<hello,w>

A Platform With Augmented Reality Games And Video Interactions Increases Inclusivity In STEM

by

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Major
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ABSTRACT

Private and public policies increasingly aim to support efforts to broaden the participation of a diverse body of students in STEM (science, technology, engineering, and mathematics) education in the United States. Unfortunately, this increase in student diversity does not always occur alongside institutional changes. Unexamined biases in school or in the household can prevent diverse students from thriving and pursuing in STEM fields. Specifically, the number of teenage girls studying engineering is still the lowest population of the STEM field. As a result, young women are stereotyped in their choice of subjects by schools and households. Even though young women have interests in engineering early, they easily begin to lose it due to the lack of interactions with mentors historically. In order for minorities in STEM to improve, new information technologies (IT) can offer new opportunities to young women in an attractive and entertaining way to better engage with engineering principles and get inspired by mentors' career paths, regardless of time and location. Augmented Reality (AR) technology provides virtual experiences and adds enjoyable gaming elements to support textbook materials or to embed in smart devices for educational purposes. Asynchronous video mentoring helps the contemporary generation of young women to cultivate confidence and a positive mindset to pursue an engineering career. As a result, young women become more engaged and interactive with their interests and mentors in engineering. The first part of this Thesis describes the result of the application of engaging games on <hello,w> based on Augmented Reality for the development of the spatial ability of students who are interested in engineering. The second part presents examples of asynchronous video communication mentoring with female role models in the industry. The use of AR technology and async video communication facilitates the students to achieve practical skills, enhance their confidence, and define the future career path in a much shorter time during their daily life.

Keywords STEM Education, Minority of Engineering, Virtual Mentoring, Video Communication, Augmented Reality, Immersive Training Game.

Teen Girls and Leadership Biases addresses children beginning to acquire prejudices and stereotypes as early as age 8.

- A research by Harvard Graduate School of Education -

Image
Harvard Graduate School of Education, Leaning Out | Teen Girls and Leadership Biases

INTRODUCTION

1.1 Motivation
1.2 Goals
1.2.1 Problem Areas to Solve
1.2.2 Desired Outcomes
1.3 Target Demographic
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1 INTRODUCTION

1.1 Motivation

Being a woman pursuing a STEM degree in Design and Technology, I realized that there are scores of lamented facts about gender imbalance in terms of occupation rate, leadership culture, and compensation. In July 2017, I participated in a sprint session as a technical volunteer in a developer conference, Pycon, for young coders. It was an annual gathering for the community programming the software open-source, Python. I looked around the room, and I was feeling nervous because there are not many girls. I met one girl who followed her mother, an engineer. The girl told me, “I like computer games and want to be a software engineer as my mother.” Her eyes glowed as she talked, and thankfully she was getting a proper education and incredible motivation from her mother.

However, I realized that most girls don’t have the same opportunity as she did. This story also made me rethink about when I was an undergraduate student majoring in Visual Design. The design industry used to be a boys club at the top, lacking diversity across both gender and race. With a lack of representation among their role models, underrepresented people can be deterred from pursuing creative positions. Thanks to the pioneering activists before us, this has been changing, and many of designers working today are other women, representing female leadership in the design industry. Whenever I observe and experience the gender gaps in the technology industry after pursuing further study in the field in the United States, I am passionate to address this problem for young women as a designer.

This project represents continuously questioning ourselves and making equality a central topic in our lives for the next creative generation.

1.2 Goals

1.2.1 Problem Areas to Solve

The United States will need 1.7 million more engineers and computing professionals in fewer than 10 years. Meanwhile, **only 12%** [1] **of engineers are women, and the number of women in computing has fallen from 35% in 1990 to just 26% today**. Because fewer young women study in STEM, these fields tend to perpetuate inflexible, exclusionary, male-dominated cultures that are not supportive or attractive to women and minorities, leading to the high gender and confidence gaps in some of the fastest-growing and highest-paid jobs of the future. Young women have fewer role models to inspire their interest in these fields, seeing limited examples of female scientists and engineers in books, media, and popular culture. It's hard to overestimate the need for efficient traditional education that help young girls and young women foster a love for engineering and technology. Given the barriers and challenges, it is critical to provide support and useful resources to young women so they pursue a STEM career.

1.2.2 Desired Outcomes

This project is part of a person's efforts to promote gender equality and empower girls and women through a platform with Augmented Reality technology and async video communication with female mentors in the industry. This platform is a mobile application that has recommended daily interactions with playful games and access to insightful mentors for meaningful and professional self-development with respect to diversity and inclusion,aiming to empower young women to pursue a STEM degree in their future.

1. Hill, Catherine & Corbett, Christianne & Rose, Andresse. (2010). Why So Few? Women in Science, Technology, Engineering, and Mathematics. American Association of University Women.

1.3 Target Demographic

The decline of interest in STEM careers is disappointing given the emphasis on promoting STEM to girls. Ensuring STEM professionals serve as role models for girls would help this initiative. Because girls and young women are systematically tracked away from engineering throughout their choice of educational resources, limiting their training and options to go into the engineering field as a student, this project's target users are young women age 13 to 18.

Why focus on girls' and women's education in STEM? Ensuring girls and women have equal access to STEM education and ultimately STEM careers is an imperative from the human rights, scientific, and development perspectives. From a human rights perspective, all people are equal and should have equal opportunities, including to study and work in the field of their choice. From a scientific perspective, the inclusion of women promotes scientific excellence and boosts the quality of STEM outcomes, as diverse perspectives aggregate creativity, reduce potential biases, and promote more robust knowledge and solutions. Women have already demonstrated their abilities in STEM fields, having contributed, for example, to advancements in the prevention of cholera and cancer, expanded understanding of brain development and stem cells, and other discoveries. Maximizing the catalytic role of STEM requires drawing on the widest pool of talent to promote excellence and leaving out women is a loss for all. From a development perspective, gender inequalities in STEM education and employment perpetuate existing gender inequalities in status and income. Gender equality in STEM will ensure that boys and girls, men and women will be able to acquire skills and opportunities to contribute to and benefit equally from the benefits and assets associated with STEM. The gender gap in STEM education participation and achievement has been the subject of extensive research over many decades. While gender differences in science and mathematics achievement appear to have decreased in recent years in many countries, as shown in large-scale cross-national surveys, they have not been eliminated. Moreover, while more women are entering the STEM workforce than ever before, women are still significantly under-represented in STEM occupations in many countries.

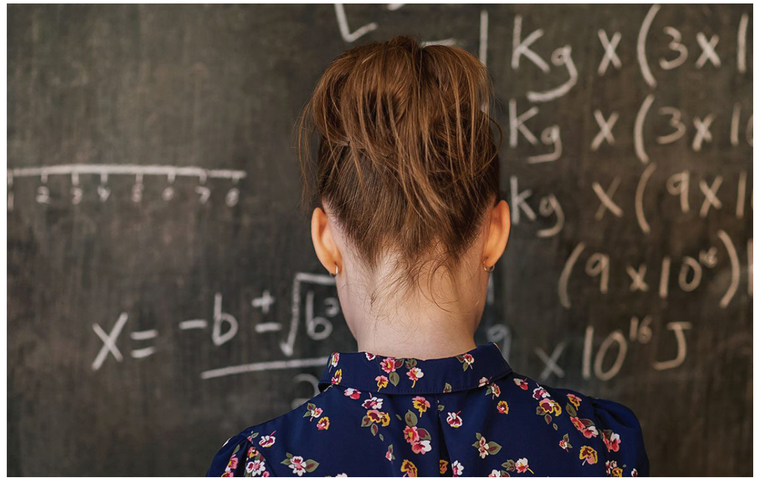


Image
J.Bergen | ISTOCKPHOTO

1.4 Problem Statement

Today, some young women don’t pursue engineering careers. Even though they have interests, they easily lose it due to the lack of role models historically and tend to feel demoralization due to traditional gender stereotypes in choice of subjects at schools or daily interaction with family members and friends.

How might we encourage young women to imagine everything they can become beyond the stereotype of an engineering career?

Image:
Electric Runway | Robotics Engineer Barbie wants to Encourage Girls into STEM

RESEARCH

2.1 Secondary Research
- 2.1.1 Approach and Methodology
- 2.1.2 Existing Results of Study
- 2.1.3 Stats and Numbers

2.2 Primary Research
- 2.2.1 Purpose
- 2.2.2 Research Questionnaires
- 2.2.2 User Interview
- 2.2.3 Findings

2.3 Hypothesis and Assumption Mapping

2.4 Competitor Analysis Matrix

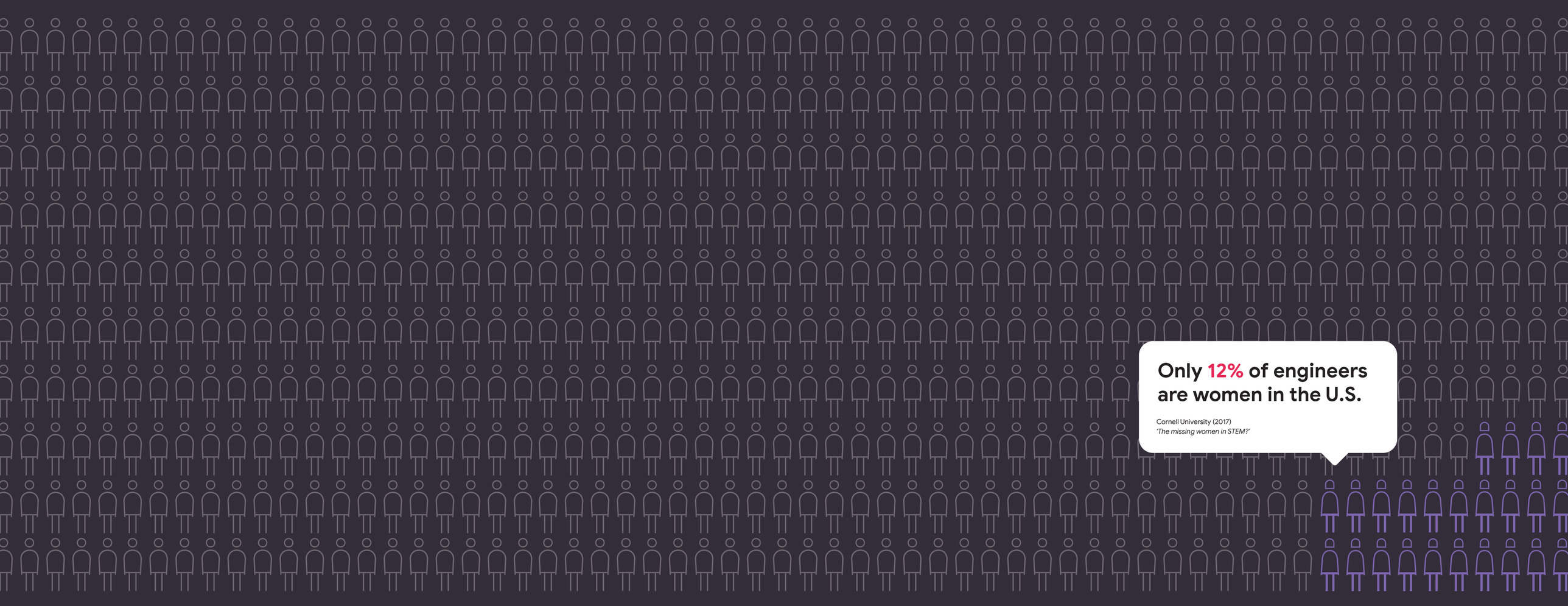
2.5 Value Proposition

2 RESEARCH

2.1 Secondary Research

2.1.1 Approach and Methodology

Secondary research or desk research is a research method that involves previously published data. Existing data is summarized and collated to discover emerging patterns of research. This approach presents the findings of data researched by Minjung Kim among resources and studies online and documentation. I organized online and offline data from internet journal articles, fact books, and thesis essays. I categorized similar documentations, studies, and existing use cases about inclusive solutions for women in technology and engineering.


Only 12% of engineers are women in the U.S.
Cornell University (2017)
'The missing women in STEM?'

2.1.2 Existing Results of Study

Harvard Graduate School of Education social scientists studies Teen Girls and Leadership Biases addresses children beginning to acquire prejudices and stereotypes as early as age 8. (36%) of boys preferred male business leaders; (6%) preferred female leaders.

A 2009 study from **MIT (Massachusetts Institute of Technology)** indicates that young people are interested in STEM at an early age, but begin to lose interest as they become older due to a lack of interaction with mentors and role models in the STEM fields. A way Junior Achievement is addressing this is by bringing STEM professionals into classrooms to deliver the organization's career-readiness programs. Research shows that one-in-five Junior Achievement alumni eventually work in the same field as their JA volunteer.

According to research by **Engineering UK** in 2011, the main reason for the low number of women in engineering is girls' subject choices in school. (Engineering UK, An investigation into why the UK has the lowest proportion of female engineers in the EU, April 2011)

According to a 2019 **OECD** study, the gender gap in STEM studies is already evident among 15-year-olds. Across the 67 countries and economies that participated in PISA 2015, girls outperform boys in science in 19, while boys outperformed girls in 22. In all other countries, the gender differences were not statistically significant. When the authors analysed gender gaps by looking at each student's "relative performance" or "strength" across the three subjects (box), the authors found that girls were stronger in reading in all countries, while boys were stronger in mathematics in all countries, and in science in 65 out of 67 countries/economies. In other words, boys scored higher in science and mathematics compared to their all-subjects average while girls scored higher in reading. These differences could explain why boys are more likely than girls to choose careers in STEM fields, even though the overall performance of girls and boys is similar: students may choose their field of study based on their comparative strengths, rather than on their absolute strengths. Girls may be as good as boys in science, but are, on average, likely to be even better in reading.

According to the **United Nations Educational, Scientific and Cultural Organization** (UNESCO), globally, women are underrepresented in the field of research and experimental development, which includes STEM fields. Women represent, on average, 29% of the world's researchers and 35% of global higher education enrollment in STEM fields

According to a report of **UNESCO**, Cracking the code, Only 17 women have won a Nobel Prize in physics, chemistry or medicine since Marie Curie in 1903, compared to 572 men. Today, only 28% of all of the world's researchers are women. Such huge disparities, such as deep inequality, do not happen by chance. Too many girls are held back by discrimination, biases, social norms and expectations that influence the quality of education they receive and the subjects they study. Girls' under-representation in science, technology, engineering and mathematics (STEM) education is deep-rooted and puts a detrimental brake on progress towards sustainable development.

UNESCO also announced an agenda for STEM education. they recognise that achieving the 2030 Agenda requires the cultivation of transformative, innovative and creative thinking and skills, and competent and empowered citizens.2 For education to achieve its potential, urgent changes are needed. This includes steps to eliminate persistent disparities in education access and achievement, to improve educational quality, and to provide learners with the knowledge, skills, attitudes and behaviours to ensure inclusive and sustainable societies. Science, technology, engineering and mathematics (STEM) education has a vital role to play in this transformation as it underpins the 2030 Agenda (Box 1). Advances in STEM have already brought about improvements in many aspects of life, such as health, agriculture, infrastructure and renewable energy. STEM education is also key for preparing students for the world of work, enabling entry into in-demand STEM careers of tomorrow.

In polling carried out for **Tomorrow's Engineers Week**, more boys (+9%) reported being encouraged to think about engineering as a career, particularly by parents. (Professor John Perkins' Review of Engineering Skills, RAEng November 2013.

2.1.3 Stats and Numbers

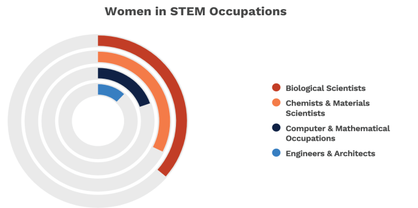


FIG. 1.1 US Bureau of Labor Statistics, "Employed persons by detailed occupation, sex, race, and Hispanic or Latino ethnicity." Labor Force Statistics from the Current Population Survey, Table 11, 2019.

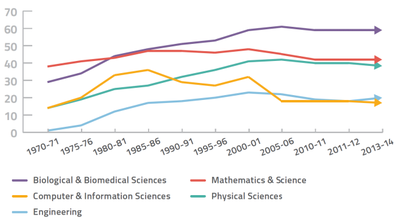


FIG. 1.2 Female Percentage of Select STEM Undergraduate Degree Recipients by NCWIT. Bureau of Labor, 2016.

Figure 1.1 illustrates women's 2019 participation in select computing occupations as tracked by the U.S. Department of Labor (Bureau of Labor, 2019). Women make up only 28% of the workforce in science, technology, engineering and math (STEM), and men vastly outnumber women majoring in most STEM fields in college. The gender gaps are particularly high in some of the fastest-growing and highest-paid jobs of the future, like computer science and engineering. **Only 15.7% of women are engineers and architects.**

Figure 1.2 illustrates Female Percentage of Select STEM Undergraduate Degree Recipients by the U.S. Department of Labor (Bureau of Labor, 2016). The female percentage of **Computer and Information Science figures are constantly decreasing** from 2000..

Women's representation in STEM jobs varies by education

% of employed in each occupational group who are women

	Among those whose highest level of education is ...				
	High school or less	Some college	Bachelor's degree	Master's degree	Professional/ Doctoral degree
All employed	41%	50%	49%	54%	42%
STEM jobs	55	59	47	47	41
Among STEM workers in ___ jobs					
Computer	30	24	24	27	21
Math	57	58	43	46	37
Engineering/architecture	15	11	14	18	14
Life science	45	43	48	55	41
Physical science	33	33	43	44	32
Health-related	81	83	80	80	45

Note: Based on employed adults ages 25 and older. "Some college" includes those with an associate degree and those who attended college but did not obtain a degree. Professional degrees include M.D., D.D.S., D.V.M., LL.B and J.D. Doctoral degrees include Ph.D and Ed.D. STEM stands for science, technology, engineering and math.
Source: Pew Research Center analysis of 2014-2016 American Community Survey (IPUMS).
"Women and Men in STEM Often at Odds Over Workplace Equity"

PEW RESEARCH CENTER

FIG. 1.3 Women's representation in STEM jobs varies by education

Figure 1.3 demonstrates nearly **80% of the health care workforce are women,** but only about 21% of health executives and board members are women, and only about a third of doctors. And, women are more highly represented in lower-paying fields, such as home health workers, nurses and the lower-paying specialties such as pediatricians.

Fewer women than men who majored in computers work in computer jobs

Among college-educated workers, % employed in job related to bachelor's degree field

	Men	Women
Health professions major working in health-related job	61%	69%
Computer major working in computers	53	38
Engineering major working in engineering	30	24
Math major working in math	5	5
Life sciences major working in life sciences	5	5
Physical sciences major working in physical sciences	10	8

Note: Based on employed adults ages 25 and older completing at least a bachelor's degree. Life sciences degree includes those with a degree in an agricultural science major.
Source: Pew Research Center analysis of 2014-2016 American Community Survey.
"Women and Men in STEM Often at Odds Over Workplace Equity"

PEW RESEARCH CENTER

FIG. 1.4 Fewer women than men who majored in computers work in computer jobs by Pre Research Center analysis of 2014-2016 American Community Survey. " Women and Men in Stem Often at Odds Over Workplace Equity."

Figure 1.4 illustrates 38% of women who major in computers work in computer fields, and only 24% of those who majored in engineering work in the engineering field.

There are racial earnings gaps in the STEM workforce for both men and women

Median annual earnings of full-time, year-round workers ages 25 and older employed in a science, technology, engineering or math occupation, in 2016 dollars

	All	% of White	Men	% of White	Women	% of White
White	$71,897		$85,000		$60,828	
Asian	$90,000	125%	$96,311	113%	$81,011	133%
Black	$58,000	81	$66,834	79	$52,718	87
Hispanic	$60,758	85	$70,000	82	$52,000	85

Note: Based on workers with positive earnings.
Source: Pew Research Center analysis of 2014-2016 American Community Survey (IPUMS).
"Women and Men in STEM Often at Odds Over Workplace Equity"

PEW RESEARCH CENTER

FIG. 1.5 There are racial earnings gaps in the STEM workforce for both men and women. " Women and Men in Stem Often at Odds Over Workplace Equity."

Figure 1.5 demonstrates **Men in STEM annual salaries are nearly $15,000 higher per year than women** ($85,000 compared to $60,828). And Latina and Black women in STEM earn around $33,000 less (at an average of around $52,000 a year).

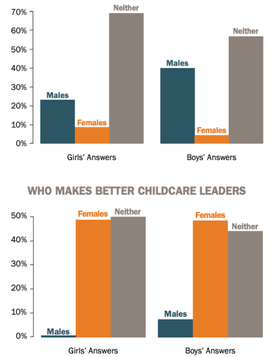


FIG. 1.6 Harvard Graduate School of Education, Leaning Out: Teen Girls and Leadership Biases, 'Who Makes Better Political Leaders'

Figure 1.6 shows both boys and girls expressed bias against girls as leaders in politics. Girls were more likely to view females as better leaders than males in traditionally female professions, such as child care directors, health care directors, and art directors. **Fully 49% of girls saw girls as more capable child care directors** while only three girls reported that males were better child care directors.

85% of teens say they know what kind of job they want after graduation, down slightly from 88% in 2018. While girls' interest in STEM careers like engineering, robotics and computer science declined, their interest in careers in the medical and dental fields increased to 25 percent, up from 19 percent in 2018. Half of all teens (51%) expect to work this summer. However, more than two-thirds of 16- and 17-year-olds (69%) expect to have a summer job. Top summer jobs include retail (26%) and food service (26%). These are followed by outdoor work (17%) and babysitting/child care (14%). Very few (5%) anticipate working in an office over the summer.

According to a British Gas survey, **almost half (48%) of young women do not even consider careers in STEM sectors**, citing a lack of STEM knowledge (30%), a perception that the industries are sexist (13%), and a belief that STEM careers are better suited to the opposite sex (9%). (Research highlights STEM gender gap, The Engineer, 10 August 2015.

A 2015 study, Engineering 2015: The State of Engineering, in 2015, 17% of STEM teachers think that a career in engineering is undesirable for their students. This rises to 19% for the 25-44-year-old STEM teacher group.

According to a study by Engineering UK 2017: The State of Engineering, **only 35% of STEM teachers felt confident in giving engineering career advice**, and this has remained unchanged for a few years.

A 2012 research, It's Different for Girls by Institute of Physics, almost half of all maintained co-ed schools in England (49%) sent no girls on to take A-Level physics in 2011.

The IoP's Closing Doors report in 2013, Closing Doors identifies **schools that do not tackle gender bias in the choice of subjects**, and **"49% of schools actually making the gender imbalance** ... worse".

On the other hand, men and women receive different career advice at school, according to a 2014 City & Guilds survey of 2000 young professionals. **The top 3 career choices recommended to girls are nursing & care, teaching, medical.** For boys, the top 3 are IT, engineering and finance.

2.2 Primary Research

2.2.1 Purpose

The purpose of this primary research is to examine individuals' attitudes and beliefs. Examples include user interviews, observations, and ethnographic research. Interviews were conducted one-on-one or focus group question and answer sessions by Minjung Kim. Interviews provide information from 16 participants and are useful to analyze an expert or knowledgeable opinion on a subject. Observations involve taking organized notes about occurrences of <hello,w>. Observations provide insights about specific female students' or mentors' experiences to learn more about an event without the biased viewpoint of an interviewee. Analysis involves collecting data from user interviews and observations and organizing it in a final prototype based on criteria I develop. They are useful to find some trend or pattern of human behaviors.

2.2.2 Research Questionnaires

Phase 1, Screening

Q 1. How old are you?

Q 2. What is your major?

Q 3. What was your future dream when you were young? Who inspired you and why?

Q 4. What was the most significant barrier while achieving your dream job, (an engineer)?

Q 6. Have you ever given or received advice to others who are engineers?

Q 7. When was the last time you gave some advice to others?

Q 8. Have you ever used products designed to empower women?

Phase 2, Pre-test

Q 1. How do you find career information online?

Q 2. How confident are you with browsing information, and role models or other online career-related tasks?

Q 3. Which device(s) do you usually use for browsing the career information?

Q 4. Have you used any career program/online site for women engineers before?

Q 5. Have you used a similar site before? (If they liked)

Q 6. What would make you decide to pay attention to that (event or product)?

2.2.2 User Interview

User interviews, a type of qualitative research, is primarily exploratory research. They are used to understand underlying reasons, opinions, and motivations. It provides insights into the problem or helps to develop ideas or hypotheses for potential quantitative research. The main participants are teenage girls, boys and young women who are engineers aged between 13 to 34. Ideally, 10 to 20 female students and women engineers participated in the first user interviews on October 19, 2020, and October 27, 2020. These user interview sessions took about 15 to 30 minutes to complete.

Image
By Minjung Kim

Name	Info	Question	Question	Question	Question	Question	Question	Question	Question	Question	Question	Suggestion	Suggestion
		What are girls/boys better at?	**What was your future dream? (When you were young?)**	**How you ever been a leader? < Tell me about your motivation and process**	**Who inspired you and why?**	**What has been the most significant barrier in your dream job?**	**Have you thought about gender bias when you were a teenager?**	**Have you felt any expectations as a daughter or son at home? How do you feel?**	**Have you had any unconscious biases training or test? < What was your bad / good experiences?**	**What are some of the challenges you have to face on a gender basis in your life?**	**Tell me about a time with different gender. < What did you enjoy about it?**	**What advice would you give to the next generation of female / male leaders?**	**How do we change teen's perceptions about gender?**
Tash	M, 12	Men are better at being in charge like my dad.	Doctor	N/A	Talked with my daddy, we got more serious to be a doctor	The pressure that I must succeed as an only son	Others around me, have invested into my upbringing...	A conflict between what I want and the stable life my parents want.	There was A WORKSHOP IN OUR SCHOOL CALLED STEM FOR GIRLS, POETRY FOR BOYS. I was able to reconsider my biases that I didn't realized before	Others around me, have invested into my upbringing... People should not underestimate the ability.	N/A	**"Do not underestimate your capabilities. Just hold your breath and jump into the pool. You will swim."**	Provide equal opportunity for girls and boys to speak
Hiroo	M, 21	I think boys have trouble with emotions.	I was pretty childish, Author > Becoming more active in high school so I wanted to be a CEO >	I was a part a school council. I wanted to be popular honestly. Attracting Funny Speech > **ENCOURAGE BOYS TO VOTE FOR ME SINCE I WAS CLOSE TO GUYS THEN I FELT CONFIDENT**	I saw other student in our school council. He was so popular.	My father always says " for guys, Art and Humanity for women" I don't know where it came from.	I played soccer a lot, but I wondered why girls not joining. When one girl joined our soccer club, then I thought why she joined.	**It'was fair, he's the person who provide the safe environment.** To become a good dad, I thought I had to follow my dad. But when I heard **"BOYS ARE MORE IMPORTANT CAUSE THEY CAN PROTECT YOUDER SISTERS/" I felt it's unfair.** So pressure.	**I KIND OF FORGOT.. BECAUSE THAT WAS BORING.** But there was an international orientation when I was attending undergrad. Orientation leader and 8 people in a group.	It's so unfair about women tech recruiting event. My female friends always said they went there and other boy friend and me just hearing that story.	76 percent of humanities teachers were women, the largest share among subject specialists.	**"Could we create programs and mentor networks that encourage boys and young men to pursue professional careers in the arts or humanities?"**	Media reinforces "Female Movie" So, **HIGHLIGHT SIMILARITIES; NOT DIFFERENCES.** Why not hang signs that say "Children are caring" and "Students are strong"
Yiko	F, 20	Children believe outdated gender stereotypes about men and women from a young age.	Artist, I like to draw	I got an position randomly from teacher.	My mother is sort of Tomboy	T/A portfolio tutoring leadership, Responsibility, they not actually motivated them.	Through pressure from the media and through everyday interaction, I am constantly told I must adhere to a sexist beauty standard. **I DON'T THINK THAT'S FAIR. I WANNA BE MY SELF.**	No expectations I have extremely high expectation by my self **ADULTS TEND TO DON'T T EXPECT THE CAREER CHECK FOR WOMEN LIKE, ARCHITECTURE IS MORE DEMANDING FOR FEMALE.**	Based on our backgrounds, gender role perspective training. **TEACHER KEEP ON SAYING GENDER IS NOT A BINARY THING WITH PROVEN DATA.**	You know how design school has more female. Meaning, you need to achive to higher expectation to get into design school.	If you are saying some team or group-based projects/activities, yes. I always have opportunities to work with diverse groups in undergrad school and I'm pretty enjoying	**"Test with AR night be cool. But sounds difficult on this stage. Show their potential bias to be embed their life with what do they really care about.".**	**BE YOURSELF MOTIVATION** My choices about my body, as a woman and as a human being, should be the concern of nobody else but me.
Jenny	F, 23	Girls lack confidence. Boys overestimate themselves.	In middle school, pianist, musician, animator	6grade, each class need to represent my class. We had to come up the promise list. When you got elected.	**MIXED-GENDER CAMPAIGN AND SOCIAL MEDIA? I FOLLOWED SOME PROFESSIONS** on Twitter and FB. Also reading posts	Financial support	I was in the class that 38 girls and 7 guys, sometimes music teacher assigned some specific instruments for girls even thought there was a girl who is good at playing a drum.	I always more ambitiuous than my older brother, so don't underestimate your career.	I don't remember at all.	Mostly girls want to be a producers than any other tech roles in film industry.	With classmates, I have watched a barbie commercial which is called imagine the possibilities. **IT CONTINUES TO INSPIRE AND ENCOURAGE THE NEXT GENERATION OF GIRLS THAT THEY CAN BE ANYTHING.**	**Parents can navigate how best to promote a healthy self-image and to not unwittingly perpetuate gender biases.**	The experiment targeted seven year-olds for good reason: while they have tangible beliefs, their beliefs are still "moldable."
David	M, 16	I heard that one of boys said "Boys are stronger and have more jobs."	Singer	Bcoks, songs, television, and the mevies	N/A	Television emphasizes male characters' strength, performance, and skill like a super man, but I don't like it	Yes, I'm tired of being told I'm too skinny for a guy. I have always been naturally slim People just said 'eat more', 'go to the gym' etc...I don't understand it.	Each day is a struggle to eat a reasonable amount, let alone that little bit more. My parents said you need to eat more to be strong as a man. That was a mental illness	We have a class about discussion job payment based on gender. I think it is really important that this is something that is brought up and talked about in class.	Think Leader, Think Male	Team activities in my class. Girls are sometimes more active then boys.	I think gender gap is persistent and pervasive but solvable.	**MAKE KIDS SEE THEY'RE EQUALLY STRONG.**
Ming Au	F, 17	Being pretty and wearing dresses?	Scientist, Doctor	N/A	Sisters, **FEMALE MENTORS WHO ARE ALREADY WORKING IN STEM INDUSTRY**	We still have a way to go before we can finally celebrate equality.	When my father's friends ask me about what I plan to do after university, **THEIR SURPRISE AT MY PLANS AND ASPIRATIONS IS GENUINELY QUITE OFFENSIVE.**	**IT'S ALMOST AS IF RELATIONSHIPS AND MARRIAGE ARE STILL WHAT WOMEN SHOULD 'FOCUS' ON. SO I FELT UNCOMFORTABLE CAUSE I WAS JUST 15.**	Oh, I attended once at a career exploration to meet inspiring female leaders in a wide range of fields. But I don't keep in touch with anyone after that program.	Underestimate, Lack of confidence among girl friends in school	Hackathon workshop was a mostly positive experience this summer. The hackathon was truly about building teamwork. And I saw one impressed young girl who is good at coding	**This is hard to overcome because it is often automatic and implicit.**	Opportunities span a multitude of interests, many representing increasing efforts to engage girls in fields in which women continue to be underrepresented (e.g. STEM, public office).
Shanon	F, 13		Programming teaches me a very distinct way of thinking.	I think there's a stereotype. It's understated and people don't want to say it out loud, but it's there — the idea that women are just not very good at computer science — and some use that to justify why our numbers are so low.	My mother said one day, "The point is not that women make better politicians or business leaders. They're equal." I remember that	Most females on prime time television are young, attractive, thin	I am strong, I am opinionated, and sometimes so when people associated me as an anger person, I said I will not conform to your stereotypes.	I tired of my feelings being regarded as simply a consequence of my race.	There's so few of us, so we definitely stick together. It's flabbergasting.	Man as doctor, woman as nurse	I know there's an organization for young girls in NYC. You need to check that. My older sister went there and she met some other girls and more older girls then her	I feel like in the △SA, it's more liberal for the gender role.	

FIG. 1.7 Organizing User Interview for Primary Research by Minjung Kim

Quotes from participants

"There's so few of us, so we definitely stick together," a young female student said. "I think there's a stereotype. It's understated and people don't want to say it out loud, but it's there — the idea that women are just not very good at computer science — and some use that to justify why our numbers are so low. It's flabbergasting." "Programming teaches me a very distinct way of thinking," she said.

"Computer science has been a male-dominated field. It still bothers me that as a woman I have to overcome prejudice and the sexualized view of women in order to be taken completely seriously."

"I think it was because of the intimidation factor," she said. "Computer science has been a male-dominated field." "It still bothers me that as a woman I have to overcome prejudice and the sexualized view of women in order to be taken completely seriously," she said. "On the other hand, this comment has pushed me to work harder and have my effort and my work stand out and be what I'm known for.

"I saw other students in our school council. He was so popular. I was pretty childish and becoming more active in high school, so I wanted to be a CEO, and then I was a part of a school council. I wanted to be popular, honestly. To attract a funny speech, I encouraged boys to vote for me since I was close to guys, then I felt confident."

"From my own experience, girls lack confidence. Boys overestimate themselves. Also, sometimes music teachers assigned some specific instruments for girls even though there was a girl who is good at playing the drum."

"Adults tend to don't expect the career check for women like, architecture is more demanding for females. Based on our backgrounds, gender role perspective training. Teachers keep on saying gender is not a binary thing with proven data. You know how design schools have more females. Meaning, you need to achieve the higher expectations to get into design school."

"Men are better at being in charge, like my dad. Whenever I talked with my daddy, we got more serious about being a doctor. The pressure that I must succeed as an only son of others around me has invested in my upbringing."

"A conflict between what I want and the stable life my parents want. There was a workshop in our school called stem for girls, poetry for boys. I was able to reconsider the biases that I didn't realize before."

"People should not underestimate their abilities. Do not underestimate your capabilities. Just hold your breath and jump into the pool. You will swim."

"Providing equal opportunity for girls and boys to speak is important at school."

"My father always says, "Business for guys, art and humanity for women" I don't know where it came from."

"I played soccer a lot, but I wondered why girls weren't joining. But honestly, when one girl joined our soccer club, then I thought about why she joined."

"I am always more ambitious than my older brother, so I would say you don't underestimate your career, girls."

"I kind of forgot the education session that I had two years ago about gender equality. Because that was boring. But there was an international orientation when I was attending undergrad."

"Orientation leader and 8 people in a group. It's so unfair about women tech recruiting events. My female friends always said they went there and other boys and I just heard that story.

"Could we create programs and mentor networks that encourage boys and young men to pursue professional careers in the arts or humanities?"

"I think children or preteens believe outdated gender stereotypes about men and women from a young age."

"I wanted to be an artist, I like to draw, and I got a position randomly from a teacher. My mother is sort of a tomboy, so she put me into many workshops for awareness."

"My choices about my body, career as a woman, and as a human being, should be the concern of nobody else but me.

"I always have opportunities to work with diverse (Mixed) groups in undergrad school, and It was pretty enjoying those activities."

"Media did not actually motivate them. Through pressure from the media and through everyday interaction, I am constantly told I must adhere to a sexist beauty standard."

"Media did not actually motivate young girls I think. Through pressure from the media and through everyday interaction, I am constantly told I must adhere to a sexist beauty standard."

2.2.3 Findings

1

Lack of Confidence

According to A. N. Pell, the pipeline has several major leaks spanning the time from elementary school to retirement. One of the most important periods is adolescence. One of the factors behind girls' lack of confidence might be unqualified or ineffective teachers. Studies have also shown that student-teacher interactions affect girls' engagement with STEM.

2

Lack of Interest

In a 3-year interview study, Seymour and Hewitt (1997) found that perceptions that non-STEM academic majors offered better education options and better matched their interests were the most common (46%) reason provided by female students for switching majors from STEM areas to non-STEM areas. Additionally, 38% of female students who remained in STEM majors expressed concerns that there were other academic areas that might be a better fit for their interests.

3

Lack of Role Model

STEM fields are often viewed as masculine, and teachers and parents often underestimate girls' math abilities starting as early as preschool. In engineering and science education, women made up almost 50 percent of non-tenure track lecturer and instructor jobs, but only 10 percent of tenured or tenure-track professors in 1996. In addition, the number of female department chairs in medical schools did not change from 1976 to 1996.

4

Gender Stereotype Threat

Study showed that even girls tended not to support giving power to other girls due to the stereotype. This fear creates additional stress, consuming valuable cognitive resources and lowering task performance in the threatened domain. Stereotype threat undermines the academic performance of women and girls in STEM subjects, which leads to an underestimation of abilities in these subjects by standard measures of academic achievement.

2.3 Assumption Mapping and Hypothesis

Assumption Mapping

Figure 1.8 illustrates an assumption analysis of a platform for young women who are interested in engineering career paths. To inform better products by understanding the assumptions being made about the desirability, feasibility, and viability of a new idea. These assumptions are then plotted based on Known vs. Unknown and Important vs. Unimportant. Those assumptions in the red background with a blue dot (unknown + important) should be evaluated further using value proposition testing. In the sky-blue background and a blue dot (known + important) should be evaluated against your current roadmap and backlog. In the sky blue background (unknown + unimportant), assumptions should lead to generating more information through user interviews or other testing methods.

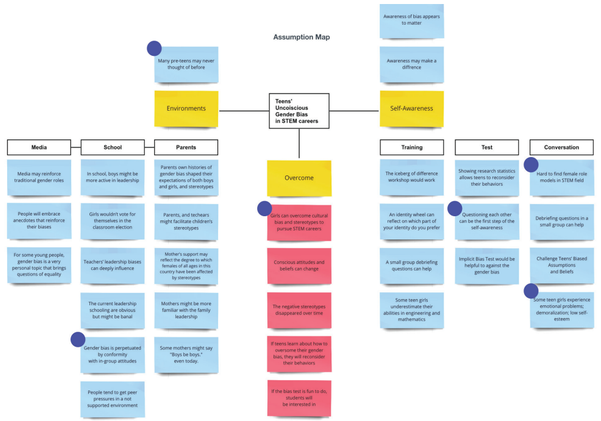


FIG. 1.8 Assumption Mapping by Minjung Kim

Hypothesis

If teenage girls explore more inspirations with playful games and role models in engineering, they will overcome their stereotyping, and better define their STEM career

2.4 Competitor Analysis Matrix

A competitive matrix or Feature Comparison Matrix is an industry analysis tool that compares the characteristics of multiple brands within the market segment to identify their differences, strengths, and weaknesses. This information helps you uncover competitive advantages and identify opportunities to grow your business. A competitive matrix can be as simple as a chart that lists each competitor along with a list of their features and benefits. This competitive matrix chart is powerful because it helps you get a clear picture of where you stand compared to competitors in your industry. A Feature Comparison Matrix is a helpful tool for comparing each competing product's capabilities.

Competitors

The Whole History Location-based AR to show augmented female statues alongside existing male figures. Users can share their learnings with friends and family.

Lioness: Using tech to empower female talent in the advertising industry which is still largely a male-dominated space despite efforts to level the playing field from organizations such as The 3% Movement.

HerStory Open the app and scan an image of a male historical figure in A History of US, Book. The app unlocks a story of an important female historical figure from that same period.

Notable Woman An augmented reality experiment that lets anyone see 100 historic American women where they've historically been left out.

Reentry Melissa Teng presented her work on the participatory design process of an in-prison virtual reality-based curriculum for women preparing for reentry back into the community.

STEMRole A role model-based social network where students and aspiring young professionals discover top careers that match that interest and get inspiration.

STEMforHer A non-profit foundation promotes education to create awareness and opportunities among girls and young women to pursue successful STEM-related careers.

GirlsWhoCode An organization which is building the largest pipeline of future female engineers in the United States.

Competitors	Accessibility on mobile	Useful resources	Functionality (Ease of Use)	Educational Training (Quiz type)	Cultivating Empathy	Face to Face Mentoring Aspects	Targeting Young Females	Retention Usage (Not for just one time event)	Affordability
hello,w	✔	✔	✔	✔	✔	✔	✔	✔	✔
The Whole History (AR)	✔	✔	✔		✔			✔	✔
Lioness (AR App)	✔	✔	✔	✔	✔				✔
HerStory (AR App)	✔	✔			✔		✔	✔	✔
Notable Women (AR App)	✔	✔	✔		✔				✔
Reentry (VR) from prison		✔		✔	✔				(VR Device)
STEMRole (App)	✔		✔			✔			✔
STEM for her (Org)		✔		✔	✔	✔	✔		(Membership)
GirlsWhoCode (Org)		✔			✔	✔	✔	✔	✔

FIG. 1.9 Competitor Analysis, Feature Comparison Matrix by Minjung Kim

Figure 1.9 compares the availability of different features of various products of a similar kind topic. <hello,w> uses AR technology to provide young women useful resources from the professional industry, educational training through enjoyable games and face to face mentoring aspects via video communication targeting young women. It is easy to follow and use on mobile devices which are related to the user's daily life and helps young girls to access the information they need and have more solid confidence. Considering a retention usage for the product business is beneficial for both student users and mentors to build a safe community. Last but not least, VR(Virtual Reality) devices are too expensive for most people nowadays. A high-end VR computer can easily cost around $1,000. Therefore, mobile AR with the main idea of <hello,w> will be much affordable than the current offers in the market.

Being the only girl in computer engineering and math classes is slightly mind-blowing but we are studying multiple STEM subjects at our UIC classes and we hope more girls will be joining us.

Image
UIC | UIC students introduce engineering to girls

2.5 Value Proposition

How might we make young women imagine everything they can become beyond the stereotype of an engineering career? Again, how might we give young women the resources they need to pursue engineering careers?

It's hard to overestimate the need for programs that help girls foster a love for science and technology. Given the barriers and challenges, it is critical to provide support to girls in the steps they need to reach a STEM career.

Solution

<hello,w> is a platform with AR games, resources, and mentors encourages young women to pursue engineering career paths. Users can play engineering-related games and connect with real mentors to get inspired, enhance a supportive mindset, and better define their career paths.

Concept and Key Benefits

<hello,w> brings the various types of AR games in a range of engineering parts, and real voices of talented female engineers right in front of young girls to help them enhance the supportive mindset, increase self-confidence, and better define their career paths and options.

Key differentiators

<hello, w> is thrilled to provide you a glimpse into the future through the AR game series and video conversational mentoring system virtually which will highlight young girls' possibilities and access to the role models from the real industry all across the United States. Unlike, being in school, or going to conferences, <hello, w> helps young women get access to gain helpful knowledge about being a confident engineer based on their curiosity and advice from role models anytime anywhere.

The market Opportunity

Re: Business aspects in other fields where need more women's leadership such as in design, bank, film, government, and etc. Needless to say, yet tech companies have experts in finance, marketing, sales — not just programming. And women account for nearly 40% of all MBA graduates. Moreover, many financial services companies hire equal numbers of men and women at the entry-level. Among MBA graduates, fewer women than men choose to go into tech-intensive fields. And when women with MBAs do opt-in, they tend to start out in lower-paying, lower-level positions than their male counterparts do. They also are significantly more likely to leave. At the same time, data cited in the report shows that, in Europe, only 1 in 5 films is directed by a woman and only 16% of the funding goes to films directed by women. The film industry is arguably the most high profile of all the creative industries, with considerable cultural, social as well as economic weight. The film industry is also a powerful medium that in many ways both reflects and shapes society and culture. Diversity and gender-parity are, thus, crucial to the re-business process if <hello,w> is to reflect the experiences and perspectives of various groups in society.

DESIGNING A PLATFORM

3.1 Idea Variation I, II, III
- 3.1.1 I - Inclusion Accelerator
- 3.1.2 II - Bias-Free Browsing
- 3.1.3 III - Self-reflection Game

3.2 Hypothesis Prototype Proposal I, II
- 3.2.1 I - Augmented Reality Mini Game
- 3.2.2 II - Video Communication Mentoring

3.3 User Journey
- 3.3.1 5E's Experience Mapping
- 3.3.2 Intersectional Content Strategy

3.4 Proof of Concept

3.5 Proof of Value

3.6 Wireframe

3.7 Prototype I, II
- 3.7.1 Prototype I
- 3.7.2 Prototype II

3 DESIGNING A PLATFORM

3.1 Idea Variation I, II, III

3.1.1 I - Inclusion Accelerator

How might we broaden inclusion in the workplace for the next generation? Problem Although American culture has progressed considerably in terms of civil rights. However, discrimination in the workplace based on gender, race, and other factors serve to maintain the status quo. Is one such factor inclusive culture? If so, how does it relate to the inequalities? Possible Solution I, **Inclusion Accelerator** makes employees feel connected, valued, included. Connecting people in the same group. This idea could measure workplace inclusion through a diagnostic tool, card exercise, and HR tool to evaluate and monitor how teams are experiencing inclusion. This tool could take an in-depth look at whether employees feel authentic, trusted, and psychologically safe at work.

3.1.2 II - Bias-Free Browsing

How might we cultivate the bias-free culture at work? Gender stereotypes give rise to biased judgments and decisions, impeding women's advancement. In some of the performance formats, there are prescriptive gender stereotypes that can promote gender bias by creating normative standards for behavior that induce disapproval penalties. Possible Solution II, **Bias-Free Browsing** This idea could be developed as a review system or search engine product in the workplace. It could be leveraging awareness of gender equality to suggest a proper word, tone, and voice of your review for a female coworker. To be specific, when you type, search, or tap something for other peers, this product tweaks our human "biased" results, further eliminating the problem somehow in an accurate way.

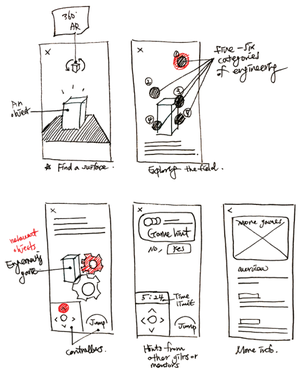
3.1.3 III - Self-reflection Game

How might we help young girls to recognize and push back against their own biases? The problem from the point of view and a perspective on non-sexist education, both stereotypes and gender biases that are often in our culture and we can easily observe in some playful media such magazines and games. Possible Solution III, **Self-reflection Games** continuously could encourage teen girls to be aware of the biases that they have. Eventually, they can combat their own unconscious biases with excellent educational games levels. On the other hand, I firmly believe that the vehicle of awareness is still schooling. However, I also still think that nowadays, creators who make games or media channels should be careful in spreading stereotypical content with specific messages.

3.2 Hypothesis Prototype Proposal I, II

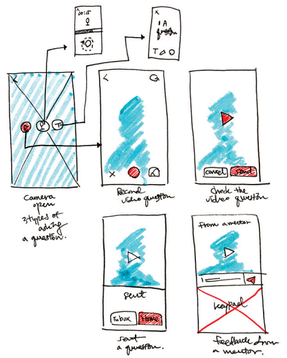
3.2.1 I - Augmented Reality Game for Training

Experiencing an immersive part of Augmented Reality is connecting students' curiosity in engineering. AR games are one of the benefits for the student to see into the other dimensions that surround them. A couple of mini AR games supposes on <hello,w> to be an educational part and icebreaking part anytime the user wants to explore more about engineering fields. Based on AR quiz results, the system will match the data, and show the mentor list with similar aptitudes and majors to the students so that the students can explore more with objects/questions. Why is it beneficial for students? AR technology on mobile is useful not only for participative learning with distanced instruction with virtual elements but for the affordability. Since the effort for implementing the technology requires technical expertise, as well as financial costs. As of the moment, it is only available to large or financially capable organizations. Furthermore, it does not need any expensive additional devices.



3.2.2 II - Video Communication Mentoring

Research shows that nowadays, the video-friendly platform will work for teenagers. Teens are incredibly super-familiar with video communication than we think, the medium itself, and it makes them feel closer. It is about interacting with mentors with video questions and answers. Why is it beneficial for students? Answering and asking experiences through a video platform can access young women to reach out to the mentors with their achievements. According to research, it is challenging to find tech-related conferences to network in some "Rust Belt" where there are not many tech people in the United States. Through video communication, young women can have more opportunities to have a person to person communication through an async video platform. Why is it essential for mentors? The number of mentors is significantly less than that of mentors, allowing various mentors to answer questions simultaneously and multiple times, regardless of time and place. Thinking responsibly about the messaging we are creating for young women is essential regardless of location.



3.3 User Journey

3.3.1 5E's Experience Mapping

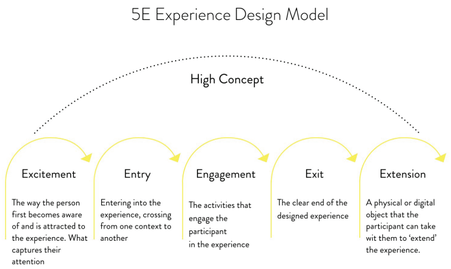


FIG. 2.1 5E Experience Design Model

FIG. 2.1 An Ideation Session for 5 E's Experience Mapping by Minjung Kim

Figure 2.1 illustrates the 5E model was first invented by Larry Keeley in 1994, the Kaospilot has since evolved the model based upon extensive use. 5Es framework reveals the step-by-step process of the entire experience of a persona. and uncover opportunities for improvement. To be specific, the 5E model is one of design methods that can be used to design meaningful services, events, or learning experiences. It will help product designers communicate the user experience design concept. It is simply a framework for building meaningful experiences. As complexity increases in society, and the line between digital and analogue experiences blurs, and think about designing experiences more holistically.

3.3.2 Intersectional Content Strategy

How do we confront the realities of what we create and consider the consequences in an approachable manner? How do we move beyond empathy and create a culture of accountability and fair representation? Intersectionality is a theoretical framework for understanding how aspects of one's social and political identities (gender, race, class, sexuality, ability, etc.) might combine to create unique modes of discrimination.

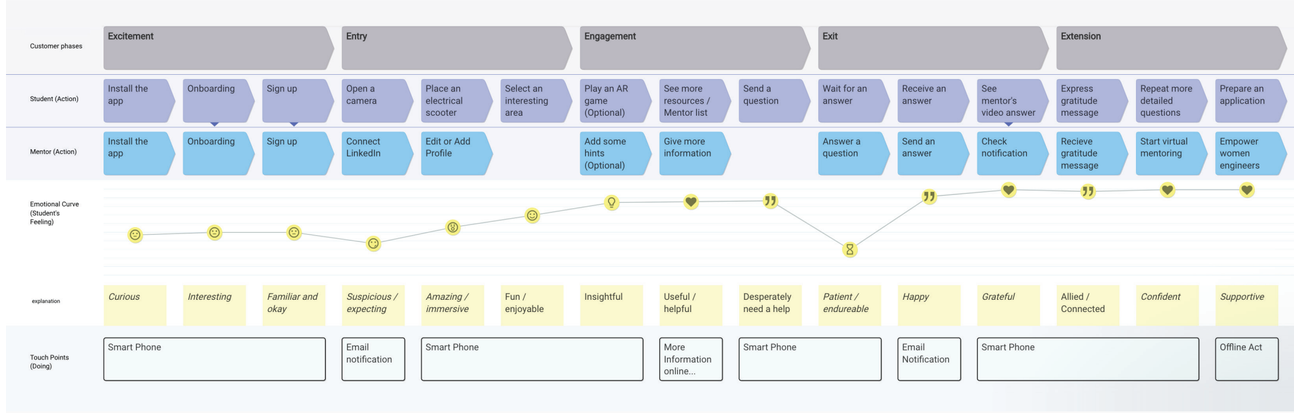


FIG. 2.1 5E Experience Design Model for User Journey of <hello,w>

Excitement

Student
→ Install the app. → Onboarding → Sign up

Mentor
→ Install the app. → Onboarding → Sign up

Entry

Student
→ Place an object on the floor.
→ Select an interesting area in engineering

Mentor
→ Connect LinkedIn profile (Optional) → (If they connected it, may want to) edit certain parts directly

Engagement

Student
→ Play AR games (Optional) → Try more levels (Optional) → See the job outline →
Find a mentor → Send a question

Mentor
→ Add game hints (Optional)
→ Suggest more information about the outline

Exit

Student
→ Wait for an answer → Receive an answer from a mentor → See the async video answer

Mentor
→ Check a question from a student → Take a video answer
→ Send an answer → Check a notification for delivering

Extension

Student
→ Express gratitude by texting → Ask another question (Optional)
→ Prepare an application for a STEM degree

Mentor
→ Recieve gratitude message →
Start virtual mentoring actively
→ More empower young women

3.4 Proof of Concept

Proof of Concept (PoC) is an implementation process to prove a solution works qualitatively. In terms of software, for designing a new product, this principle can apply that concept to give the green signal, the transition can be made to develop a prototype followed by an MVP (Minimum viable product), which further leads to the development of a full-fledged distinctive app. However, PoC by itself may not be enough to determine if a new solution is valuable. So, that is why there is the following method which is called Proof of Value.

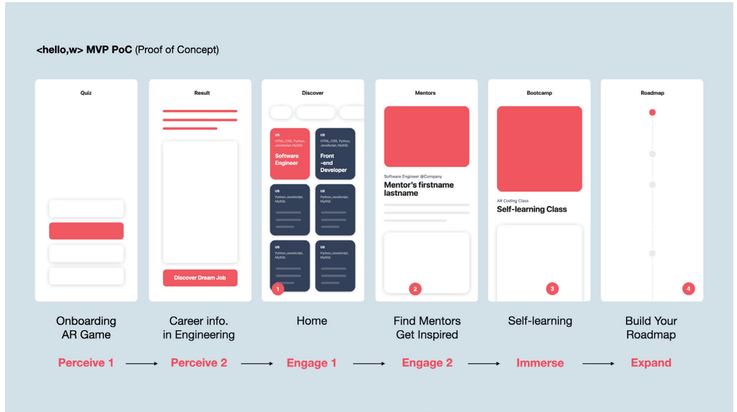


FIG. 2.3 Proof of Concept for AR game and virtual mentoring solution by Minjung Kim

Figure 2.3 illustrates the MVP concept of <hello,w> with the critical screens on mobile environments. To clarify the hypothesis, the concept of the first feature navigates the way to find young women's interests like "What kind of engineer should you be?" by using augmented reality technology on mobile. The second feature is about motivating young women by providing a mentor's journey and professional advice from their successes and experiences. Therefore, teenage girls and young women can get inspired through virtual communication with mentors in the engineering field and can structure their future career roadmap anytime and anywhere.

3.5 Proof of Value

Unlike PoC, Proof of Value (PoV) takes a deeper dive into what that solution means for the project. Using a detailed business use case which is quantifiable explores why the project should adopt the PoC solution. PoV can help you better understand the anticipated value the solution will bring to business.

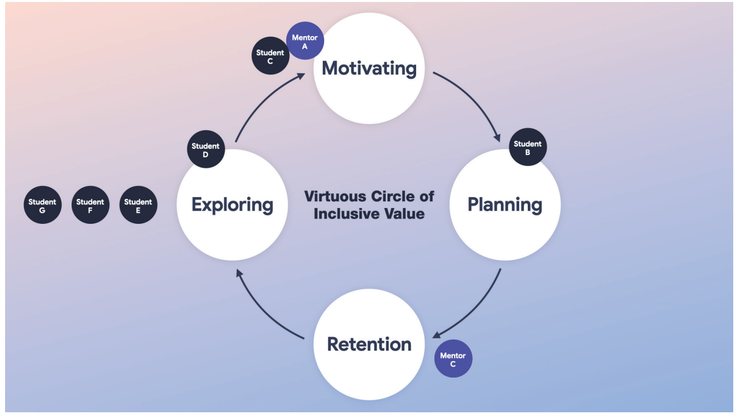


FIG. 2.4 Proof of Value Process for young women and female mentors by Minjung Kim

Figure 2.4 demonstrates the virtuous circle of inclusion which represents the value of <hello,w>. Thinking about 'What if' scenarios, a 'student A' will discover information in this product, and her 'mentor A' who can give motivations from their personal and professional tips. The 'student A' will be planning her own roadmap, at the same time another new 'student B' enters on the platform. Once the 'student A 'completes her own achievements, It allows the 'student A' to be a mentor. Moreover, this virtuous circle leads to retention of the product. Eventually, students can be mentors through their whole journey on <hello,w>.

3.6 Wireframe

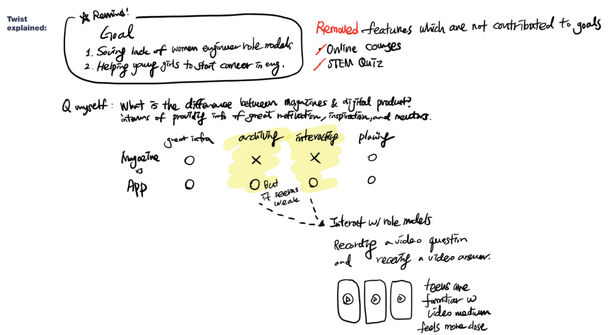
Wireframes keep the concept user-focused and effectively facilitates feedback from the users, instigates conversations with the stakeholders, and generates ideas between the designers. Conducting user testing during the early wireframing stage allows the designer to gain honest feedback and identify key pain points that help to establish and develop the product concept. Seeing the features on a wireframe will also allow UI and Product Designers to visualize how they all work together and even prompt UX Designers to decide to remove a few of the items not quite working with the rest of the elements on screens. Mid-fidelity wireframes feature more accurate representations of the layout. While they still avoid distractions such as exact images or typography, more detail can be assigned to specific components, and features are different from each other. Varying text weights also be used to separate headings and body content.

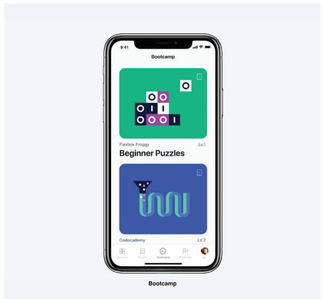
FIG. 2.5 Initial Wireframes for <hello,w> by Minjung Kim

3.7 Prototype I, II

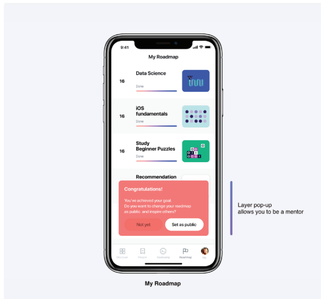
3.7.1 Prototype I

Prototype I click-through depicts the elements on the pages of the main screens of <hello,w> app, as shown in Figure 2.6. It more closely mimics a real user experience than sketches and paper prototypes do. They link various screens through hotspots mainly focused on video interaction with mentors this time. To explain the first tab of the core screens, young girls can explore and play exciting games on the list of engineering-related games. Moreover, check the progress and score of the game on the road map to continue motivation. On the second tab, they can meet a list of mentors, scroll vertically to expand the mentor's profile. Mentor profiles include roles and skills, more role models, and a list of video answers. Video answers can help not only young girls get inspired by mentor's feedback but see other female student's questions and curiosity. This prototype is more advanced versions of low-fidelity prototypes, as well as the simplest versions of interactive prototypes so that it was tested and iterated designs on Prototype II by Minjung Kim.

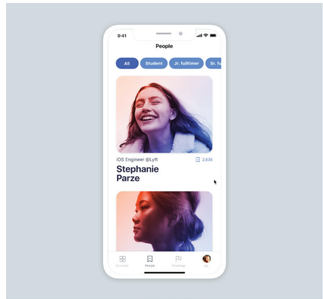




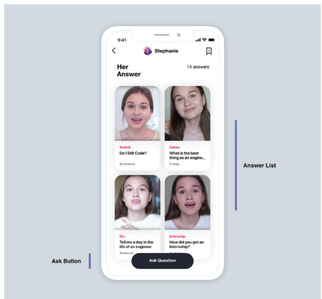
Engineering game list



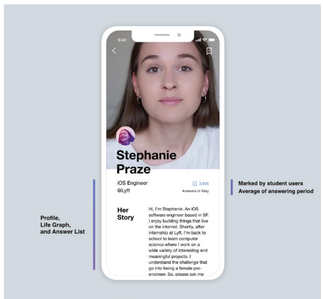
User's roadmap



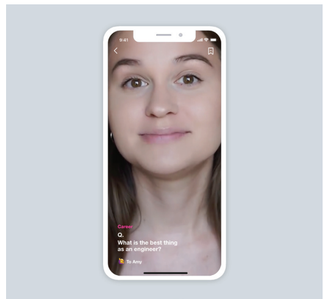
Mentor list



Mentor's video answer list



Mentor profile



Video questions and answer

FIG. 2.6 <hello,w> click-through prototype I by Minjung Kim

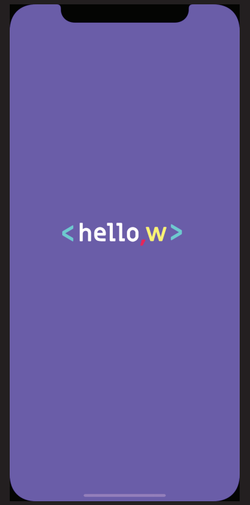
Reimagining gender inclusivity in engineering

<hello,w>

3.7.2 Prototype II

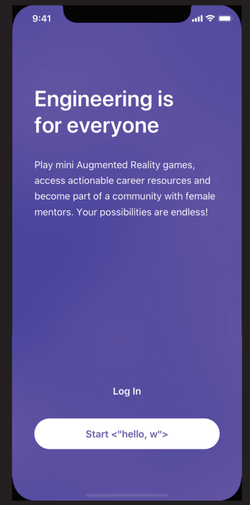
Based on prototype I, considering the whole user journey was needed, and user experience about what happens before discovering mentors and more educational resources to get inspired. The real principal value is still to increase numbers of teenage girls studying engineering in order to foster equality in the STEM field. In the second prototype, focusing on the idea of exploring immersive experiences to access and better understand the field as an optional advantage. Experiencing an immersive part of Augmented Reality is connecting a curiosity. A couple of mini AR games are supposed to be an educational part and icebreaking part to see into the other dimensions that surround them and show the categories in engineering. With similar aptitudes and majors, a student can explore more mentors with questions. While taking a video question, a student can check their question with an AR bubble message to make sure the point of a question.

Interactive prototypes, such as that shown in the right side, are more advanced versions of click-through prototypes created using a prototyping application that supports interactivity. Interactive prototypes are both clickable and responsive, enabling users to interact with them and see animations in response, and it is more aesthetically pleasing than their low-fidelity prototype precursors.



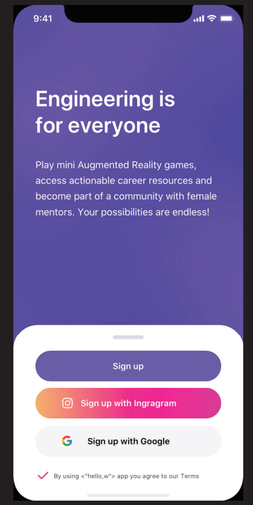
Splash

Install the mobile application.



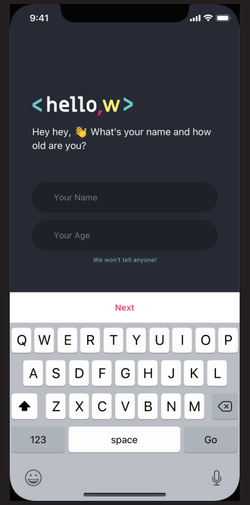
Log in / Sign up

Meet the intro page to explain what <hello,w> offers for young women and start by tapping the bottom button ‘Start <hello,w>’.



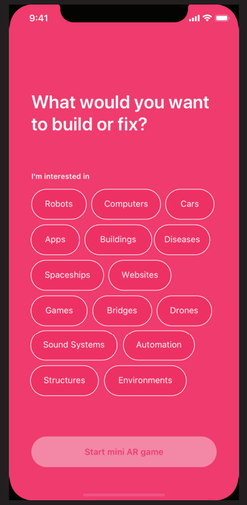
Entry

Connect with social networking channels or sign up to create an account successfully.



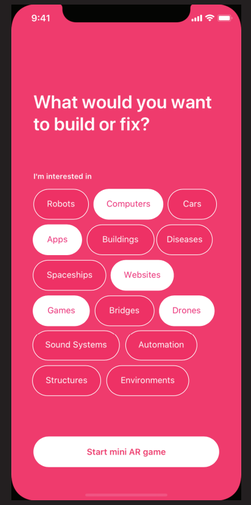
Profile

Enter user name and age.
<hello,w> won't tell anyone.



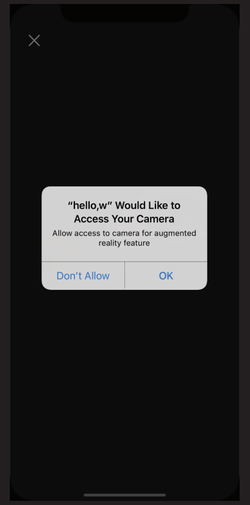
Interests

Young women will be able to pick their interested objects they may want to fix or build.



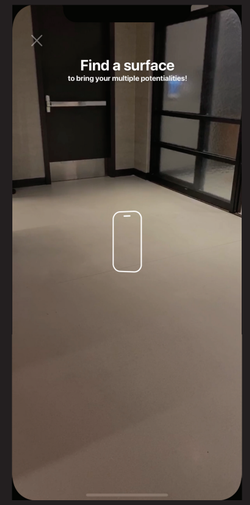
Interests

It allows young women to start an ice-breaking and also educational game with an augmented reality object.



Camera Access

Allow access to camera for augmented reality games.

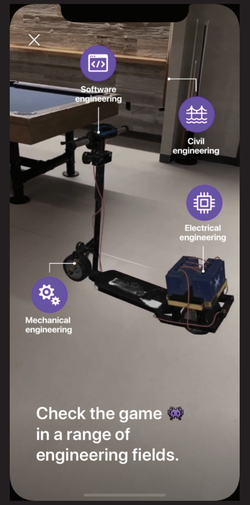


AR intro

Find a surface to bring an object and see how engineering affects everyday objects.

AR experience

AR brings an electronic scooter right in front of young women to explore four major categories in engineering field to give them educational games.

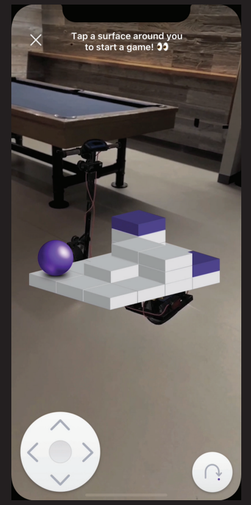


Explore

Take a closer look into an object, allowing for immersive experiences.

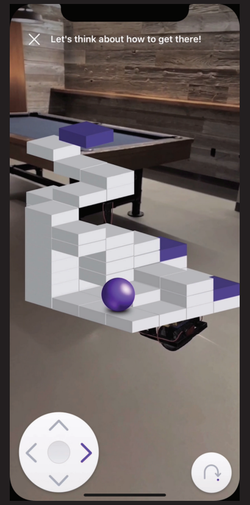
Pick a section

Tap the icon you wanted to know more about. The app gives AR games to teach basic principles of engineering field regarding your choice.



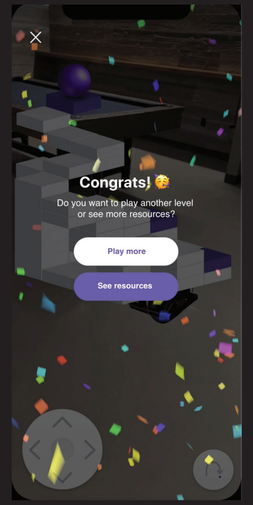
Play a game

For software engineering, this puzzle game make you encounter learning skills like sequencing, overloading, procedures, recursive loops, and conditionals.



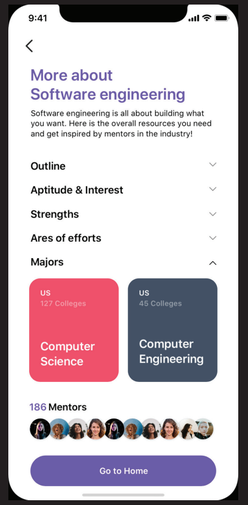
Play a game

After tapping a surface, the white blocks generate automatically to the purple block so that you need to think about how to get there by using your surroundings and the controllers freely.



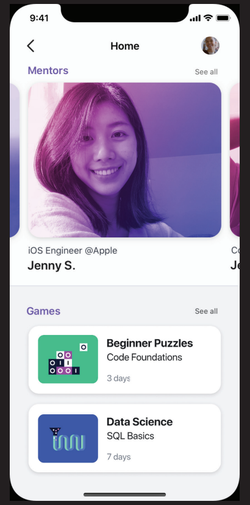
After playing a game

Try the next levels or see further educational resources about the engineering field you selected.



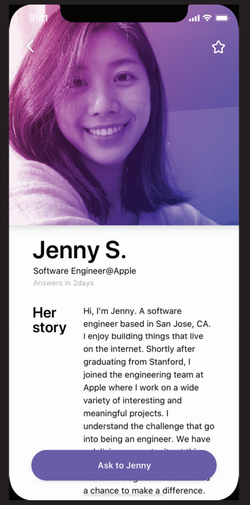
More resources

Access all the different resources into one page.



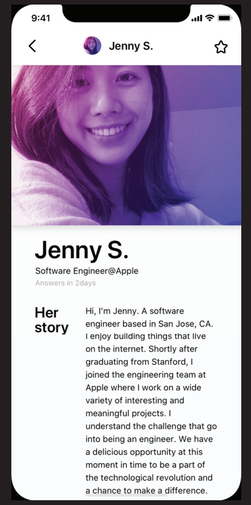
Main

Young women can find more games and mentors in the main page. It will save their time and effort to find mentors online since those mentors are already here to help them.



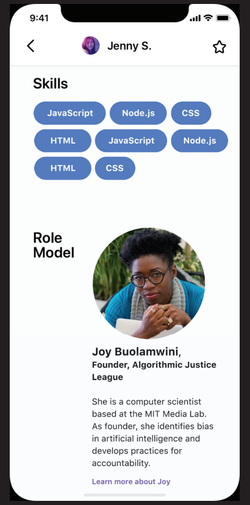
Mentor's profile

Get inspired by others' genuine stories, and ask a question directly to the mentor.



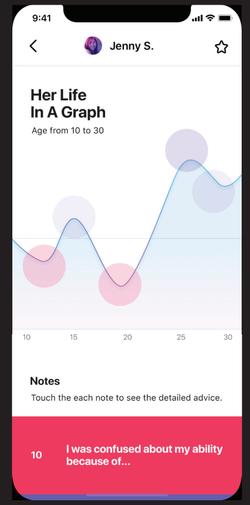
Interaction

When a scroll occurs on the page, the top navigation bar appears and 'Ask' button disappears to focus on the user's interaction with the page.



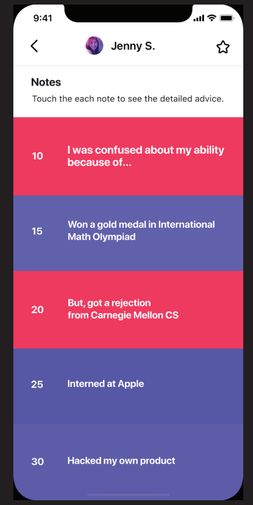
Skills and Role model

View skills, and more role models.



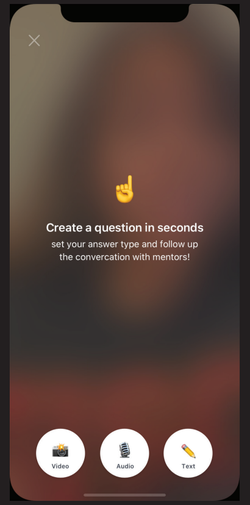
Life graph

Young women can have more opportunities to discover valuable lessons from their successes or tips while pursuing an engineering career.



Life notes

Each note can be expanded by tapping the area to show the detailed memos by mentors.



Question type

If young women want to ask a question to someone personally, they can create a question in seconds by tapping on video, audio or text types whatever they feel comfortable.

Take a video question

Record a question to pursue engineering career path.

Check

Check a question before sending it and hit the send button if you like it.

Send

Wait for the answer about your question from the mentor and go back to the AR games to play more levles or other parts of engineering.

Notification

Follow up on the conversation with the mentor through a notification of the application.

View an answer

Receive an answer from the mentor virtually anytime and anywhere and express your gratitude to the mentor by texting some warm words.

Enjoy learning
Get Inspired
Set your path

with <hello,w>

RESULTS

4.1 Methodology
4.2 Usability Testing
4.3 Factor analysis

3 RESULTS

4.1 Methodology

4.1.1 Purpose

This part presents the findings of a <hello,w> Usability Testing (UT) conducted by Minjung Kim among a sample of 10 15-23-year olds, comprising 2 males and 8 females. This UT was live on Mar 16-30, 2020 to observe individuals' interactions with a hypothetical prototype of <hello,w>. Respondents for this UT are selected from among those who have volunteered to participate in online sharing and testing by interacting with <hello,w> prototype. Because the sample is based on those who initially self-selected for participation, no estimates of sampling error can be calculated. All cases of UT may be subject to multiple personal opinions, including, but not limited to crucial error, or error associated with nonresponse.

4.1.2 Research Questionnaires

Phase 3, Test with a prototype

Q 1. What is the main element of the page that stuck with you?

Q 2. Who do you think the intended audience is?

Q 3. I noticed you did mention about[ ]. Can you tell me why?

Q 4. Which of these two approaches/options do you find best? Why? (This is useful if you're trying to determine the more appealing of multiple options.)

Q 5. Can you tell me what you think of [ ]? (icons, menus, text, layout of the content)

Q 6. How did you find the experience of using the prototype to complete this task?

Phase 4, Post-test

Q 1. What was your overall impression of <hello,w>?

Q 2. What was the best/worst thing about <hello,w>?

Q 3. How would you like to change <hello,w>?

Q 4. How would you compare <hello,w> to competitors? (This is an opportunity to see how different details of my product stack up against competitors like Tiktok or Instagram in the eyes of users.)

4.2 Usability Testing

Gathering feedback from the real users is a crucial part of this new prototype for a mobile platform, especially for the next generation. The way in which UT(Usability Testing) can gather the feedback varies depending on what kind of questions the researcher and observator are trying to answer and act. Qualitative usability testing is widely considered to be one of the most effective user research methods for gathering feedback, due to the great amount of insight this can gather from such a small group of users. This UT method focuses on observing users behaviors and better understanding their decisions by asking a series of follow up questions about a clickable prototype of <hello,w>. For this reason, having an understandable and interactive live digital prototype for them to interact with and representative tasks to complete, is essential.

Based on research, adding a training part that uses AR was decided to bring to enrichment resources on the mobile application for female students who want to pursue engineering careers in the U.S. This UT conducted by Minjung Kim with six participants. Considering the AR aspects as a part of self-training by using their surroundings and sharing opinions and personal challenges with mentors while pursuing engineering careers as a female student were the key observations. The UT data has been analyzed by providing a low-fi clickable live prototype by Minjung Kim.

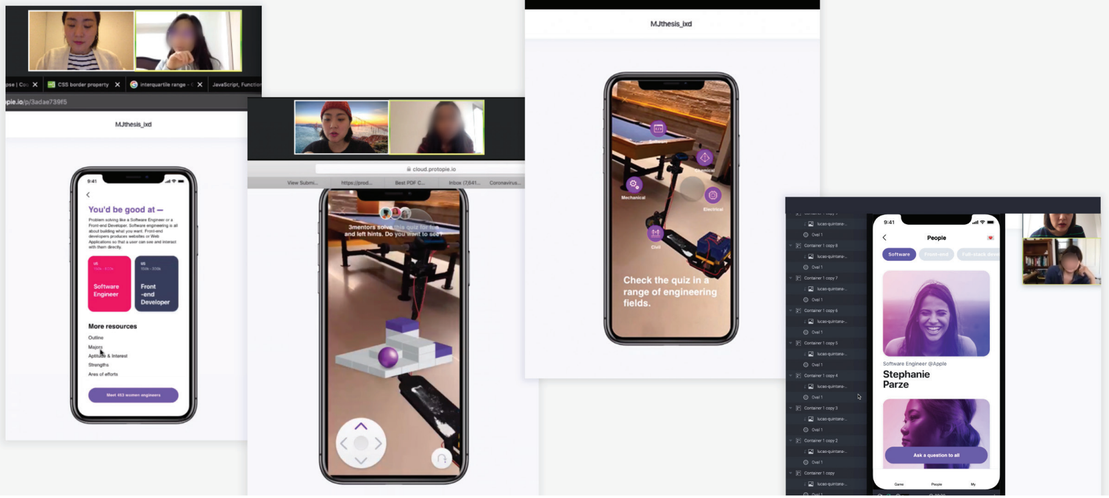


Figure 2.9 illustrates the results of post-test with insights and quotes from the real users who used the first version of <hello,w> prototype. Taking a look at qualitative metrics to understand the reasons behind some issues and discover how to overcome them was the main purpose. Three color codes, blue, yellow, and red represents each cell based on severity. Yellow color illustrates new critical ideas which came from participants for completing a task. Red color means some serious issues which are frustrating for most participants. Blue color identities minor issues which can be irritating but won't drive users away. Overall, people gave positive feedback about the concept of providing basic engineering AR games which tells them what they could have interest in from now on and understood well reaching out to mentors after playing the fundamental games. And setting a time limit would make it fun because it feels like there's a challenge.

Null = Not much											
User #1 / Mar 14, 2020 **Aditri** F, 21, Carnegie Mellon University, Computer Science	"Only 12% engineers are women sounds like discouraging. Maybe the introduction could be like "[Coding is for everyone], more positive"	"I'm not sure about connecting Snapchat account on it"	"I have no troble here actually."	"I would order it aphabetically maybe."	"I might not really sure right now what it's asking."	"The icons and labels make sense." "A little info button would be added o know more about this object."	"It could be Interesting! I'm wondering how the surrounding is incorporated."	"When someone stocks, the hints can be showed maybe after 5mins based on how difficult the quiz."	"Setting a time limit makes it fun because it feels like there's a challenge. But if you run out the time, it shouldn't be GAME OVER. Instead, you can show this hints.	"It looks clickable but I can't click it."	"I like this page's look and feel. It's clean and minimalistic."	"It feels more interactive and it helps you feel more connected." "It's easier because it compiles all the different resources into one app and also mostly focused on female mentors. Because on Instagram or Facebook you will have to search for that community and you don't know they want to get random questions or not."	"The overall experience is quite intuitive and interesting. One thing I would include in games is linking a url that you can **learn about more courses which related to the games**. It helps to teach you the skills. You were introduced to students."
User #2 / Mar 15, 2020 **Yuka** F, 18, High School Student	"I notice the target is women in the US who try to pursue engineering careers."	"I don't have any trouble here, I just would skip Snapchat, because I'm not ture it's common things."	"I can imagine if I enter my name now, it will show some useful resources."	"Not the categories spreaded out, but I can see a sort of group though, so grouping it more maks sense to me."	"It's impressive because I can interact with my virtual environment anywhere."	N/A	"So far, it looks really fun because it's interactive."	"If I wanted to see hints, do I click mentor's profiles? I think you need a button."	"I think limiting time would be fun for the competition but also motivating, too."	"I'm assuming that if I will click the items under More Resources, it will extend and show more details."	"The layout is organized well. And, there are essential informations about them like a title and name. I think it's good to catch info quickly."	"Editing option is great. I would edit my question just by tapping the bubble."	"I love this concept and everything. I have one question though. Let's day I shoot the message to a mentor, is there any like a chatroom **where I go to see my questions and responses**?"
User #3 / Mar 17, 2020 **Lou** F, 19, Georgia Tech, Neurosciences, Second year Student	"I think it's great. It sounds encouraging young women who want to be an engineer."	"If I want to find mentor, I wouldn't say I will use Snapchat."	"It's really clear."	"It's great to see these objects I can see in our daily lives."	"I'm confused how it related to the categories I chose in the previous page."	"I think the background would be my camera, right?"	"Jumping icon is little confusing. I thought it's a going back to previous screen."	"So far, it looks really fun because it's interactive."	"For me, it's fun to have challenges here. So, I would hit the second option, it'll try it again! "	"Mostly colors stands out and the position is centered making me look at them"	"Looks cool. And this flow is verty smoth."	"Is it possible to stop the vedio by tapping? Some people might "	"It seems a good app to encourage women especially in engineering. "
User #4 / Mar 17, 2020 **Jesse** F, 17, High School Student	"Putting a new lens of gender roles sounds cool for me. I wonder what's it exactly though."	"I'm familiar with Snapchat and also Tiktok."	"Oh, W means Whole World, interesting. Maybe it could say just "hello, everyone"?"	"Start AR quiz drags my eyes"	"Oh, it's cool because I can see this scooter in my place"	"I think those bottons stand for each specific engineering."	"So, it means some software engineering. I kind of get it as far as I understand."	"Yes, I want to see the hints if it's little bit hard to solve. Because I couldn't find a button to jump."	N/A	"Maybe the $ sign for the salary make this more understandable." "I'm curious why these colors of cards different."	"Answers in 2days? What is it? Maybe I can ask a question to her? That'd be so great. I'm going to just hit the button now."	"What if I don't want to record the video right now?"	"If I can see some relationship between a mentor and her role model, I can understand how Joy influenced others. **Connect a mentor's profile and her role model somehow.**"
User #5 / Mar 18, 2020 **Stephanie** F, 18, Georgia Tech, Computer Science, First year Student	"Ok,I like this is encouraging people like me."	"Facevook is an option but I'm usually using Google account."	"Cool."	"I think it's straight-forward."	"I can't kind of expect what is the next flow here."	"This game is really fun. If I can move the ball, and use my surroundings, it would be super engaging."	"Oh, no no. I thought the bottom-right button means UNDO."	"I want to try it again without hints because I like a little challenge. But if I really stuck with it, I will see it after few more try."	"I think time limits doesn't matter here, if it's just for ice-breaking part." "I want to see another level of this game."	"I like the part that I can reach out to female engineers. It feels safe."	"I want to see her education information, location and also her recent projects so I can ask something more personal question"	"Even if you scroll down, you can still tap the asking button like sorting them on the top who you want in the previous page lol I like I don't have to go all the ways to the top."	"I would like to see more detailed information about what kind of software engineers out there with some example."
User #6 / Mar 18, 2020 **Sam** M, Mentor	"Very specific and important target. Great"	"Google and Facebook make sense to me."	(Clicked Next right away)	"Understandable objects."	"Quiz or Game? I think Game makes sense."	"But, to be clear, how about five different objects for each engineerings like the interests page?"	"I would recommend a game for Civil engineering : Mini Motorways, the city's traffic problems are in your hands and you can fix it."	"It's great to see a help from real people."	"It's great to see a help from real people."	"Where the analysis came from?"	"Students might want to see her entire timeline visually. You could find Asana Gantt, cells timeline to show a details about each step with emotions."	https://www.videoask.com/product" "I like this idea. Asynchronous video communication makes your audience easy to engage."	"I think you don't really need to build a real AR, just **create convincing game screens to prove it is a hook for connecting interests and remember the actual mentoring and video platform is the key value**.
User #7 / Mar 19, 2020 **YJ** F, High School Student	"Interesting stats and numbers would be more useful here."	N/A	"It looks really good, very eyecatching."	"It looks really good, very eyecatching."	"I'm assuming maybe some character pops up and get on the scooter here?"	"Such a great idea!"	"It's cool when I control the ball."	N/A	"I want to see another level of this game."	"Will you going to write it from scratch or bring any proven aptitude tests?"	"The interface is so elegant, clever, and smart, and makes such a powerful statement."	It would be great to let the user can select the answer types: Video, Audio, Text."	"I felt I'm a bit lost when I know there are two parts, AR game and Video platform. It'd be great if you can combine both well because I think it's truly a new position in market."
User #8 / Mar 18, 2020 **Henry** M High School Student	"I can feel this app has a specific concept with the central goal of empowering and inspiring girls and young women in engineering or tech."	"Amazing. Such a wonderful movement."	"Thinking about the privacy seems a thoughtful copyright."	"Without other devices, but I still think I can enjoy this on my phone all day."	"Can I see other objects?	"It's fresh. What's the next?"	"Some improvements could be done on the AR objects in the app though."	"It would be great to teach important facts simply in a short time."	"I hope this is just the start - there are so many more issues to address and stories to be told and this is a beautiful way to do that."	"I found it easy to use, eye catching, and clever."	"I like how you can search women and click on them to learn info."	"You may want to add tap to edit text of the question somewhere in the bottom."	"I think video question and answer are very nice because it's more personal. Also think that some people may not like record it because of the privacy."
User #9 / Mar 19, 2020 **Jessica** F, 18, NYU Computer Science, First year Student	"More graphic elements would be more friendly."	"Maybe just not Snapchat."	"Looks clear."	"Objects idea is wonderful for teens."	"I think the electric scoter is a good idea."	"I'm assuming if I tap on this, that will be a quiz realted engineering?"	"You are creating a tool that helps young girls imagine women on different points of engineering."	"I might want to try myself for 10mins."	"I might want to see scores"	"So, maybe this result would depend on the five AR games."	"I love all the stories. They are all so cool and great."	"What's really meaningful about this tool is that it gives people the chance to tell their own stories."	"You did really good job. I think you put many values into it. It's pretty valuable." "Also I think its both as interesting for men as it us for women."
User #10 / Mar 24, 2020 **Theo** M, Mentor	"I understand the concept a second."	"My friends and I actually think Facebook is out-dated."	"Making sense."	"It will be great to find daily objects around them."	"What I'm thinking right now is why is this app showing this screen."		"Controller looks great, easy to use within the area near my fingers."	"Love the concept of celebrating female mentors advice."	N/A	"You may want to put more information that helps young girls imagine women on different points of engineering."	"It looks clean, I like the filtering mentors based on their position."	"If this app seeks to make women more visible in engineering, it needs to reconsider how invisibilization happens."	"It seems a good app to encourage women especially in engineering."

FIG. 2.9 User Testing Organizing Chart by Minjung Kim

Quotes from participants

"The overall experience is quite intuitive and interesting. One thing I would include in games is linking a URL that you can learn about more courses related to the games. It helps to teach you the skills. You were introduced to students." "It seems a good app to encourage women especially in engineering." — Aditri F, 21, Carnegie Mellon University Student

"If I can see some relationship between a mentor and her role model, I can understand how Joy influenced others."

"I really love the concept of it and everything, especially how a simple game can tell you what you could be good at. For someone who is still unsure/not confident like me, something like that helps to boost my interest in engineering and motivation to pursue it." — Yuka F, 18, High School Student

"It feels more interactive and it helps you feel more connected." "It's easier because it compiles all the different resources into one app and also mostly focuses on female mentors. Because on Instagram or Facebook you will have to search for that community and you don't know if they want to get random questions or not." — Lou F, 19, Georgia Tech, Neurosciences, Second year Student

"If I can see some relationship between a mentor and her role model, I can understand how Joy influenced others. Connect a mentor's profile and her role model somehow." — Jess F, 17, High School Student

"I would like to see more detailed information about what kind of software engineers out there with some examples." — Jess F, 17, High School Student

"I feel a bit lost when I know there are two parts, AR game and Video platform. It'd be great if you can combine both well because I think it's truly a new position in the market." — Stephanie F, 18, Georgia Tech, Computer Science, First year Student

Critical New Ideas from Users

"Only 12% of engineers are women'' sounds like discouraging. Maybe the introduction could be like "[Coding is for everyone], more positive"

"Not the categories spreaded out, but I can see a sort of group though, so grouping it makes more sense to me."

"Setting a time limit makes it fun because it feels like there's a challenge. But if you run out the time, it shouldn't be GAME OVER. Instead, you can show these hints.

"Oh, W means Whole World, interesting. Maybe it could say just "hello, everyone"?"

"I want to see her education information, location and also her recent projects so I can ask something more personal question"

"But, to be clear, how about five different objects for each engineer like the interests page?"

AR Training Game

"So far, it looks really fun because it's interactive. I'm wondering how the surrounding area is incorporated." — Yuka F, 18, High School Student

"The icons and labels make sense." "A little info button would be added to know more about this object." — Aditri F, 21, Carnegie Mellon University Student

"This game is really fun. If I can move the ball, and use my surroundings, it would be super engaging." — Stephanie F, 18, Georgia Tech, Computer Science, First year Student

Virtual Mentoring

"Editing option'' in my question is what I exactly wanted to do. I would edit my question just by tapping the bubble. You may want to add a "Tap to edit" text somewhere in the bottom." — Yuka F, 18, High School Student

"I have one question though. I shoot the message to a mentor, is there any like a chatroom where I go to see my questions and responses?" — Yuka F, 18, High School Student

"The layout is organized well. And, there is essential information about them like a title and name. I think it's good to catch info quickly." — Aditri F, 21, Carnegie Mellon University Student

Issues

"I'm not sure about connecting my Snapchat account on it."

"I might not really be sure right now what it's asking."

"If I wanted to see hints, do I click mentor's profiles? I think you need a button."

"I'm confused how it related to the categories I chose in the previous page."

"Jumping icon looks a little confusing. I thought it was going back to the previous screen."

4.3 Factor analysis

At the basic levels of augmented reality game produced an introduction of the play guidance in a slightly longer time. However, it did so in a manner that appeared to afford a higher opportunity for the young student to engage in immersive troubleshooting than the game progress. Given the students' desire to discover their interest or want to know the information at all engineering parts of its range, this tradeoff between putting slightly more time into instruction in exchange for a higher chance to develop independent problem-solving skills may be worthwhile. Further testing is needed to measure how robust the learning results are as compared to current school and organization methods. The technology generally functioned well both for young female students with little science and math experience and for experienced engineering skills with little familiarity with the specific procedures to solve the AR game. The initial review of the data indicated there were some distinctions in how experienced and inexperienced STEM-related education used the AR game protocol. Clearly, the pace of the game guidance is something that would need to be adjusted for these two types of learners. For example, it may be useful to require more instructions to young women. They have no educational experience in science, engineering, or math to hear fundamental basic theory and explanation of every game during an initial AR game screen. However, experienced students who are already interested in engineering will be impatient with an iteration of such obvious basics.

As a prototype, the AR game has limitations, which all participants acknowledged. A more compact and robust development would be required to fully implement the games to play in all steps of the engineering game. The AR elements, objects, and graphics may not be visible through the prototype in all categories of engineering, particularly in areas with more levels of other categories of engineering. Some users found it challenging to play it while looking at their work through a clickable live prototype. Others, particularly experienced students, showed evidence of discomfort playing basic levels of the AR game. For the video mentoring part, in fact, one young woman posed a skeptical question about managing video messages between mentors and them on the application.

As a first step toward that goal, two issues are that some of the AR game visual representations were not functioning effectively, and some of the young female students spend their time into many steps on the AR game to read text explanations. If the educational game content is ever to be produced at mass scale for such 360 degrees augmented technology or audio instruction, further study is needed to define the design features of visual representations and dialog scripts. Such a study needs to focus both on how to design to implement all pre-developed steps, but,

more importantly, also to understand what conversational design in the mentoring system may serve as useful content to deeper learning and communicating with the professions.

CONCLUSION

Overall, all the participants —Teenage girl high school students, Engineering instructors, and experienced mentors— have generally positive ratings to the engineering AR game and Video Communication prototype and concept. Mainly, they like the specific game examples and virtual mentoring. Because, consistent with interactive learning theory from the game and the career journey from mentors, these representations required less mental effort than the finding of playful, educational resources or people to define their future career paths. The data suggest that traditional engineering education in school and a lack of interaction with role models historically present a particular challenge to young women pursuing a STEM degree. As a result, those female students perceive the AR games and virtual mentoring through a video platform to gain useful information efficiently in a short time.

The virtual mentoring via a video conversation with mentors appears to reduce the anxiety of young women asking questions for their future career, as indicated by the reports from all the study participants. However, this study still needs to test whether using the AR game, and the video mentoring system does improve retention. Besides, a goal for the <hello,w> is to increase numbers of young women pursuing engineering careers that may improve equality in the STEM field. In this study, Minjung Kim did not observe any actual industry statistics that would be expected to reflect this conceptual knowledge and assumption of AR training games and video mentoring systems yet since this study is finished in May 2020. These are the questions to be explored further through design and testing.

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A Platform With Augmented Reality Games And Video Interactions Increases Inclusivity In STEM

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