmented Reality as a tool for conversational anchoring

- Promotion of parental involvement in children's career exploration

1.4. Structure of Thesis

Chapter 1
Consists of the introduction which includes a brief explanation of career education

in childhood, parental involvement in Indonesia, tangible Augmented Reality and joint media engagement. The research question and proposed solution are also included.

Chapter 2
This chapter presents the overview of career education for elementary children, parental involvement, joint media engagement, tangible Augmented Reality in educational practice and related works.

Chapter 3
Elaborates the design concept, design components and prototype result of the proposed solution. The target user, user flow, and prototyping tools and processes are included.

Chapter 4
Specifies participants' interaction while using the media. The validation process and setup, result, feedback, and discussions are also included in this chapter.

Chapter 5
The conclusion of the research with a concept validation based on data from previous chapters and plan for improvement in the future.

Chapter 2

Literature Review

2.1. Career Education and Parental Involvement

The term careers can mean different things to different people. However, the definition of career itself can not be limited to work only but rather a combined lifelong experience including education itself, which begins in childhood and continues throughout the lifespan [10] [11]. Formal and informal definitions of career education have been advanced over the years. Activities and experiences designed to assist adolescents acquire and use the knowledge, skills, and attitudes necessary to make work a meaningful, productive, and satisfying part of life can also be categorized as career education [12].

Why Start Early?

Young people's aspirations and ideas about careers are formed early, even before they reach secondary school. Seligman stated that 'The childhood years are important ones in the process of career development and considerable attention to the early stages of this process is warranted' [13]. Other scholars of career education and guidance also suggest that career education should start early before young people have to make any decisions with a lifetime impact. The Department of Education conducted an evaluation of career education in primary school and found a number of positive impacts on career education [14]. For example, young people who participated in career education increased their knowledge about the types of work and the career path.

Sixth-grade Australian children who joined career education activities developed a better understanding of occupational information sources, more interest in career information, and a better perception of the relationship of school to work [15].

They also showed an increased ability to list occupations and to identify a favorite occupation. In particular, studies have pointed to the predictive value of early occupational aspirations [15].

This suggests that career education can work in primary school. The purpose of career education in primary level is not to sort young people into particular careers, but rather to show children the vast range of possibilities open to them, developing an awareness and appreciation of the many kinds of work and workers, and to help them keep their options open as long as possible [16].

2.1.1 Objectives and Career Reasoning

The Objectives

Effective career intervention has to be aligned with the career development phase. Career development standards used by the American School Counselor Association (ASCA) as well as the Blueprint competencies for Canada and Australia (Ministerial Council for Education) categorized career education objectives into four categories (see table 2.1).

Application-type and Reflection and Refinement-type of career intervention are appropriate for use with children with higher levels of reasoning. For children in the upper elementary level, content-type intervention would provide opportunities to discover and explore their individual interest, to become aware of particular skills they would like to have and to expand the number of occupations of which children are aware. It also allows them to become familiar with the tasks performed by workers in those occupations and the basic characteristics of this range of occupations. Process-oriented intervention helps children to gain the understanding that workers in particular occupations need to gain specific knowledge and develop the skills used regularly in that occupation. Exposure to role models, utilizing media, and instructional content are often being used in intervention for younger children, it could enhance their knowledge of the world of work and raise their awareness of the larger community and world [17].

Table 2.1 Career Education Objective

Intervention Type	Objective
Content-type	Expanding the knowledge of self and familiarity with the world of work
Process-type	Focusing on processes such as exploring the world of work, setting and pursuing goals, and making career decisions
Application-type	Carry out some action such as setting short- and long-term goals and making developmentally appropriate decisions.
Reflection and Refinement-type	Encourages the critical examination of the knowledge gained, the tasks undertaken, and the outcomes experienced to guide one's career development in the future.

Elementary Career Reasoning

Career development phase in elementary school children The Career Choice and Attainment (CCCA) model was developed to better understand children's reasoning about vocational development [18]. The CCCA model identifies three common approaches to children's conception of career choice reasoning: Association, Sequence, and Interaction (see table 2.2).

Based on this model, it is true that generally, children in the upper elementary level tend to be reasoning at the association and sequence level. Children in the upper elementary level can identify the specific tasks of various occupations and emphasize the need to develop the required skills and gain the required knowledge before being able to enter those occupations [1].

Table 2.2 Children's Conception of Career Choice Reasoning

Level of Thinking		Ability
Association	Pure Association	Recognize that careers exist but unable to explain how individuals choose their careers.
	Magical Thinking	Able to describe a basic method for attaining a job but cannot explain how this method operates and results in the job.
Sequence	External activities	Characterise learning about careers by describing external and observable skills and/or activities. May recognise certain steps that are necessary to obtain a job.
	Internal processes and capacities	Hone in on their interest and abilities and consider jobs that match these qualities. Understand career attainment as a result of learning the necessary skills and possessing competence to do the work.
Interaction	Interaction	Able to describe a complex process of choosing and attaining a job by recognising individual, relational, and immediate environmental levels.
	Systemic Interaction	Incorporate factors at systemic levels such as the current status of the job market when explaining how one chooses and attains a job.

Occupational Knowledge

Career exploration was said to promote occupational knowledge, which facilitates the development of an accurate representation of the world of work and the making of informed career decisions. Career exploration facilitates collecting information on aspects and categories which are partially known so that new information can be linked to already existing knowledge [19]. In primary level, it is designed to create the awareness that work-tasks are applications of academic skills [16]. Assessment of children 's occupational knowledge is commonly done by asking children to describe actions, abilities, skills, and knowledge that are useful to perform a job [19].

2.1.2 Parent-Involved Career Intervention

Parents lay the foundations of career development in childhood. They also serve as a major influence in their children's career development and career decision making and it is no longer necessary to debate the primary influential role of parents [15]. Wide ranges of career interventions have been designed to involve parents and to help them to support their child's career both inside and outside of the educational context, as children seek out their parents as a primary resource for discussion about careers.

To engage parents in the process, the Australian state of Victoria has developed a program called Engaging Parents in Career Conversations Framework (EPiCC) that provides parent workshops and resources for parents or practitioners [1]. It is distinguished as parent-involved career intervention with a family learning approach, where the aim is to help parents in 'remedial' or preventive ways in educational terms (low-educated, minority parent, parents with a child with special educational needs or disabilities) [20]. The intervention is supply-driven and both parents and their child are supposed to be actively involved.

However, in families of poverty in developing economies, many parents may work long hours on all days of the week, or be out of the house in search of work, or be engaged in labor-intensive household work and may have little time or energy to engage in parenting [1]. Approximately 115 million Indonesians, or 45 percent of the country's population, have yet to achieve economic security and

the lifestyle of the middle class, the World Bank's latest report shows. Other than that, not every parent is an adequate role model for their children and all of them have the privilege to give their children hands-on experience [21].

2.1.3 Career-Related Conversation

Other than the level of education or training that their children achieve, parents also influence the knowledge that children have about work and different occupations [1]. One strategy to encourage career exploration in children is to build bridges to more complex learning, begin with what children 'know' to help them move to what is 'not yet known', by changing it from a passive to an interactive which allow them to strengthen their knowledge and understanding of the world [16] [22].

Formative discussion about occupation should have happened well so children can make informed decisions about future career pathways. The conversations parents and children have together about careers are not specified entirely by the individual intentions or actions of either person but are determined by what happens between them. Engaging in conversations with parents around a topic of interest - namely, work and future aspirations - may provide multifaceted benefits such as provide opportunities to address career-limiting thinking and enhance the relationship between school subjects and the world of work [1].

2.2. Augmented Reality in Education

2.2.1 Introduction

Emerging technologies have generated new opportunities to enhance teaching and improve learning experiences, and Augmented Reality is one of them. Augmented Reality (AR), is an emerging technology that integrates digital information or objects onto the real world in real-time utilizing digital technologies such as smartphones, tablet, or head-mounted displays, it offers unique opportunities to use the media together [4].

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1   https://www.qualifax.ie/index.php?'option=com_content&view=article&id=179&Itemid=207

The New Jersey Institute of Technology (NJIT) reported that augmented reality has the potential to revolutionize learning in primary and secondary schools more than any other technology has done in the recent past [2]. It can be used in many levels of schooling; from pre-school education up to college and enables learners to experience scientific phenomena that are not possible in the real world [3] and to enhance their understanding.

In spite of all the new possibilities that AR can bring to education, there are concerns about how it can cause cognitive and/or emotional overload in learners. At first, learners are required to know how to operate the system and to become familiar with it. This could be problematic if learners also have to perform complex tasks. The other concern is if there are too many gameplay elements in the system, learners may become too fixated on playing and not focusing on the learning material itself [4].

2.2.2 Tangible Augmented Reality

The term "tangible" refers to a variety of human-computer interaction techniques that move beyond computer screens and create opportunities for people to interact with digital systems using their bodies and physical artifacts [23]. Combining the enhanced display possibilities of Augmented Reality with the intuitive manipulation of Tangible User Interfaces, tangible Augmented Reality emphasize in its physical object form and interactions which do not require the user to use or wear any special-purpose devices and tools. Thus, it provides the possibility of face-to-face communication and collaboration. Users can go beyond the screen and physically interact with the digital-augmented objects [6].

Learning with Tangible AR

While traditional learning in general usually engages just two senses; hearing and vision, tangible AR promotes the concept of engaging multiple senses; hearing, vision and touch [6]. Tangible objects themselves have the ability to increase exploratory behavior as well as support the exploratory activities and collaboration

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2   https://arvrjourney.com/how-can-augmented-reality-be-used-in-education-b1a3ad6780f1

by their appearance, affordance, and their ability to help focus users' attention [7]. It enables users to explore the digital-augmented object from all perspectives and to learn through discovery.

AR environments itself could increase learners' motivation and interest, which may help them develop better investigation skills and gain more accurate knowledge on the topic in return [3]. In addition, AR can enhance learning experience not only by providing solutions for learning difficulties such as the difficulties to visualize unobservable phenomena or process (e.g., chemical reaction), but also enabling students to inspect 3D objects or the phenomena itself from different perspectives to enhance their understanding which could promote learners' thinking skills and conceptual understandings about invisible phenomena and correct their misconceptions [3] [24].

In terms of social interaction, tangible AR enables ubiquitous, collaborative, and situated learning where it could enhance social interactivity when learners collaborate through mobile devices and naturally support face-to-face interactions [4] [6] as it allows users to monitor each other's gaze and thus interact more easily [7].

Interactions with Tangible AR

AR bridges the real and virtual world. The objects in the real world can enables a wide range of intuitive and natural interactions, support seamless interactions between the virtual and physical world, offer a more exiting and enjoyable learning experience [25] [26]. The display technologies used in AR itself focus on three types: see-through head-mounted displays, projection-based displays and handheld displays [25]. Handheld displays are said to be good alternative for AR application because it is socially acceptable, readily available and highly mobile. This includes the use of tablet PCs and smartphones.

Tangible AR has been used in many applications and many interaction techniques was designed to enable manipulating AR content as easy as interacting with real objects. VOMAR application by Kato allow users to use a real paddle to select and arrange virtual furniture in an AR living room design application. Utilizing gesture based as the input command, user can tilt the paddle to place a virtual model in the scene and hitting a model to delete it. Gesture based

command include both hand gesture recognition and finger tracker [25].

In the application of Tangible AR for children, applicable interaction can be seen in [26], where it focused on two types interaction types which are digital screen-touch interaction and real-world tangible interaction as input commands. Screen touch technique is simple and easy to learn even though it has limitations in providing direct interaction with the augmented objects. Tangible interaction (turning and lifting) enables a wide range of intuitive and natural interactions, offering a more exiting and entertaining experience.

Combined tangible and AR approach can enhance learning without requiring complex technologies or customized electronic hardware. It can be realized with as little as a handheld displays (tablets or smartphones) and traditional book with AR marker on it. However, a research that utilize Tangible AR in interactive storytelling for children [27] mentioned traditional book only allow 2D planar configuration (cards and paddles) and does not improve the use of touch very much, nor allow 3D exploration of the story contents. Thus, it address the issue by using a tangible and intuitive physical object. Their preliminary user study shows that most of the users feel very entertained when they can physically manipulate and explore the cubes to see and hear the story, compared to being passively given a video clip and a magic book.

2.3. Parents, Children, and Media

Education is now being disrupted by technology and digitalization, and learners today are already accustomed to various technologies. Educational technologies are often utilized as valuable learning tools for learners from various age groups. "When used wisely, technology and media can support learning and relationships", National Association for the Education of Young Children (NAEYC) and the Fred Rogers Center said [8].

According to Stevens and Penuel, joint media engagement (JME) refers to spontaneous and designed experiences of people using media together which can happen anywhere and at any time when there are multiple people interacting together with media [28]. This includes interaction and engagement between participants, shared attention between other participants and media. Both participants play

an important role in sustaining the attention during interactions to learn from the media, which can draw both verbal (asking open-ended questions, providing feedback, labeling and describing complex content, and modeling responses) and non-verbal communication (e.g. pointing, moving to share visual perspective, etc.) [8] [9].

Media as a conversation catalyst could offer a context and starting point for productive conversations between young children and adults and could bring up deeper lessons. It can support learning by providing resources for making sense and making meaning in particular situations as well as future situations [28]. Using media to help ground referents in conversations could draw on both the cognitive and the social dimensions of communication [29] which support children's ongoing construction and understanding of concepts, introduce ideas to children, expand and reinforce children's ideas while engaging parents in topics that they initially perceive as too complex [8] [9].

2.4. Related Works

2.4.1 Career Conversation Tools

Related work has been done to assist career conversation. A small scale pilot research using career conversation cards as stimuli was done with children, parents, and teachers. Each card features an age-appropriate career scenario (a brief story) based on individual, social, and environmental-societal influences on career development that is followed by "conversation-starter" questions [1]. The stimulus questions are useful for parents to have conversations with their children and the upper elementary school children derived to learn from the cards. Teachers also had ideas to integrate the career conversations into the curriculum.

Another work is Careers for Kids to Think and Talk About Card decks. Each card provides four elements which are; 1) Learn About It, a short description of the job, 2) Think About It, a fun scenario about how how to success in the job, 3) Talk About It, an open-ended question to start conversations related to the job, and 4) Do It, which show an actions that children can do to look for more information or get started with that career. In Medicine careers for kids conversation cards,
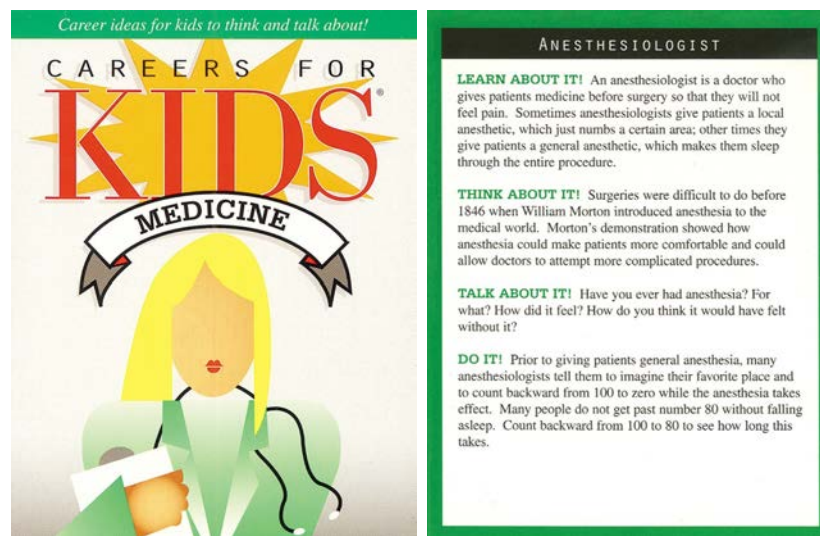
Figure 2.1 Careers for Kids to Think and Talk About Card Decks
(Source: *Medicine Career for Kids* [3])

career options that are related to medicine such as genetic Engineer, Physician, Dietician, Dentist, Emergency Medical Technician and many more.

2.4.2 Tangible AR Experience

Augmented reality is increasingly being used as a teaching and learning tool in education. Merge Cube is a simple AR/VR tool that allows users to physically hold and interact with 3D objects using AR technology. It is made of foam and covered with symbols on all sides that act as the AR marker. Merge Cube can be used in classroom settings, library, lab, even at home and remote learning. Many applications that utilize merge cube for educational purposes have been developed, Anatomy AR+ is one of them. Anatomy AR+ was developed by Hybrid Medical Animation. Children can take a closer look at some animated iconic organs in the body; brain, heart, and lungs. It provides annotations and descriptions of the organs and allows children to; interact with it pressing the screen then show the inner part of the organs, and let them examine the organs from all angles.

Another interesting example is 57 North developed by Mighty Coconut, which utilizes merge cube as a narrative storytelling device. Users can use virtual reality headset to view the story or play in a handheld mode by holding their phone as

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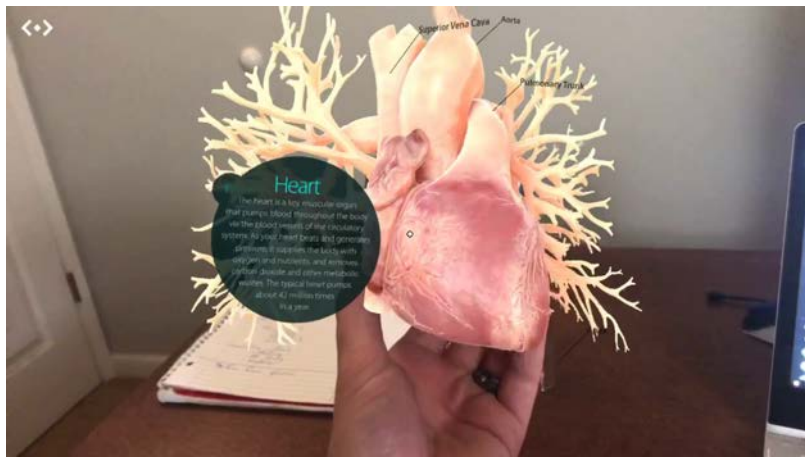
Figure 2.2 Anatomy AR+
(Source: *Youtube* [4])

they view the cube through the screen. In the game, users will come across events where they have to choose the step that is going to direct which way the story will go, by rotating the cube to the appropriate side. All sides except one active side have a wooden texture, this directs the user to go to the active side of the cube where the story happens.
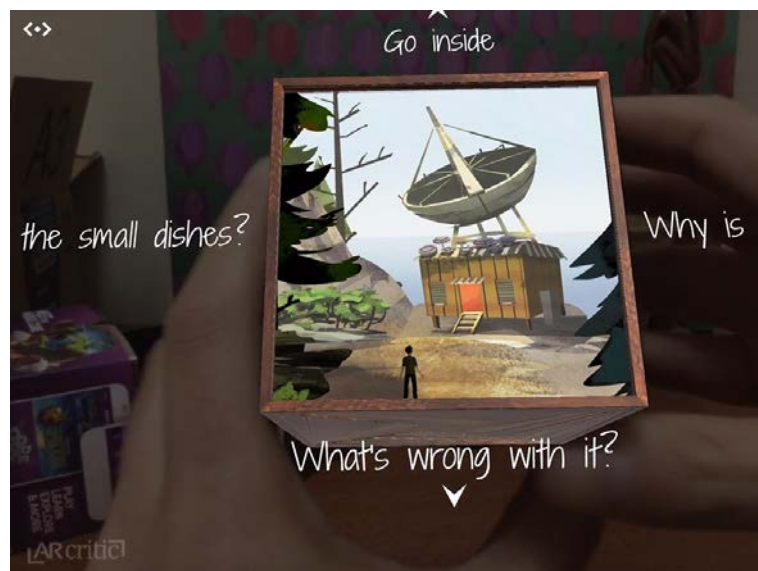
Figure 2.3 57 North
(Source: *Artcritic* [5])

2.5. Summary

In summary, career education can work in primary school and give a number of positive impacts that laid the foundation for career development in later years. Content-type and process-type career intervention are suitable for elementary level children as it aligned with their phase of career reasoning [1]. At elementary level, career education should show children the range of possibilities open for them, help them to develop an awareness that work-tasks are applications of academic skills, and appreciation of the many kinds of work and workers [16]. Many stated the importance of engaging parents in the process as parents will influence the knowledge children have about work and different occupations.

Career related conversation or informative discussion about occupation and future aspirations, should have happened well for children to make an informed decision in later years. However, there are many challenges to engage parents in career education programs especially in developing countries. Not every parent is an adequate role model for their children, and not every child has the opportunity to have hands-on experience. Career conversation tools mentioned in related works could encourage career-related conversation or discussion about occupation and enrich the conversation topics, however definitional issues might happen during conversation as the card only have single image for one occupation and it does not provide more detailed information regarding the occupation itself.

On the other hand, emerging technologies have opened many possibilities to enhance and support learning. Tangible Augmented Reality is an emerging technology that provides the possibility of face-to-face communication and collaboration. Moreover, it has the ability to increase exploratory behaviour and enhance learning experience by visualizing unobservable phenomena which could promote learners' thinking skills, conceptual understandings, and correct misconceptions [24] [3]. Related works which utilize Tangible AR experience for education and storytelling inspired the design of this research. Thus, it suggest that Tangible AR could be utilized to visualize the working process and working tools for children.

Media can be used to help ground referents in conversations could draw on both the cognitive and the social dimensions of communication [29] which support children's ongoing construction and understanding of concepts, introduce ideas to children, expand and reinforce children's ideas while engaging parents in topics

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that they initially perceive as too complex [8] [9].

To facilitate parents-children career-related conversation, Tangible Augmented Reality is considered as a potential media that could provide information about occupation and can encourage social interaction which could promote parents and children's joint engagement in career related conversation, as it could provide varieties of visual information utilizing a simple tool, interactive, support face-to-face communication and collaboration. This thesis propose utilization of Tangible Augmented Reality media to provides more detailed occupational information for parents and children in a way which children understand, while encouraging them to discuss it.

Chapter 3
Design

3.1. Concept

Based on literature review, related works, and user studies, tangible Augmented Reality can provide a new experience to engage parents and children in a career-related conversation. In this research, career-related conversation is limited to discussion about occupation. The initial concept is to design a media that provides occupational information for parents and children in a way which children understand, while encouraging them to discuss it. The design of this tangible AR media, which is named Q-Be, focuses on Indonesian families and meant to be used in home environments. Thus, it has to be engaging, accessible, and allow face-to face interaction [6]. The idea of the name comes from Q-Be's feature that could transform into or become anything and also because Q-Be provides information about aspirations that children aspire to be.

Q-Be aims to promote parents and children joint engagement in career-related conversation. Through the design components, Q-Be aims to engage children and parents in the story about occupation while giving the chance to explore and deepen existing understanding and knowledge about occupation. In addition, Q-Be's design components also give chances for children and parents to express preferences on skills related to the occupation, explore possible future self and to have discussion around topics of interest. This could help children to make an informed decision in later years and keep parents updated with the most recent information about an occupation.

3.2. Target User

Q-Be is designed for, children at elementary level and their guardian. In this research, guardians are limited to parents. The first primary target are children aged 8-10 years old whose reasoning are at the association and early sequence level. Children in this age can identify specific tasks and are aware of the need to develop required skills to enter one occupation. Getting them interested in an occupation might encourage them to have further exploration about the occupation. Parents, both mother and father, influence children's knowledge about occupation and their decision in the future. The targeted parents in this research have at least one working parent in the family and are able to utilize the internet or has a smartphone. The ages vary between 30-40 years old.

3.3. Design Components

3.3.1 Contents

To encourage career-related conversation and utilize the benefits of tangible AR in education, three design components are implemented in Q-Be. The components are: (1) occupational information, (2) open-ended questions, and (3) tasks and mini quiz.

Occupational Information

Occupational information is the main component of Q-Be which works as the story line. Each story provides information about the occupation which is presented in a form of videos and 2D or 3D augmented objects. The gathered information are categorized and arranged into three parts, which are:

- Introduction
  Explaining the basis of working activities (function and task) which introduce and give simple descriptions of the job, the working process, and working place.

- Working Instruments
  Are working tools that are commonly found in the working process, will be

presented in a form of 3D Augmented objects. This will give children and parents time to explore working tools from any angle that they want.

- Conclusion
  Summarize the whole information that was given. Other than that, this section also mentions basic skills needed by people who are working in the field and relate it to school subjects.

The information was tailored for both children and parents. Audio is used as a voice over for video narration and to guide the user. The language used for the video narration and voice over have simple wordings which has to be understandable for children. More detailed and updated information for parents related to discussed occupation such as career path, explanation of the working tools, updated technology and/or more technical terms are given in Parents Trivia Cards which can be found in a form of 2D augmented cards.

Open-ended Questions

Are questions that are related with the job, mainly asking children about their experience and preferences to trigger further conversation with parents. This gives children space to express their thoughts and ideas about the job. Parents get the chance to understand their child's thoughts about the occupation they are discussing and may discover some insight about their child.

Tasks and Mini Quizzes

Are given to enhance interaction between parents and children, encourage them to communicate and collaborate to finish the task. The questions and tasks given are related to occupational information within the story line.

3.3.2 User-flow

The story is structured based on the three parts of occupational information which are introduction, working tools or instruments used in the job, and conclusion. Each part was then divided into several scenes which consist of a smaller scale of information and other design components are implemented within the story line.

Interaction such as touch the screen or rotate the tangible object is required to continue from one scene to the other.
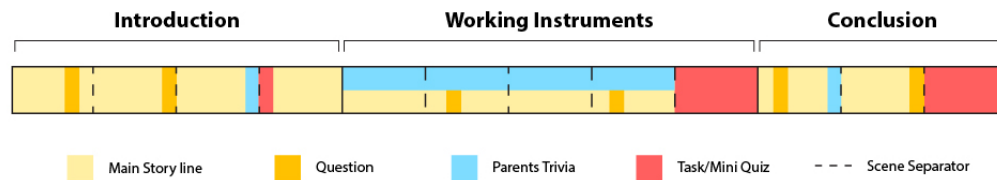
Figure 3.1 User-flow

3.4. Prototype

3.4.1 Tangible Experience

Tools

To demonstrate the idea, the Merge Cube was used. Merge Cube is a tangible AR toy which has a precise AR marker. The contents created are then being uploaded to Merge Cube from CoSpaces Edu. Each phase is divided into 3-5 scenes in CoSpaces. Due to the limitation of the platform, custom 3D objects cannot be animated outside the platform. From now on, Merge Cube will be shorten as 'Cube'.
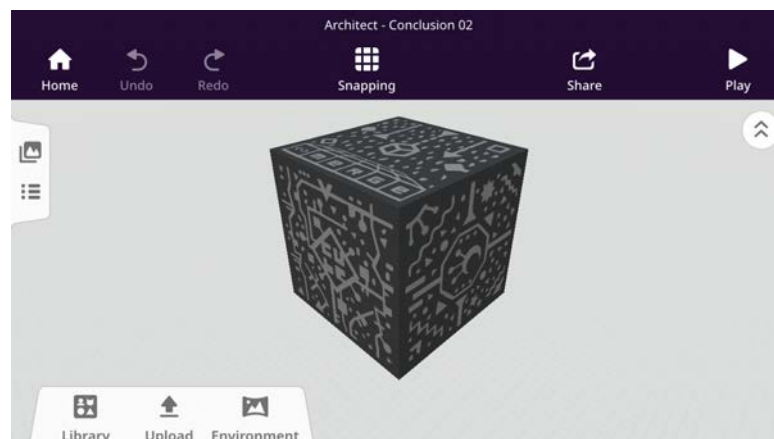
Figure 3.2 Merge-cube in CoSpaces Edu
(Source: *CoSpaces Edu*) [1]

User has to scan the Cube to see the augmented object. Thus, it is recommended to have one person hold the phone and the other person to hold or manipulate the cube.

Interaction

Each part is then divided into several scenes in Cospaces Edu. Some interactions are available to be coded within CoSpaces Edu and being used either to go to the next scene or to complete the tasks. Some of the possible interactions are :

- Spatial Manipulation
  Rotation manipulation can be used either to freely explore the 3D augmented objects or as an action to continue the story.

- Screen Interaction
  Users can select specific objects to go to the next scene, complete the tasks or answer quizzes. To give the user direct response, there are two states for each object which are (1) idle state and (2) hovering state.
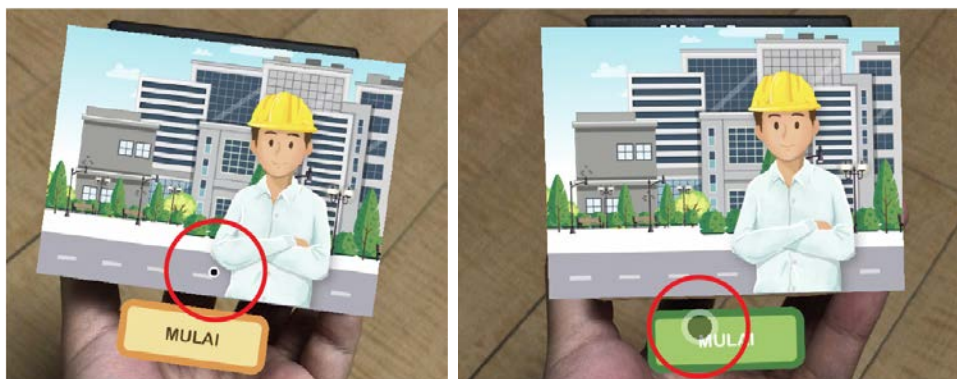
Figure 3.3 Button State Idle (Left) and Hover (Right)

3.4.2 Content Design

The prototype was originally designed for one family, whose child aspires to be an architect. Thus, the occupation architect was chosen. Other than that, the preliminary survey with 10 children from Bandung, Indonesia, showed that several children have misconceptions about architect's job, saying that an architect

'builds' the house instead of 'draw' or 'design' the house. Firefighter is generally known among children. Survey showed that all children know about firefighters and can explain what they do in general. However, in Indonesia, it is not a job in demand [2]. The career path itself is not widely known even among parents.

Data Collection and Storyboard Design

An online interview with experts was conducted through email. Total of four experts were interviewed to understand more about architects and firefighters' working process and working tools. All experts have more than two years experience in the field and represent both man and woman point of view. For a complete list of questions, please see Appendix B. The interview results were then categorized into three parts that were mentioned in the previous section ; (1) Introduction, (2) Working Instruments, and (3) Conclusion.The categorized information was used to create the script and storyboard according to the user flow. The storyboard showed the design components and interaction in every scene (see Figure 3.4).

Visualization and Coding

In this step, the script was recorded, some were used for the video narration and some others as voiceover. The contents (videos, 2D and 3D visual assets) were produced. A main character for each story was designed to guide users through the overall storyline, and some of the background, video, and house mock-up pictures was taken from the internet for prototyping purpose [3] [4] [5]. As Q-Be was designed for children, the colors and typography chosen for the visualization have warm and friendly vibes.

Finished assets and audio were then uploaded to CoSpaces Edu and coded

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2   https://www.republika.co.id/berita/nasional/daerah/17/07/08/osqz35280-solo-kekurangan-
    armada-pemadam-kebakaran

3   https://youtu.be/9QXyUDb6o2k

4   https://www.123rf.com

5   https://www.freepik.com
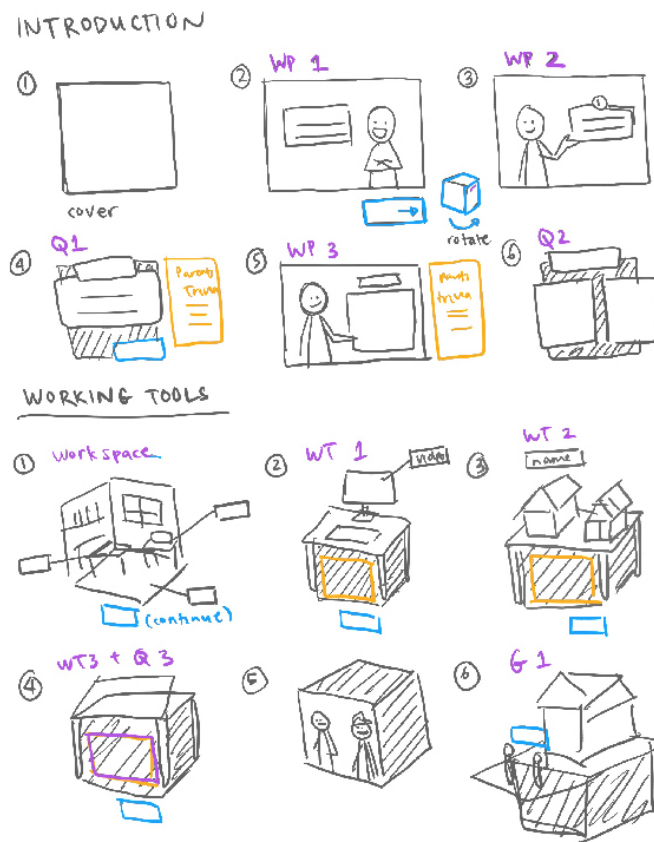
Figure 3.4 Storyboard Design

Figure 3.5 Asset Design

according to the storyboard. Along with the coding process, the positions of augmented objects were iterated to make sure that users can experience the whole story smoothly and did not face any difficulties to select the button or to read the information. For example, in some scenes, the Parents Trivia card was originally positioned beside the video and shown all the time as what can be seen in Figure 3.4. After several iterations, it was decided not to put the objects next to each other because the card is too far from the marker and it could also divide the focus of users.

3.4.3 Implementation

Described below are prototype result for the architect's story. For the firefighter's story, please see Appendix C.

Part 1 : Introduction

- The first scene introduces the character name and simple explanation about the occupation. To start with the video, the user has to click the 'MULAI' (START) button. After the video is finished, the user has to click the 'LAN-JUTKAN' (CONTINUE) button, then an instruction 'Rotate to the right to continue' will be shown. The instruction will take user to the next scene.

Figure 3.6 Introduction and Rotate to the Right

- Scene 2 explains the first two steps of the architect's working process. The first one is to know what you want to build, then after that you can start drawing. In the video, the architect explains that nowadays he often draws houses on the computer. After the video is finished, an open-ended question will pop-up. The question said : 'If you are an architect, what are you going to draw? How many floors is it going to be? What are going to be inside the building?'. This question are meant to encourage children to share their thought and imagine their possible future self.

Figure 3.7 Architect's Story - Scene 2

- The third scene gives simple explanation that shop drawings have numbers and measurements, and more detailed explanation about shop drawings in the Parent's Trivia card. Again, to go to the next scene the user has to click on the 'LANJUTKAN' (CONTINUE) button and rotate the cube to the right. After that, a mini quiz that asks children to select which picture is considered as a shop drawing appears. After participants select the correct answer, the story will continue to the fourth step of the architect's working process which is building the house. The voice over will tell children that we will go take a look at the architect's office before going to the construction site.

Figure 3.8 Architect's Story - Scene 3

Part 2 : Working Instruments

Part two consists of working instruments used in the job. The visuals for this phase mainly used 3D Augmented objects. First of all, 3D Augmented objects of the architect's office and firefighter's working place will be shown. In the architect's story, a voice over is included in this scene. It tells children and parents to explore or rotate the cube and see the office from different angles. Some object names will be shown when the objects are hovered.

Figure 3.9 Architect's Story - Office

The next four scenes in this phase will show single 3D working instruments alongside with voice over and more detailed explanations in Parent's Trivia augmented card. Four instruments that are going to be shown are (1) architect's computer, (2) house mock-up, (3) tracing table, and (4) construction hat.
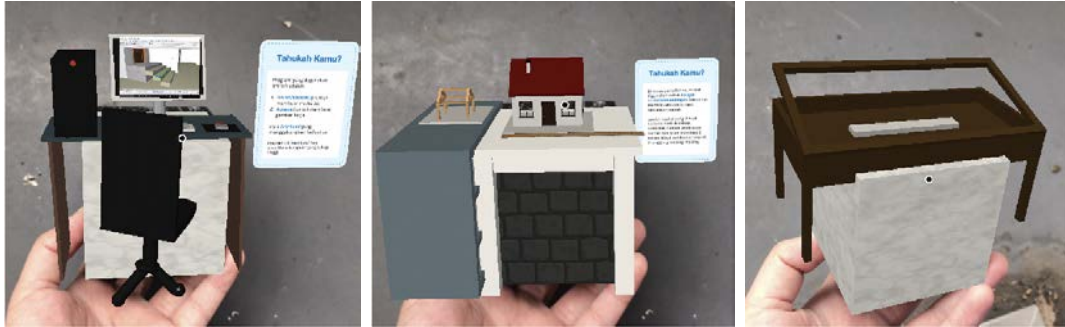
Figure 3.10   Architect's Story - Working Instruments

The next scene will show a mini game where children and parents have to help the architect to complete the house by clicking the red button. The house will progress every time users click the red button, and will be completed after users click the red button four times.

Figure 3.11   Architect's Story - Mini Game

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Part 3 : Conclusion

The last part of the story sums up the overall information given in the previous parts. This part consists of videos, open-ended questions and Parents' Trivia. In the last scene, the cube will turn into some working instruments. Children and parents can choose a working instrument and take some pictures with the augmented objects.

Figure 3.12 Architect's Story - Conclusion

Chapter 4

Proof of Concept

4.1. Validation

4.1.1 Validation Process

As mentioned before, the goal of this research is to facilitate parents-children career-related conversation. User tests were conducted to see how Q-Be promotes parents-children joint engagement in career-related conversation in different families with various backgrounds. The user tests were done with four different families in the home setting. Firstly, an interview with parents and children was conducted separately both before they tried Q-Be. The interview was conducted to collect more in-depth accounts on how parents and children talk about occupation in the family, their knowledge about occupation and their motivation when talking about career. Observation was performed when parents and children were using Q-Be. Observed elements are verbal communication (asking/answering questions, providing feedback, describing, expressing interest) and non-verbal communication (smile, laugh, concentration sign). Interaction and gestures such as pointing or moving to share visual perspective are also observed. The observation was evaluated according to two aspects, which are (1) interaction between participants and engagement between participants and Q-Be, and (2) whether it supports learning by providing resources and adding meaning to a particular situation. After that, post-interview were then conducted to get feedback from participants.

4.1.2 Remote Testing Setup

The user test was conducted remotely. All participants are living in Indonesia. A user test kit consisting of the Merge Cube and Instruction Sheet that was pre-

pared beforehand was sent to participants. Participants were asked to prepare two gadgets, a laptop or computer for video call and a smartphone to install CoSpaces Edu Apps. Installation instructions, steps to open the project in CoSpaces Edu Apps, features introduction, and how to use the cube are all explained in the Instruction and Explanation sheet. Participants were asked to install the CoSpaces Edu Apps at least a day before.
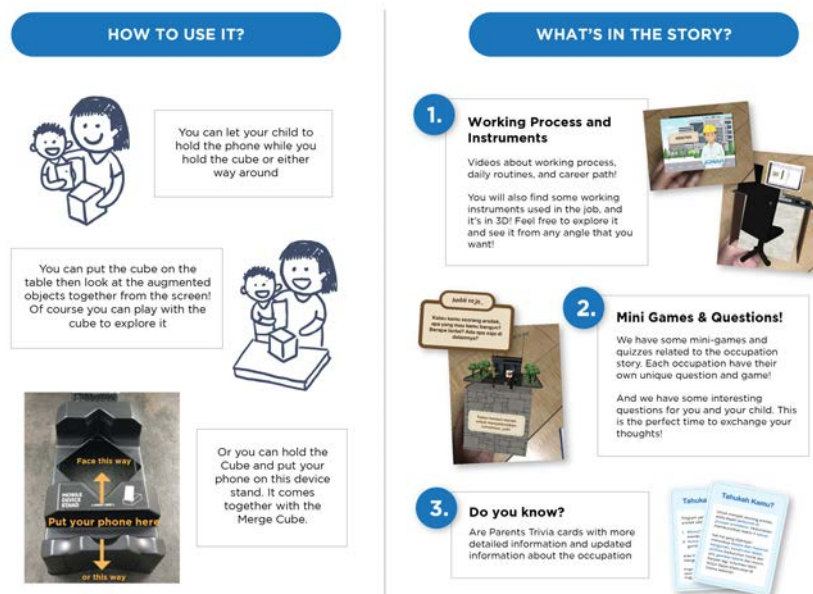
Figure 4.1 Explanation Sheets
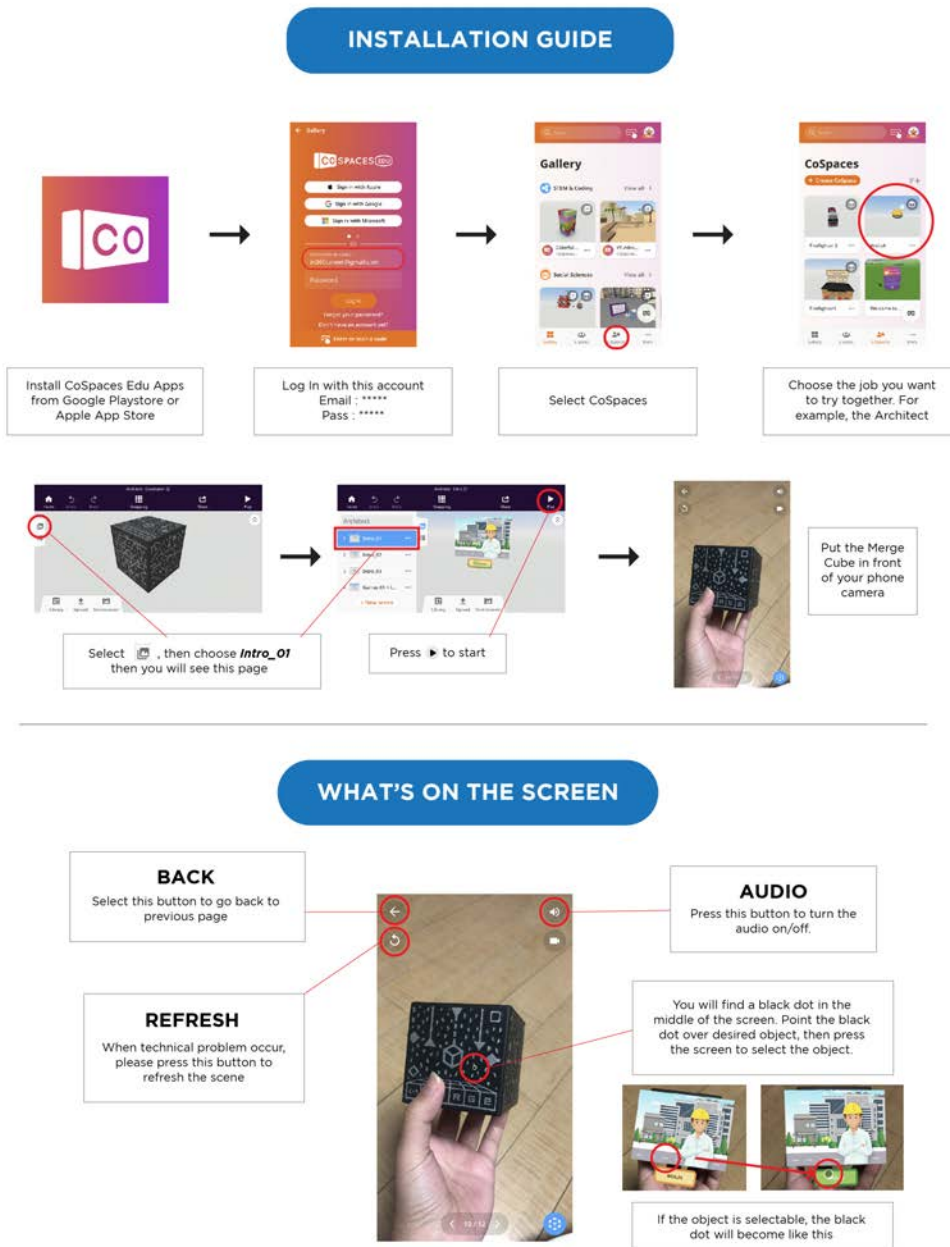
Figure 4.2 Instruction Sheets

To make sure the designed prototype can perform well, a connection test was done between Japan and Indonesia before the first user test. In this connection test, a user was asked to perform the whole process written in the Instruction sheet from installation, log in, then use the Merge Cube with CoSpaces App to estimate the loading time between scenes. The Instruction sheet was originally written in Bahasa Indonesia.

The process was recorded only from one perspective. Therefore, it is not possible to see exactly what the participants were seeing on the phone. Because of the limited internet connection and hardware limitation from the participants, it is not possible to record the phone screen while using it. Other than that, the presence of the writer during the testing process might make some children or parents uncomfortable, even though the camera was turned off and the participants were told that the writer was not present.

4.2. User Test Result

The prototype was tested on four different families in Bandung, Indonesia. Every family has different backgrounds and the participants vary. All children go to different elementary schools.

4.2.1 Family 1 (Father Y and Daughter K)

There are four members in Family 1, those are : father, mother, and two daughters. For the user test, Q-Be was used by father and the eldest daughter together. Father Y, 36 years old, is a Lecturer for Interior Design Major at a Private University in Indonesia. His job is flexible but he spends most of his time outside from home. Daughter K, 10 years old, is a fourth grade elementary school student who wants to be a gamer. She goes to a private school, her hobbies are drawing and playing games.

Father Y and daughter K rarely talk about jobs and occupations at home. At home, they usually spend their time by themselves but daughter K will ask her father if she has something that she does not understand. Father Y never really talk about his days at work with daughter K, but he takes her to the university sometimes. In the university, Daughter K can see what her father is doing. She

does not know what her mother does and she can explain 13 from 18 occupations given in the questionnaire. Daughter K has her own phone, she usually uses it to watch videos and play games. Daughter K and Father Y have never used any AR devices before.

Figure 4.3 Daughter K and Father Y Using the Cube Together

In the user test, father Y holds the phone. At first, they put the Merge Cube on the table. The profession 'Architect' was chosen. Complete result of Family 1 can be seen in Appendix A.1. All statements mentioned below are from Appendix A.1. Due to poor internet connection during the call, some conversation can not be heard and some interaction can not be seen clearly.

Engagement

At the beginning, father Y told daughter K to come and explained to her how it works, they were smiling (statement 1.1). However, daughter K did not stay beside father Y and did not want to be seen (statement 2.1). Daughter K joined father Y and began to concentrate more from the mini-quiz scene (statement 3.1). Daughter K commented on the content and answered father Y's question several times even though what she said can not be heard clearly (statement 7.1, 8.1, 9.1). She paid attention in the video scenes.

Father Y pointed out some objects at the screen then explained it or asked if daughter K knows what that object is, as can be seen in statement 4.1,7.1, and 8.1. Father Y held the phone and rotated the cube, but he told daughter K to touch the screen when it was time to continue the story in almost every scene. Sometimes he moved the phone closer to the cube or either way around. In the game scene (statement 9.1) father Y told daughter K that he is the one who fills the house. He repeated it several times (statement 9.1, 10.1)

Supporting Learning and Adding Meaning

Daughter K can explain what an architect does. She forgot the tracing table, but she remembered that it is a table with a lamp underneath it. Father Y works as an interior designer, thus he does not get any new knowledge. He thinks it would be interesting to add information that Interior Designer is the one who fills the house. Father Y explained to daughter K that his job is related to what they saw (statement 9.1, 10.1)

Feedback

Daughter K likes the video part, she wants to try another occupation that she does not know (programmer). For father Y, Q-Be can help him to explain occupation. It feels more interactive compared to just watching and hearing. It involves our sense of touch. He is interested in exploring other applications using tangible objects. Father Y thinks Q-Be is best to use at home with family, especially when parents want to explain an occupation to their child. He also said that he would like to try another available job story that is not related to what he does.

4.2.2 Family 2 (Mother Y, Daughter J, and Daughter S)

Family 2 has four members : father, mother, and two daughters. Mother Y and her two daughters, J and S, participated in the user test. Mother Y is a 39 years old housewife who helps her husband with his work. They run a music store at their house and mother Y is in charge of the online store. She knows that daughter S used to love basketball and daughter J loves swimming, but lately she starts to get bored of it. Daughter J (10 years old) and S (12 years old) goes to

a semi-international private school. Both of them describe their father's job as 'selling something' and they know that mother Y is a housewife. They want to be an athlete because they love swimming. Daughter J can explain 13 out of 18 jobs given in the questionnaire and daughter S can explain 15 jobs.

Mother Y and her daughters rarely talk about occupations at home. She assumes that her daughter knows about their father's job from what they see in daily life as they're living in a shop house. Lately they talked about occupations because of daughter J's school assignment that required her to describe many jobs given and to interview her father. Sometimes they talk about it when daughter J or daughter S is curious about something they saw then they asked their parents. When talking about occupation, mother Y usually talks about what people in that occupation do. They have never used any AR device before.

Figure 4.4 Daughter J, Daughter S, and Mother Y Using the Cube Together

Complete result of Family 2 can be seen in Appendix A.2. All statements mentioned below are from Appendix A.2. Family 2 tried the Architect story. At the beginning, mother Y let daughter J and daughter S explore the cube, she helped them by directing the phone to get a better view of the augmented Object.

Engagement

When they were given questions either from the video or open-ended questions, mother Y always asks daughter J and daughter S as can be seen in (Statement 1.1, 2.3, 4.1). She asked other questions to confirm if her daughters understand the information (statement 4.2) Mother Y connected information about shop drawing with Daughter S's school subject. Mother Y told daughter S that the architect uses scale ratio and she has learned about it at school (statement 2.1). She also reminded Daughter S about a house mock-up that they have seen before (statement 6.2). Mother Y also explained some information as can be seen in statement 3.1 and 9.4. In general, mother Y often repeats and concludes the information given. Examples can be seen in statement 5.3, 6.1, 9.4.

Daughter S and daughter J asked mother Y about things that they did not know (statement 7.1, 9.2). Daughter S and daughter J shared their thoughts either when they were asked by Mother Y or when they express their opinion as can be seen in statement 3.2, 9.3, 11.1, and 11.3. Daughter J told mother Y if she still wanted to explore the scene (statement 8.2). Even though she held the cube most of the time, she invited daughter S to touch the screen to continue or to read the Parents Trivia card.

In Parents Trivia sections, they take turns to read the Parent Trivia cards. Mother Y helped them when they can not read what's written in the cards. Moreover, they collaborate to figure out the way to complete the mini game (statement 9). Exploration such as rotating the cube happened more in scenes which augment 3D objects.

Positive instantiations such as smile, laughing, concentration signs can be found in almost every scene. Smiling and laughing occur as a response to conversation content or when they saw the cube turned into something interesting (statement 2.3, 4.1,8.1). Concentration signs can be found when they watch video or read Parents Trivia cards. Pointing gestures can be found when they point out something interesting or to clarify which part of the object they were talking about (statement 4.2, 5.1), while moving to share visual perspective happened mostly in scenes which augment 3D objects as can be seen in statement 8.2.

Supporting Learning and Adding Meaning

Daughter J and daughter S said they get new knowledge about architect's working tools. They discover house mock-up and skills needed to be an architect. Information wise, mother Y did not think that she gained new knowledge, but she thinks that her daughters learned some new vocabulary. The interesting things are programs used by architects because the name is hard and her children were having a hard time to read it.

Feedback

Daughter J and daughter S like Q-Be and want to use it again in the future. They also want to try the firefighter story. Mother Y said that Q-Be helped her to explain an occupation. Visualization of an object is one of the most interesting and important factors that could help her because sometimes she is having a hard time to explain something to her children or to find the right words. Moreover, the feeling of 'really holding something' did give a different sensation for her. Q-Be enables her children to explore every angle and helps her to explain things too. Other than that, the mini-games which show the house construction process is remarkable because it helped her children to visualize the process.

She thinks Q-Be might be able to help her children to relate their current preferences with their future aspirations. Mother Y gave an example where daughter S said that she does not want to be an architect because she does not like mathematics. Overall, mother Y thinks Q-Be is really good because it can give more knowledge to her children and she wants to use it next time to explain other occupations. After the user test is finished, they tried the firefighter's story and took some pictures with it.

"To be honest I just realized that daughter J prefers math to drawing. Daughter J did go to an art lesson but quits after a few months, but I know that daughter S likes art and craft."

Figure 4.5 Daughter S and Daughter J Holding the Augmented Object

4.2.3 Family 3 (Mother V and Daughter Q)

There are four members in Family 3, those are parents, a daughter, and a son. The mother and daughter participated in the user test. Mother V is a 40 years old housewife. She spends most of her time with her children. She takes her children to after school lessons from Monday to Saturday. When they arrive at home, she helps her children to finish their school assignments. She loves to cook and this influences her 10 years old daughter.

Daughter Q goes to a private elementary school, she loves cooking and she wants to be a chef. Sometimes Mother V takes her to see cooking competitions. Daughter Q said that she is currently reconsidering because she heard from her cousin who works as a chef that her boss is really strict and tough. Other than that, she also watched a cooking show and she found that the chef's are scary. She knows her father is a tax consultant, moreover she often talks with her father's friend and she enjoys it. Daughter Q can explain 15 out of 18 occupations given in the questionnaire and she could give more detailed explanations for some occupations, mostly from her personal experience. For example, she met an architect when her family was going to renovate their house. She explained that she saw the architect's drawing and heard when the architect talked with her parents.

Mother V and her daughter usually talk about her days at school, they talk

about dreams and occupation sometimes. Daughter Q gets most of her knowledge from cartoons or TV shows, if she finds something interesting she will either search it online or ask her mother. Other than that, her school also has a firefighter come to visit one time. She can explain what a firefighter does and firefighter uniform. Daughter Q knows about VR, both daughter Q and mother V have never used AR before.

Figure 4.6 Daughter Q and Mother V Using the Cube Together

In the user test, mother V held the phone and daughter Q held the cube. Mother Q invited her son to join them and said it was interesting but her son refused. The architect's story was chosen. Complete result of Family 3 can be seen in Appendix A.3. All statements mentioned below are from Appendix A.3. Family 3 chose the Architect story.

Engagement

The very first time the cube turned into a different object, mother V expressed her interest to daughter Q and she agreed with her (statement 1.1, 2.1). Open-ended questions were given from the augmented video and text, mother V repeated the questions to daughter Q as can be seen in statement 2.2, 3.3, 4.1, 6.2, and 11. Mother V restated the information given or pointed out the important thing (statement 3.1, 3.3). She also reminded daughter Q that they have seen a house

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mock up before (statement 6) and answer daughter Q's question. Most of the time, mother V touched the screen to continue the story as she held the phone and daughter Q rotated the cube.

When her younger brother came and wanted to touch the cube, daughter Q took it then he went away (statement 4). She asked mother V what a tracing table is (statement 7) and also commented on the design process video as she found it familiar with a game (statement 2.1). In scenes with 3D augmented objects, more exploration with the cube happened (statement 4,8,9). In the mini-game scene, daughter Q leaned forward and moved the cube closer to the phone, held the phone together with mother V then clicked the red button.

In the Parents Trivia card, mini-game, and scenes with 3d augmented objects mother V and daughter Q move the phone or the cube to take a closer look (statement 5,8,9). Concentration signs can also be found when they read the Parents Trivia card or watch the video (statement 3.1). Positive instantiations such as smile and laugh were seen most of the time (statement 1.1, 2.1, 3.3).

Supporting Learning and Adding Meaning

Daughter Q said she just knew that an architect does not draw directly on paper but use a computer to design a house. It was the first time she saw a table with a lamp underneath it. Mother V said that she just knew about a tracing table and got more detailed information especially about architect's working tools. As mentioned in statement 6, mother V relates the information given to their previous experience. She also related the question 'what do you want to build' to daughter Q's dream, to open a cafe.

"'At first I thought an architect draw directly on big paper, but it turned out that they drew it on computer first."

Feedback

Daughter Q thinks Q-Be is interesting because she saw the 3d augmented objects and she feels like the objects are really there even though it is actually not. She would like to try a story about a chef and imagine the cube turns into chef's

working tools and a chef's hat. Daughter Q said that she does not want to be an architect in the future, but she is interested in creating houses on the computer.

Overall, mother V thinks that Q-Be itself is already interesting. Moreover, it can change into many objects and show children the working process. 3d augmented objects give more detailed visual information and it feels more real. Except for the interesting visual, the information given is more detailed. It broadened daughter Q's perspective and gave her more information, for example an architect also uses math in their working processes and the house construction process.

"It makes daughter Q have to think more and get a better picture about a hotel that she wants to build and gives her more detailed information that she could relate to her school subject."

As mentioned before, mother V knows that daughter Q wants to build a hotel and have a cafe in the future. She thinks that the question given makes daughter Q think so she can have a better picture about the hotel that her daughter wants to build in the future. Q-Be gave her a different feeling that she can't explain, but holding something feels more than just seeing it. It also enables her and daughter Q to explore the augmented objects from every angle and it feels more interactive. Both mother V and daughter Q want to use it again in the future.

Figure 4.7 Picture of Daughter Q with the Augmented Object

4.2.4 Family 4 (Mother S and Son D)

Family 4 has four members : father, mother, and two sons. Mother S and her eldest son, D, participated in the user test. Mother S is a 40 years old employee at a private company. She works in the same company with her husband from the morning, they arrive at home everyday around 7.30 pm. She usually cleans up her house, puts her youngest son to bed, then helps son D with his school assignment. Son D is a 9 years old boy who wants to be an architect. He went to a private school and does not join any after school lessons. Son D can explain 16 out of 18 occupations given in the questionnaire, he also gives examples for some occupations. He does not have any specific hobbies, he spends his time playing with his 2 years old brother and his grandma. He said that both of his parents are labourers and he knows that they work in the same company.

Mother S said that her son often tells her that he wants to be an engineer in the future. When mother asked son D about his day at school, he always asked her back about her and her husband's day at work. As an example, when he was shown a picture of a machine technician, he said that it is like what his father does. His father works with machines. When they talk about his future aspirations, Mother S always tells him to study well so he will not become a labourer like his parents. Beside this, never talk about other occupations at home. Son D gets most of his knowledge about occupations from television, because the television in their house is always on. Mother S knows that son D has a good grade at Math. Son D rarely uses a mobile phone, he has not used it to play mobile games for around two years. Mother S uses her smartphone a lot while she is working, mostly to contact suppliers but rarely use it at home. She stated that she is not really good with technology. Both of them have never used AR before.

While using the Merge Cube, son D held the Merge Cube and mother S held the phone. Family 4 tried the Architect story because son D wants to be an architect. In this user test, connection problems occurred resulting in longer loading time and someone is helping to record the video. Complete result of Family 4 can be seen in Appendix A.4. All statements mentioned below are from Appendix A.4.

Figure 4.8 Mother S and Son D Using the Cube Together

Engagement

When mother S was given questions either from the video or open-ended questions, mother Y always asked son D (statement 2.2, 4.1) even though she did not always restate the question (statement 11). Other than that, she asked if son D was interested in becoming an architect (statement 2.1, 9.1). When son D seemed hesitant to answer the question, mother S tried to elicit a response by describing things that she knows about son D's dream house as can be seen in statement 2.2 and 11.2. Mother S smiled as she saw the house is progressing when she touched the red button (statement 9), she showed it to son D. When she saw that son D is interested, she reminded him to study more (statement 10.1, 11.1).

In between the loading time, Son D still pay attention to the screen and read the numbers in the progress bar from time to time. Son D shared his experience and reminded mother Y about his school assignment in the house mock up scene (statement 6.1). He smiled as he got the right answer in the quiz scene (statement 3.3). He was shocked when he read Parents Trivia cards which said that it took for years to get a degree in architecture (statement 10). Sometimes he commented on the content even though it cannot be heard clearly.

Most of the time, mother S and son D read the Parents Trivia cards by themselves. However, mother S asked son D to confirm if he has finished (statement

3.2, 5.1, 7.1). Son D rotated the cube a little in some scenes and did not try to see every angle of the cube. Positive instantiations such as smiling and laughing can be found in scenes which require them to complete a task, as can be seen in statement 3.3 and 9.1. Concentration signs can be found when they watch video or read Parents Trivia cards.

Supporting Learning and Adding Meaning

Son D found out that architect works together with 'reconstruction' (contractor) to build a house. He just knew that architect use both computer and paper to draw houses, and use a tool that can trace pictures. He told us that an architect can work at his house and construction site. Mother S said she got more detailed information about architect, although she did not really specify. She tried to elicit a response by describing things that she knows about son D's dream house. She also encourage son D to show his house mock-up after the story is finished (statement 6).

Feedback

Son D said that he loves the whole thing about Q-Be, although he did not want to try another story because architect is the one that interests him the most. He made a house mock-up for a school assignment last week then he showed it.

Mother S thinks that Q-Be let his son visualize a job as an architect and it might be interesting to use it to explain another job too. Compared to just explaining an occupation by herself, Q-Be can give son D more information and motivate him at the same time. Even if son D uses it by himself, mother S said that he will still go to her to tell or ask something about the story.

"This makes son D more motivated and gets him more interested in being an architect in the future."

Figure 4.9 Mother S Taking a Picture of Son D with The Cube

4.3. Discussion

Q-Be received good results and feedback from both children and parents. Through AR features and design components, parents and children engage in the story about occupation and have formative career-related conversation.

Parents think that the information given is more detailed, so both parents and children gain new knowledge. All parents agree that Q-Be provides detailed information about occupation that can help parents to explain occupation to their children and help them to learn some new vocabularies related to occupations. One participant said having a 3D augmented object in front of them not only enables children to see the tool from every angle and to visualize the process, but also helps parents when they can't find the right words. Parents Trivia card gave direction to parents, which helped them to explain the 3D augmented objects especially when they do not know about the object. In addition, even though Parents Trivia cards were meant for parents, some participants ended up reading it together or taking turns to read it.

3D augmented objects help their children to visualize and develop a better understanding about the occupation, they explore the augmented objects and ask questions about it. It also trigger questions from children when they see something they could not understand. A child realized that she had a misconception about an occupation and others showed interest to explore all sides of the augmented objects. Other than asking, children also look for confirmation from parents regarding the information they think they already know. Thus, their parents gave

immediate feedback either agreeing, explaining, or linking it to their experience. After using Q-Be, a child also realized that she had a misconception about architect's working process. More over, more exploration happened in working tool scenes which augment 3d objects. Children engaged with Q-Be, rotated it to see the working tool from every angle. Q-Be also allow participants to refer to the same thing by pointing and directing the camera to show specific part of the augmented object.

Questions given in either video or open-ended question scenes can trigger conversation between parents and children, parents ask children to answer the question most of the time. It gives children a chance to communicate their thoughts and preferences. A participant also got a new insight about her daughter's preference. In some scenes, parents also connect the content to their or their children's existing knowledge or personal experiences either to answer their child's questions or to explain the information. However, most of the time, parents did not share their thoughts or preferences and only listen or responded to their child's answers instead. The mini game and quiz given in the story also caught children's attention and interest especially when children or parents were distracted because of long loading time. It also encourages conversation between parents and children as they collaborate to find out the way to complete the task together or to select the correct answer.

Dividing the story into smaller scales of information encourages parents to conclude or describe the information to children. Interactions such as click and rotate to continue between every scene keep participants engaged through the story and allow participants to take their time to discuss the information given in each scene. Other than that, interacting with the cube while holding the phone give different task for children and parents, and keep both users engaged in the story. When children stare too close at the screen, parents remind them and move the screen or the cube a little bit further to keep some distance between eyes and the screen.

Based on findings above, it can be said that Q-Be could promote parents-children joint engagement in career related conversation. It has to be noted that every child has different abilities to explain their understanding about the occupation and every family has different backgrounds, family relationships, and familiarity with digital media.

Chapter 5
Conclusion

5.1. Conclusion to Research Question

The purpose of this research is to design a media that provides occupational information for parents and children in a way which children understand, while providing information for parents and encouraging them to discuss it. This raise the question that this research tried to answer : *"How does tangible AR media promote parents-children joint engagement in career-related conversation?"* and *"What components in tangible AR media trigger interaction between parents and children in career-related conversation?"*

Through the design components and utilizing tangible Augmented Reality, Q-be is proven to be an interesting media for all participants. Parents and children are actively involved while using Q-Be as ground referents in conversations or known as conversation anchoring. Q-be's contents provides context and guides parents and children as they explore and discuss the augmented contents at their own pace. Dividing the story into smaller scales of information which require interaction between each scenes act as a 'pause point' where parents can explain about the information given in the scene.

They are able to engage in the story about occupation, explore and have deepen understanding or knowledge about occupation, and express preference on skills related to occupation. It enriches their conversation and allows them to have deeper understanding, and also help parents to explain things related to the occupation. For example, one child realized that she had a misconception and others showed interest to explore all sides of the augmented objects. A parent also said that her child learned some new vocabularies.

Challenges given caught parents and children's interest, encouraged collabora-

tion and conversation to happen between them. Open-ended questions allow children to express preference on skills related to occupation and relate it to school subject. However, most of the time only children answer the question and the depth of the conversation itself is different depending on the family. The content of information and open-ended questions could be improved to encourage more in-depth career-related conversation between parents and children, to trigger parents to share their thoughts, preferences, or opinion on related topics.

5.2. Future Works

While Q-Be has the potential to engage parents and children in career-related conversation at home, there are many improvements that could be made for both the content and the platform itself. Currently, Q-Be only provide two story options. Thus, more story option is needed. The information given is general information. From results and findings it was suggested that covering other topics in the story such as gender or hierarchy at work, or topics related to children's perception about one occupation could be one of possible future works for this research.

The question given could be improved by; covering more personal or in-depth topics such as self concept (imagining the self doing various work tasks or being a part of a different work setting), and improving the wordings to encourage parents to share their thoughts.

Career development is a lifelong process, and career intervention cannot stand by itself. The complete version of the platform is another thing that could be done for this media. A feature to connect parents and children to role models, more specific information resources, communities, service, or after school classes related to the occupation story can encourage them to explore their interest further.

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Appendix

A. User Test Results

A.1 Family 1

Participant : Father Y (FY) and Daughter K (DK)

Duration : 15 minutes

Scene.No	\<Video Content/Audio >Statement Content *(Action)*
Introduction	
1.1	\<video start > FY : Come, Kei. *(DK come and join him) (They hold the phone together, FY explain how it works, they tried it)* FY : *(smile)* select, select *(DK touch the screen) (smile)* *(FY hold the cube and rotate it, loading then put it back)* *(DK walk around FY)*
2.1	\<Video start > *(FY and DK watch the video)* *(DK touch the screen) (DK does not want to be included in the camera)* \<Question 1 >*(DK rotate the cube)*
3.1	\<Video start > FY : Come, Kei *(mother gives her a chair to sit on)* Come, select continue. *(FY read aloud Parents Trivia card) (DK look at FY)*
3.2	\<Quiz 1 > FY : Which one is a shop drawing? DK : This FY : Select, select *(DK touch the screen)*
4.1	\<voice over start > *(FY hold the cube and rotate it) (DK said something)* FY : This is a house mock-up, this is the computer *(DK said something while pointing the screen) (FY smiled)*

Scene.No	\<Video Content/Audio>Statement Content *(Action)*
	Notes : Unstable connection
	FY : Continue *(DK touch the screen)*
	Working Tools
5.1	*(FY put the cube on the table) (FY read aloud the Parents Trivia)*
	(DK touch the screen)
6.1	*(FY move the phone closer to the cube)*
	(DK and FY read the Parents Trivia card)
	(DK touch the screen)
7.1	\<... help you to trace pictures ... >
	FY : You know, right? The one with class and lamp underneath it *(look at DK)*
	(DK nod, said something)(DK touch the screen)
8.1	*(DK look away)* \<voice over start >
	FY : Kei, do you know what is this?
	DK : A hat *(look at the screen)*
	FY : Yellow helmet
	\<... is a construction hat ... >
	DK : I'm correct, it's a hat! *(look at FY) (said something)*
8.2	*(FY read aloud the parents trivia)*
	(DK look at FY, said something)
	FY : Continue (DK touch the screen)
9.1	*(DK touch the screen several times, nothing happened)*
	\<reload the scene >
	FY : Kei, it almost started *(DK come closer)*
	FY : Push the red button to continue. Push it, Kei. Push it.
	(DK touch the screen)
	FY : Push *(DK touch the screen)* Again.. *(DK touch the screen several times)*
	FY : There you go, the house is completed
	DK : *(said something)*
	FY : Then, I'm the one who fill the house
	Conclusion
10.1	FY : Select *(FY and DK watch the video)*
	FY : I'm the one who makes the house interior, Kei. Here, continue
	(DK touch the screen)

Scene.No	\<Video Content/Audio \>Statement Content *(Action)*
	(FY read aloud the parents trivia card) FY : The one who fill it is Interior designer, that is what I'm doing. *(DK nods)*
11.1	*(DK smile) (DK shake her head)* FY : Which one do you prefer, drawing or mathematics? DK : *(said something)* FY : Between drawing and mathematics? DK : No.
12.1	FY asked his wife to take picture of them.

A.2 Family 2

Participant : Mother Y (MY), Daughter J (DJ), Daughter S (DS)

Duration : 23 minutes

Scene.No	\<Video Content/Audio \>Statement Content *(Action)*
	Introduction
1.1	\<Video Start \> *MY held the phone together with DJ, DJ held the cube)*
1.2	\<Do you know what an architect does? \> MY : Do you know? *(look at DJ and DS)* DS & DJ : Yes *(still looking at the screen)*
1.3	\<Video finished \> DS : Then select it. *(DJ make a gesture to touch the screen, but DS touch the screen first)*
1.4	*(DJ rotate the cube)* MY : Ohh. It's cute. *(smile and laugh, look at DS, DS smiled)*
2.1	\<First, we have to know what are we going to build. \> MY : See *(still looking at the screen)* \<Does it have a swimming pool? \> MY : Are you going to help him? *(Look at DS, laugh)* DS : Of course not! *(All of them smiling then laugh)*
2.2	\<Video architect drawing with computer \> MY : *(Look at DS)* You've tried something like this, right? But that one is more like a room, do you remember? *(DS shake her head, still looking at the screen)*

Scene.No	\<Video Content/Audio\>Statement Content *(Action)*
	MY : Hmmm, no? *(look at the screen)* You've drawn something like this, but it's a room *(point the screen)*
	DS : Ahhh yes, I remember! *(Look at MY)*
	MY : Yeah, you put something then you draw on it . . . *(Look at DS)*
	DS : Oh yeah the door looks like this *(hand gesture)*
	DJ : Push to continue, push
	(My look at the screen, MY click the screen) (DS look at the screen)
2.3	\<Question 1 \>*(DJ and DS look at MY)*
	DS : Swimming pool *(smile)*
	DJ : House *(smile, look back at the screen)*
	MY : A house with a swimming pool? *(look at DS)* And then?
	DS : Dufan, dufan *(smile, look at the screen, look at MY) (everyone laugh)*
	MY : Dufan
	(DJ and MY click the screen)
	MY : How about you, Jessica? *(rotate the cube)*
	DJ : I want. . . *(touch her lips)* Hotel *(Look at MY) (DS laugh)*
	MY : Build a hotel? *(Look at DJ)* It's harder than a house (smile)
3.1	\<Video start \>*(Everyone look at the screen)*
	\<Contractor is the person who build a house \>
	MY : So, an architect does not do it alone
	DJ : *(look at DS)* Ahh he does not build it *(look back at the screen)*
3.2	\<This is an example of a shop drawing \>
	DS : *(Shocked, look at MY then said something)*
	MY : This is the scale, this drawing use the scale *(point at the screen)* You've learned this, right? *(point at DS)*
	DS : Aihhh I don't like it. . . *(point the screen)*
	DJ : Sis, sis, it's your turn to continue *(Point the screen)*
	(DS touch the screen, look at MY then said something, smile) (MY look at the screen)
3.3	DJ : Aih, a question! *(smile) (DS look back at the screen)*
	MY : What does it say??
	(DS read aloud the Parents Trivia, everyone look at the screen)
	DS : . . . conversation . . .
	MY : conversation? *(look closer to the screen)*

Scene.No	\<Video Content/Audio \>Statement Content *(Action)*
	DS : Eh, I don't know *(laugh)*
	DJ : Estimation
	(DS continue to read aloud the parents trivia)
	DJ : Be quite, we will get a question after this *(MY click the screen, rotate the cube)*
3.4	\<Quiz 1 \>
	MY : Which one is a shop drawing?
	DS : *(Point the screen)* This one
	DJ : This *(direct the black dot)*
	MY : This one *(select the screen)*
3.5	\<... Correct! ... \>
	MY : We can select it by rotating it? *(rotating hand gesture)*
	DS : *(look at MY)* There is a black dot in the middle to select the object *(rotating hand gesture)*
	(MY nod) (DJ touch the screen, MY touch the screen, DS touch the screen to continue)
4.1	\<Architect's office \>
	DJ : Sis, rotate it sis *(Point at the cube)*
	(DS rotate the cube, put it down, and hold it again)
	MY : Wow *(DJ hold the cube with DS, rotate it)*
	(DJ rotate the cube when the voice over is still playing on the background, DS and MY look at the screen)
4.2	\<... computer, house mock-up, ... \>
	MY : Do you know house mock-up? *(look at DS)*
	DJ & DS : No *(shake their head)*
	MY : This one *(Point the screen)* So this one is the house *(hold the cube, with DJ)* This is the house, and this is what's inside the house *(Point the screen)* And this one is what we called a house mock-up *(look at DS)* House mock-up is like small houses, we can find it ...
	DS : Ooooo I know, I know! The one at ... right? *(look at MY, smile)*
4.3	DJ : Look look! Look at this!
	(hold and rotate the cube, show the hovered object)
	(DS and MY look at the screen)
	DJ : This one, and what is this? *(hovering the objects one by one)*
	DJ & DS : *(read)* Drafting table, and this one is...

Scene.No	\<Video Content/Audio \>Statement Content *(Action)*
	MY : I think that's all. This one, this one, and the house mock-up. *(point the screen)* Three important things for an architect. So at least an architect has to have a drawing table, computer, and . . . *(look at DS)* DS : A house mock-up MY : A house mock-up, they are going to use it when . . . *(DJ rotate the cube, select continue to the next screen)*
	Working Tools
5.1	\<voice over \>*(DJ and MY hold the cube together)* DS : Uwao *(expression) (then put it on the floor)* DJ : There's a chair *(point at the cube)* DS : *(lean forward)* There's a 'Do you know?', read the card! *(DJ rotate the cube)*
5.2	MY : Ehhh wait why is it like this *(rotate the cube again)* DJ : Not yet mom, this . . . MY : Eh it's gone! *(smile, everyone laugh)* DS : Read the 'Do you Know'? card.
5.3	*(DJ read aloud the parents trivia)* DJ : . . . . Atau auto.. Kad? MY : Autocad *(everyone laugh, DJ continue to read)* *(MY lean forward and hold the phone together with DJ)* DJ : . . . archi.. Kad? *(MY read the rest of Parents Trivia together with DJ, DS read it together with them)* MY : So an architect have to own that program so they can make . . . *(point the screen)* DJ : Sis, sis *(show the screen to DS) (DS click continue)*
6.1	\<voice over started \> *(DJ rotate the cube, MY help her to find the correct angle)* MY : This is the house mock-up, and .. *(held the cube, direct the phone)* DS : House mock-up, it's called a house mock-up DJ : It's a house mock-up MY : So this small thing over is the house mock-up *(point at the screen)* Move it closer so we can see it clearly *(move the phone closer to the cube)*
6.2	*(MY read the parents trivia)* MY : *(look at DS)* You've made a house mock-up before, right? What building did you make again? *(DS answer her)* Ahh yes.

Scene.No	\<Video Content/Audio \>Statement Content *(Action)*
	(DJ move the phone further, and see other angle of the cube)
	MY : *(point the screen)* Where is the continue button?
	DJ : Wait, there it is *(smile)* *(MY click the cube)*
7.1	\<voice over start \>*(MY direct DJ to move the phone, DS rotate the cube)*
	MY : This table is . . . *(rotate the cube)*
	DS : What is this for? *(DJ hold the cube and rotate it)*
	MY : Aah, to trace pictures.
	DJ : This one is ruler? *(while rotating the cube)*
	MY : I think it's a lamp. This table usually have a lamp and it looks like this.
	DJ : Do you want to continue?
	MY : Let's read it first *(lean forward)* What does it say?
7.2	*(DJ read the parents trivia)*
	MY : So if you can't draw it on the computer, we draw it . . . *(look at DS)*
	DS : draw it on paper
	MY : and there's a lamp underneath *(DJ select the screen)*
8.1	MY : Wow
	DJ & DS : Ehh a hat *(smile, move further)*
	\<voice over start \>*(MY rotate the cube to every angle)*
	(DJ move the phone to see the cube from other angles, MY direct the phone closer so DS can see it)
	DJ : Sis, read it. *(move the phone closer to DS)*
8.2	*(DS lean forward, read the Parents Trivia)*
	(MY hold the cube and move it closer to the phone. DJ hold it together with MY)
	MY : Finish?
	DJ : I want to take a look at the other angle. *(Hold the cube)*
	MY : It's the same *(point the cube)*
	DS : Continue
	DJ : Sis *(point the cube)* *(DS select the screen)*
9.1	DS : It's upside down
	MY : Really? *(rotate the cube, try to find the right angle)*
	(DJ touch the screen, MY try to touch the screen too)

Scene.No	\<Video Content/Audio \>Statement Content *(Action)*
	DS : Upside down
	MY : Like this? *(rotate the cube)*
9.2	DS : Yes, like that! Is that an underground house? Is that a ramp?
	MY : No, *(point the screen)* So when you're going to build a house, we have to put this iron poles to make sure the house is strong enough, . . .
	DS : Ahh I think we've seen it before, I can't remember. . .
	DJ : Ohh maybe this one is for the roof *(point at the screen)*
	MY : Yes, that one is for the roof *(point at the screen)* It's called the house construction, building structure
	DJ : Is this for the floor?
	MY : Yes, maybe. Or maybe something else
	(DJ rotate the cube)
9.3	MY : So how can we complete the construction?
	DS : We have to finish this together, right? I think i saw a person (MY rotate the cube) Look, it says push the red button
	DJ : Push it, push it *(DJ and DS touch the screen together)*
	DJ, DS, MY : Woww
	DJ : Push it again, again
	DS : Let me do it, let me do it *(touch the screen together, again and again)* Woww
9.4	MY : See, so we have to build the house structure first. After that, we can add more the left side, the right side *(look at DJ and DS)*
	DJ : Continue, mom?
	DS : Let's continue, push! *(MY and DS rotate the cube)*
	Conclusion
10.1	\<. . . did you learn something new? . . . \>
	MY : Did you learn something new?
	DJ & DS : Yes
	MY : So, is the architect the one who built houses? *(look ad DJ and DS)*
	DJ & DS : Noo
	MY : So what does he do?
	DS : Make the blueprint
	DJ : Draw the house
	MY : Draw the house, and also the floor plan for the house

Scene.No	\<Video Content/Audio \>Statement Content *(Action)*
10.2	DS : Mom, read this *(MY read the Parents Trivia)* MY : Further information can be found at ... don't know the name of the website *(smile, laugh)* DJ : google it, google *(smile, touch the screen)* *(MY rotate the cube)*
11.1	\<... are you interested? \> MY : So, are you interested in being an architect? *(DJ shake her head)* DS : Hmm not really because I'm not good at scale. *(smile)* *(MY laugh, DJ told MY to hold the phone)*
11.2	\<... and learn mathematics ... \> DS : See! I have to use mathematics! *(point at the screen)* MY : Yesss *(DJ look at the screen)* DS : I don't want too *(smile, look at MY. Everyone laugh)* If it's related to math, I give up *(DJ touch the screen to continue)* MY : It looks fun, tho
11.3	\<Question 2 : Which one do you prefer, math or drawing? \>*(DS read the question)* DJ : Math! I think drawing is harder DS : You'll see when you're in the 5th grade *(laugh)* MY : How about you? *(look at DS)* DS : Of course drawing, because I just have to draw a house. MY : How about Jes? So you prefer math.
12.1	MY : Wow! It became a hat ! DS : Use the hat, use the hat *(hold the phone)* *(DJ take the cube)* MY : It says take a picture DS : But how?
12.2	DJ : I know! Put the cube on my head *(put the cube on her head)* *(DS hold the phone together with MY)* They take some pictures together

A.3 Family 3

Participant : Mother V (MV) and Daughter Q (DQ)

Duration : 13 minutes

Scene.No	<Video Content/Audio >Statement Content *(Action)*
Introduction	
1.1	<Video start > MV : Come Roy, take a look at this! *(DQ put the cube on the table, MV lean forward and move the phone closer to the cube)* MV : *(MV touch the screen)* Turn to the right. *(DQ rotate the cube)*
2.1	<video start > MV : It's cute, right? DQ : He eh *(smile)* <contohnya seperti ini > DQ : It's cool. *(smile)* MV : Making a design. DQ : It looks like a game at . . . MV : What game? DQ : There's one, but we have to pay MV : Queen, continue *(DQ touch the screen, then rotate the cube)*
2.2	<Question 1 > MV : One floor? *(DQ nods)* And what do you want to have inside? DQ : Hmm, I don't know how many floors . . . MV : What's gonna be inside? A swimming pool? DQ : Swimming pool! MV : Ehh this again, continue *(touch the screen)* Turn to the right . . . *(DQ rotate the cube)*
3.1	<. . . contractor is a person who . . . > MV : Contractor is the one who builds the house. Architect draw the house, contractor build it. <. . . it has numbers and measurements . . . > MV : See there's a number *(point the screen)* *(DQ nods)* MV : Select continue *(touch the screen)*

Scene.No	<Video Content/Audio >Statement Content *(Action)*
3.2	*(MY read the parents trivia) (DQ look at the screen)* *(MY touch the screen) (DQ rotate the cube)*
3.3	<Quiz 1 > MV : See *(smile) (DQ look at the screen, smile)* MV : Which one is shop drawing? *(look at DQ)* DQ : This one *(point the screen) (direct the cube)* *(MV touch the screen)* <... correct!... >*(MY look at DQ, smile. DQ smile)* *(MV touch the screen)*
4.1	<Architect's office > *(DQ and MV smile) (DQ's little brother come and ask, he touched the cube but DQ doesn't let him so he went away)* DQ : We can rotate it *(DQ rotate the cube)* <... what can you see inside ... > MV : What can you see inside? *(DQ answer her, still rotate the cube)* MV : Computer, house mock-up, tracing table *(point the screen) (DQ lean closer)* MV : Continue *(touch the screen)* It's cool right? *(smile, look at DQ)* DQ : Yes *(smile)*
	Working Tools
5.1	<voice over start >*(DQ and MV smile)* *(DQ rotate the cube, lean forward)* *(MV touch the screen to continue)*
6.1	<... have you see a house mock-up? >MV : Have you? *(look at DQ)* DQ : Hemmm have I .... ? *(look at MV)* MV : Do you remember when we went to Kota Baru Parahyangan, there's a house mock-up there DQ : Ahhh yesss MV : Let's continue *(MV touch the screen)* *(DQ said something)*
7.1	<... trace pictures ... >*(DQ rotate the cube)* MV : Ahhh, thats ... *(DQ and MV read the Parents Trivia)* MV : ... trace floorplans, ... *(DQ say something)*

Scene.No	<Video Content/Audio >Statement Content *(Action)*
8.1	*(DQ and MV smile)* <... Construction hat ... >
	MV : Construction hat.
	DQ : Use it, put it on my hat *(smile, move the cube closer to her head, then put it back)*
	(MV move the phone to read the Parents Trivia) (MV touch the screen)
9.1	MV : Wow cool *(DQ look at the screen) (MV said something)*
	(DQ rotate the cube, she lean forward and move the cube closer to the phone)
	MV : Push the red button! *(DQ hold the phone together with MV)*
	(DQ touch the screen)
	<the house progressed >
	(DQ and mom smile) (DQ touch the screen several times)
	(DQ said something, rotate the cube)
	MV : *(look at DQ)* So cool *(touch the screen to continue)*
Conclusion	
10.1	<video start >
	(DQ and MV watch the video, MV touch the screen to continue)
	<Parents Trivia >
	(DQ and MV take a closer look at the screen) (they say something)
	(DQ rotate the cube, smile)
11.1	<... are you interested? >
	MV : Are you? *(look at DQ) (DQ nods) (MV look back at the screen)*
	<... Mathematics ... >
	DQ : *(shock)* No *(shake her head)*
	<... measure the door height ... >
	DQ : Noo *(MV smile, touch the screen to continue)*
11.2	<Question 2 : Which one do you prefer, math or drawing? >
	DQ : Drawing
	MV : Drawing? Why?
	DQ : Because it feels more real
	MV : More real?
	DQ : And math is... Hard *(laugh)*

Scene.No	<Video Content/Audio >Statement Content *(Action)*
12.1	*(MV move the phone further) (DQ held the cube and move it closer to the phone)* They took some pictures

A.4 Family 4

Participant : Mother S (MS) and Son D (SD)

Duration : 12 minutes

Scene.No	<Video Content/Audio >Statement Content *(Action)*
	Introduction
1.1	<Video start > *(MS and SD watch the video)(SD's younger brother joined them)* MS : *(MS touch the screen)* Rotate, rotate *(SD rotate the cube)*
2.1	<video start > MS : See Darrel, do you want to be something like that? Make houses. *(touch the screen)* SD : I already want to be something like that
2.2	<Question 1 >MS : Answer the question *(look at the screen)* SD : Continue continue MS : Want to build a house, three floors *(touch the screen) (SD rotate the cube)* and have a swimming pool inside? SD : Yes, swimming pool. I want a house with a swimming pool inside. *(smile)*
3.1	<video start >*(SD's little brother joined them again)* MS : *(MS touch the screen)*
3.2	*(MS and SD read the Parents Trivia card)* MS : Have you finished? SD : Yess *(MS touch the screen)* Rotate to the right *(SD rotate the cube)*
3.3	<Quiz 1 > MS : Answer Darrel SD : The right one? *(MS touch the screen)* Yes! *(Smile)* MS : Pay attention, Darrel. What if another question pop up?

Scene.No	\<Video Content/Audio \>Statement Content *(Action)*
4.1	\<architect's office \>
	SD : Wahh? Wahh? MS : What's inside? *(SD rotate the cube)*
	SD : House, computer, eemm a table for drawing, table
	MS : That's all?
	SD : That's all *(MS touch the screen)*
Working Tools	
5.1	\<voice over start \>*(MS and SD read the Parents Trivia card)*
	MS : Finish?
	SD : Finished *(MS touch the screen)*
6.1	\<... it's like a smaller version of ... \>
	SD : Small house *(smile) (rotate the cube a little) (said something to MS)*
	MS : Be quiet the video is on
	\<... have you seen a house mock-up ... \>
	SD : I have! I've made one before *(smile)* I just finished
	MS : Let's show it to auntie Elva later *(MS touch the screen)*
7.1	SD : Finished
	(MS touch the screen)
8.1	SD : This looks like my toy
	(MS read aloud the Parents Trivia card)
	(MS touch the screen) (SD said something, MS reply)
9.1	\<... Let's complete the house ... \>
	SD : Ha.. Push the red button
	MS : *(MS touch the screen)* Wow *(smile) (MS touch the screen)* Wow.
	See, are you interested, Darrel?
	SD : Let's continue!
	MS : Are you interested in becoming an architect?
	SD : Yes I want to be an architect
Conclusion	
10.1	\<video start, finished \>*(MS touch the screen)*
	(MS and SD read the Parents Trivia card)
	SD : Heeee it took four years? *(shocked)*
	MS : That's why you have to study more, don't be lazy *(MS about to touch the screen)*
	SD : Sstt don't say anything yet! I haven't finished! *(continue to read)*
	Ok done *(MS touch the screen)*

Scene.No	\<Video Content/Audio \>Statement Content *(Action)*
11.1	\<... are you interested in becoming an architect? \>(SD nods)
	MS : Your answer?
	SD : Yes *(smile)*
	\<... and study mathematics ... \>
	MS : See *(nods)*
	SD : Waa *(smile)*
	MS : Are you listening? *(MS touch the screen)*
	SD : Yess
	MS : Don't be lazy
11.2	\<Question 2 : Which one do you prefer, math or drawing? \>
	MS : So which one do you like?
	SD : Drawing or mathematics?
	MS : Math?
	SD : Yes *(MS touch the screen)*
	MS : It's because you can not draw, how can you be an architect if you can't draw *(smile)*
	SD : You're right *(smile)*
12.1	*(MS move the phone further, then took some pictures)*

B. Interview questions for experts

1. Can you tell me your name?

2. Where do you work?

3. How long have you become a ... ?

4. Why do you become a ... ?

5. When did you know you wanted to be a ... ?

6. How will you explain 'job as a ... ' to children? What does a ... do?

7. What is your daily activity/routine at your workplace?

8. Is there any ... working process that could be explained to children?

9. Who do you work with?

10. What are some . . . attributes/tools that would be interesting for children? What is that for?

11. If I want to be a . . . , what should I learn/practice as an elementary school student?

12. Anything else that would be interesting to tell to children?

13. Is there any (special training/university major) if you want to be a . . . ? How long does it take?

14. What are the best and worst time of the job?

15. How do you normally dress when there is no call/emergency state?

16. Can women/men become . . . ?

17. Does . . . have holidays?

C. The Firefighter's Story

In the firefighter's story, the next scenes are divided into two parts which explain firefighter's working hours and daily activities. Parents' trivia will show up after every video. Same as the first scene, to go to the next scene the user has to click on the 'LANJUTKAN' button and rotate the cube to the right.

Figure C.1 Firefighter Story - Introduction

The second part starts with a mini game where children and parents have to find out how many fire engines are inside the building. They will continue to the next scene that shows firefighter lockers.

Figure C.2 Firefighter Story - Mini Game

After that, single 3D instruments will be shown. Four working instruments that are going to be shown are (1) firefighter's suit with a mini game and Parents' Trivia, (2) fire engine, and (3) jaws of life.

Figure C.3 Firefighter Story - Working Instruments

The last part of the story sums up the overall information given. This part consists of videos, open-ended questions and Parents' Trivia. In the last scene, the cube can turn into firefighter's working instrument.

Figure C.4 Firefighter Story - Conclusion

D. Preliminary interview questions for children

1. Name, class, school etc (basic information)

2. Do you know what your parents' job is? Can you tell me what they do?

3. Is there any other occupation that you know? Can you name as many occupations as you can? What do they do? Where do they work? What do they use?

4. (Show them some picture and ask them what do they know about that job)

5. What do you want to be when you grow up? What skills do you think you'll need?

6. What are your hobbies?

7. What is your favorite subject at school?

8. Do you have a smartphone? How often do you use it? What do you usually do?

9. Do you know Augmented Reality? Have you ever used it before?

E. Preliminary questions for parents

1. Name, age, occupation

2. Do you often have a conversation with your child? What do you usually talk about

3. How often do you talk about career or jobs with your child?

4. If you were to talk about a certain job with your child, what would you tell him/her?

5. Have you ever talked about your job with your child? What did you tell them? Did you find any difficulties?

6. What's your child's dream job? What are his/her hobbies?

7. How often do you use your smartphone? What do you use it for?

8. Do you let your child use a smartphone? Do you keep an eye on what he/she did with it?

9. Do you know Augmented Reality? Have you ever used it before?

F. Post Interview questions for children

1. Can you tell me about the (job)? (ask them to explain first)

2. What does (job name) do? Where does he work?

3. What does (he) use? Can you tell me how does it looks like? What is that for?

4. What do you have to do when you want to be a (job name) when you grow up?

5. Is it fun? (rate from 1-4)

6. Which part do you like the most?

7. Would you like to try it again with another job?

8. Can you express what you like and you don't like?

G. Post interview questions for parents

1. Did you get any new information about (job)? Can you tell me what is it about?

2. Did you learn something new about your child?

3. Are you having a good time?

4. Do you think this media helps you to explain a job to children? If yes, what helps?

5. Do you think actually 'holding' a tool makes any differences?

6. Do you want to continue using this media?

7. If yes, how do you plan to use it? In what case?