

Career Elevator: Redesigning Early STEM Exploration for Girls

Design for Equality Statement

The Invisible Barrier: Gender Gap Begins During Exploration, Not Selection

This project addresses the systemic barriers that cause girls to exit STEM pathways long before they reach the workplace—not due to lack of ability, but due to accumulated psychological and structural disadvantages during the exploration phase.

Background

A Decade of Stagnation

Women remain significantly underrepresented in science, technology, engineering, and mathematics (STEM) worldwide. According to UNESCO (2024), women account for only 35% of STEM graduates and merely 28.2% of the global STEM workforce—figures that have barely shifted in ten years. While participation rates vary across regions, the pattern is consistent: women are significantly underrepresented in the fields that concern our future (OECD, 2023; MOE, 2023).

This persistent imbalance is often attributed to hiring practices or university admissions; however, evidence suggests that the gender gap in STEM emerges much earlier in the educational pipeline.

The Disconnect: The "Ability Myth" Debunked

Research indicates that girls' interest in STEM subjects peaks around the age of 11 and declines sharply by age 15. Decisively, unlike interest in humanities subjects, this decline does not recover later in adolescence or adulthood (Microsoft, 2017, as reported by CNN). This four-year period between ages 12 and 15 represents a critical yet under-addressed window during which girls disengage from STEM pathways before making formal academic or career choices.

Crucially, this disengagement gap is not driven by cognitive ability.

According to the 2022 Programme for International Student Assessment (PISA), girls do not perform worse than boys in science across OECD countries, with no statistically significant gender difference observed (OECD, 2023). While boys outperform girls in mathematics by an average of nine score points and girls outperform boys in reading by 24 points—roughly equivalent to one year of schooling, these gaps have remained quite stable over time.

Yet, a "confidence gap" appears during a critical developmental window. Research indicates that girls' interest in STEM drops sharply between ages 12 and 15 (Microsoft, 2017). This implies that while girls possess the aptitude for science, they lack the engagement to pursue it.

From these findings, we can find that women's withdrawal from STEM is not driven by cognitive or physiological limitations, but by cultural, social, and structural factors. However, the long-term consequences of early disengagement are visible at both the tertiary education and workforce levels. **This imbalance is particularly concerning given that STEM qualifications are among the most in-demand in the global labour market, yet women represent only 31% of new entrants into STEM programmes across OECD countries (OECD, 2023).**

In 2023, women accounted for only 38% of STEM graduates in the United States, 34% in the United Kingdom, 28% in Germany, 27% in South Korea, and just 18% in Japan (OECD, 2023). And later, this underrepresentation continues into professional environments, where women face male-dominated cultures, limited access to role models, implicit and explicit bias, and persistent challenges related to work–life balance (Conrad et al., 2021; UNESCO, 2023).

This perspective is also grounded in our own lived experiences. As two girls pursuing STEM-related paths, we have both grown up surrounded by persistent doubts, discouraging voices, and explicit gender stereotypes, regarding women's suitability for STEM fields. Despite these external narratives, we have remained in the fields we chose, not because the path was smooth, but because we were able, at critical moments, to give ourselves another opportunity instead of completely interpreting previous setbacks as evidence of personal inadequacy.

Problem Statement

The Crisis of Belonging

The core issue is "premature self-exclusion" driven by cultural framing. Young women often struggle to establish a sense of belonging due to a lack of visible role models and pervasive stereotypes (Cheryan et al., 2017). Within these structural contexts, women are also more susceptible to psychological barriers such as stereotype threats and imposter syndrome, which often lead them to misinterpret normal learning challenges as signs of inadequacy. Even when they achieve objective success, these challenges can erode their self-confidence and distort their self-evaluation (McCullough, 2020); all of which can significantly accelerate

their voluntary withdrawal. Furthermore, the lack of role models who affirm their potential causes girls to withdraw from STEM fields long before formal selection or elimination. Therefore, we argue that the challenge lies not in teaching them the STEM skills they might already possess, but in how to genuinely demonstrate women's sense of belonging in STEM fields. As we can see, research above collectively suggests that gender inequality in STEM fields is not a matter of individual ability, but rather a structural design problem. As a result, to address this imbalance, targeted and systematic interventions need to be implemented as early as possible to bring hidden barriers to light, expand their opportunities to have meaningful STEM experiences, and support girls in building confidence, a sense of belonging, and diverse success narratives during the critical stages of identity formation.

Four Compounding Barriers

1. Lack of Belonging in STEM Spaces

- STEM environments are majority-male, creating immediate feelings of "not fitting in"
- Lack of role models continues to channel girls' career choices away from STEM fields ([CNN](#))
- This shortage makes it harder for girls to imagine themselves in these fields

2. Abstract Career Imagination

- Learning subject knowledge (physics, coding, math) doesn't tell students directly about what daily work actually feels like
- As one 14-year-old student expressed: "My tests indicate that I'm a good engineer and I wish I knew what that looked like in real life" ([Microsoft](#))
- Without experiential understanding, choices are mostly made based on grades, not genuine interest

3. Internalized Performance Pressure

- Girls tend to have less confidence in their STEM performance than boys, even when their actual performance is better (NESET, European Commission)
- Conformity to social expectations and gender stereotypes creates a "double conformity bind" where girls must choose between femininity and STEM ([CNN](#))
- Gender stereotypes shape what families consider "appropriate" for daughters

The Compounding Impact:

These barriers lead to:

- **Fear-Driven Early Exit**

A single moment of difficulty is interpreted as "I don't belong here"

- **Internalization of Systemic Problems**

Girls blame themselves for struggling in systems not designed for their success

- **Self-Elimination Before Selection**

The gender gap starts when girls remove themselves from consideration entirely, not when they're rejected.

Thus, this is a retention problem that happens during the exploration phase, when uncertainty is highest and support is lowest.

These dynamics are not abstract to us; they closely mirror our own educational trajectories.

We both recall experiencing intense frustration and self-doubt when first learning to code during our first year in university. After initial failures, we temporarily stepped away from the field, questioning whether we simply “were not cut out for it.” Months later, we returned with a different question in mind: were these difficulties genuine indicators of unsuitability, or were they the result of limited experience, unexamined bias, and the weight of prior failure shaping our self-perception? This second attempt led to renewed engagement and sustained participation in STEM-related learning.

Similar patterns emerged earlier in our secondary school time. In environments where comparison was constant and recognition uneven—particularly in mathematics—encouragement from peers, perseverance, and continued exposure proved decisive. The result shows that **what ultimately shaped our trajectories was not exceptional ability, but the opportunity to persist long enough to develop confidence and context, to imagine the sense of belonging in these spaces. While in the long term, to eternally develop a real sense of identification with the field.**

These experiences underscore how easily girls without strong internal conviction, sufficient exposure, or visible role models may be discouraged from continuing in STEM, not due to lack of potential, but due to the cumulative effect of doubt, invisibility, and external judgment.

This platform is motivated by a desire to intervene at precisely these moments of hesitation by making future pathways more visible, work contexts more concrete, and role models more accessible, so that uncertainty does not lead to premature exclusion from possibilities girls have not yet had the chance to fully explore.

Solution: SHIFT – Career Elevator

SHIFT is a WebXR-based immersive exploration platform designed not to change who girls and women are, but to **transform the systems and contexts around them**. Rather than focusing on individual deficits or capability gaps, **SHIFT** intervenes at the **earliest moment of disengagement** by providing exposure, support, and visibility during the exploration phase. Through redesigning the first point of contact with STEM, **SHIFT** ensures that uncertainty does not become an exit, enabling girls and women to access alternative

pathways, express their unique potential, and create outcomes that were previously inaccessible within existing systems.

The name **SHIFT** draws from the keyboard metaphor: just as the *Shift* key does not replace any letter but **unlocks entirely new combinations**, SHIFT expands the spectrum of possibilities available to girls and women in technology and innovation. Each individual is not directed toward a single “correct” future, but empowered to arrive at a **distinct yet equally valid pathway**.

The SHIFT Framework

SHIFT operationalizes its intervention through five interconnected design principles:

S – Structural

Shift the structure

Addressing *structural* gender inequality in technology and innovation, and how small yet intentional shifts in structure can unlock entirely new possibilities.

H – Hidden Bias

Revealing invisible barriers

SHIFT works to reveal hidden biases embedded in education, career narratives and technological cultures. By making these biases visible, it could prevent girls and women from internalizing structural barriers as personal failure.

I – Inclusion

Designing for access, participation, and representation

We ensure inclusive access regardless of their background and prior exposure. Inclusion is treated not as an outcome, but as a design constraint from the outset.

F – Future

Enabling future-ready pathways

SHIFT enables future-ready pathways by sustaining engagement during exploration, without directing users toward specific careers or evaluating suitability.

T – Transformation

Driving transformative change through design and technology

By combining immersive environments, non-verbal emotional reflection, and anonymous collective presence, SHIFT transforms how exploration is experienced.

Individual uncertainty becomes shared, normalized, and generative—laying the groundwork for long-term systemic change.

Target Users

Primary Users

The core challenge described above disproportionately affects **girls aged 12–18**, who are at a critical stage of identity formation and early career exploration. These users are not necessarily lacking ability or motivation; rather, they are often uncertain, hesitant, or unsure whether they belong in STEM environments.

At this stage, many girls have limited exposure to what STEM work actually looks like and rely heavily on grades, stereotypes, or external expectations to form their self-perception. Moments of confusion, difficulty, or comparison are therefore easily interpreted as signals of unsuitability, leading to premature self-exclusion before formal academic or career choices are made.

These girls are navigating a critical window of exploration when uncertainty is high and support is low and need a psychologically safe, non-evaluative environment in which they can explore, reflect, and imagine possible futures without pressure to decide or perform.

Secondary Stakeholders

Secondary stakeholders include educators, schools, and organizations involved in career exploration, gender equality, and social-emotional learning. For these stakeholders, SHIFT functions as a complementary tool that supports early engagement and emotional safety during exploration, rather than a prescriptive career guidance system.

Summary

SHIFT addresses structural inequality by **uncovering hidden bias, fostering inclusive participation, and enabling transformative futures** for girls and women in technology and innovation. Rather than fixing individuals to fit existing systems, SHIFT redesigns the systems themselves—so that exploration, uncertainty, and difference are no longer liabilities, but legitimate starting points.

Core Functions

Function 1: WebXR-Based Immersive Career Exploration

This function provides an immersive career exploration experience for girls through WebXR technology. The system runs directly in a web browser and supports 360° interactive environments, allowing access via everyday devices such as laptops, tablets, and smartphones without requiring specialized VR hardware.

Through interactive 3D and 360° workspaces, users can move within simulated professional environments and observe everyday work contexts, gaining an experiential understanding of what daily professional life looks like rather than passively reading about career options.

By prioritizing accessibility and device flexibility, the system treats technology as a means to **lower barriers to exploration rather than introduce new forms of exclusion**. Immersive experience fosters empathy, situational understanding, and imagination in ways that text-based career information cannot.

Why WebXR:

- Accessible via any modern web browser (Chrome, Firefox, Safari)
- No app download or installation required
- Works on smartphones, tablets, and computers
- Supports both 2D exploration (mouse/touch) and VR headsets
- Cross-platform compatibility ensures maximum reach

Function 2: Non-Verbal Emotional Reflection

This function provides a psychologically safe reflection space that allows girls to acknowledge their emotional responses to career exploration without verbal pressure, explanation, or comparison. The design emphasizes emotional normalization and communicates a simple message: *you are not alone*

Key components:

- **Color-based mood reflection**
At the end of each career exploration experience, users select a color to represent their emotional state. The five emotion categories are informed by established affective models that describe emotions along dimensions such as valence and arousal, and are adapted to reflect common emotional responses during exploration (e.g., curiosity, confusion, excitement, hesitation, and reassurance). This enables non-verbal emotional acknowledgment without requiring users to label, justify, or evaluate their feelings.
- **Collective emotional visualization**
Individual color inputs are aggregated into a shared visual board within each career exploration space. Identical colors accumulate and overlap, forming visible clusters that reflect the collective emotional presence associated with that career context. This visualization makes shared emotions perceptible while avoiding individual identification, comparison, or ranking.

- **Persistent personal reflection with optional anonymous sharing**

Users may optionally leave a short sentence describing their feelings. By default, reflections are saved privately and remain visible only to the user over time. Users can choose to share reflections anonymously with the community, where messages appear without names, profiles, or engagement metrics. This design allows users to recognize that their feelings are shared by others, while gently reframing uncertainty and hesitation as normal parts of exploration rather than personal failure.

How it promotes equality:

- Removes language barriers and performance pressure
- Validates uncertainty as a normal part of exploration
- Treats emotional responses as valuable data, not weakness
- Creates a record of exploration without evaluation

Function 3: Role Model wall

This function introduces role models as relatable references within each career exploration space. Users can interact with the Role Model Wall to explore personal stories that highlight everyday experiences, challenges, and non-linear career paths. Rather than presenting idealized success narratives, the design supports confidence-building through identification and a sense of belonging.

Belonging is critical during adolescence. When girls see that uncertainty is shared, they are less likely to interpret hesitation as personal failure and more likely to remain engaged in exploration.

How it promotes equality:

- Provides psychological safety for exploring non-traditional gender paths
- Removes competitive comparison that often disadvantages girls
- Transforms "personal uncertainty" into "collective experience"
- Builds belonging without requiring self-disclosure or permanent identity

User Experience Flow

Step 1: Visibility - Entering the System



On entry:

A quiet landing page that transitions into a warm, open lobby, with an elevator visible at the far end.

User action:

The user can pause, look around, and remain in the space without pressure to decide. When ready, she may enter the elevator or leave the experience at any time.

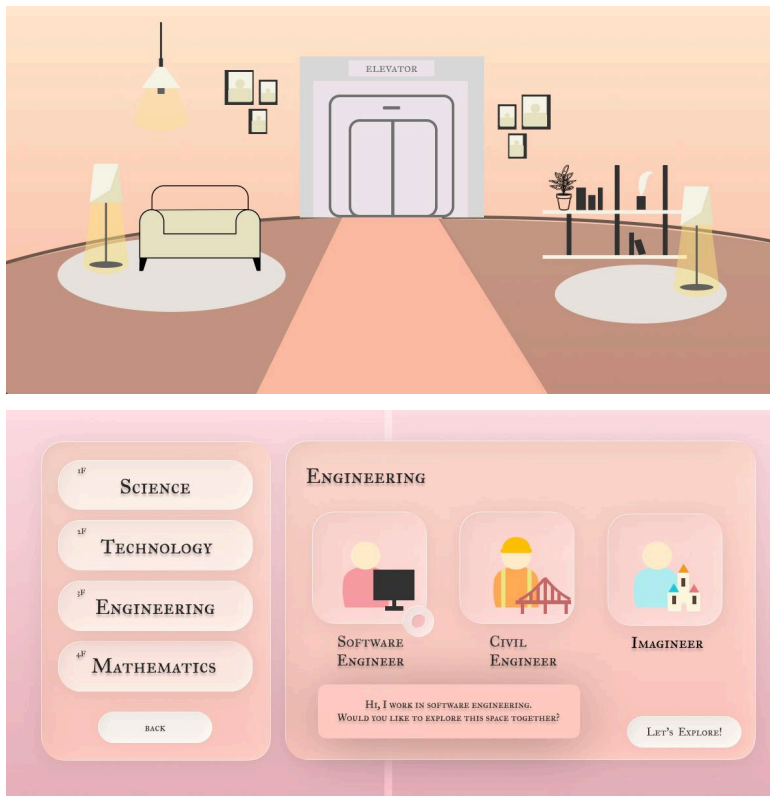
System intention:

A pressure-free entry point with no instructions, expectations, or evaluation.

Why it matters:

Many girls disengage at the very beginning of exploration due to fear of judgment or making the “wrong” choice. By removing decision-making pressure at entry, the system allows exploration to begin on the user’s own terms.

Step 2: Experience - Career Elevator



On entry (inside the elevator):

Inside the elevator, four clearly defined floors represent broad career themes within STEM. Each floor introduces a thematic area and contains multiple related roles to explore.

- Science
- Technology
- Engineering
- Mathematics

Each floor offers at least three career spaces, signaling that no single role defines the field.

User action:

The user selects a floor based on curiosity rather than certainty. After choosing a floor, she can explore any of the related career spaces within that theme.

Example — Technology:

- Software Engineer
- Civil Engineer
- Imagineer

System intention:

To make career exploration feel open and flexible, not like a one-way path. By presenting multiple roles within each theme, the system avoids implying that there is a single “correct” or representative career path.

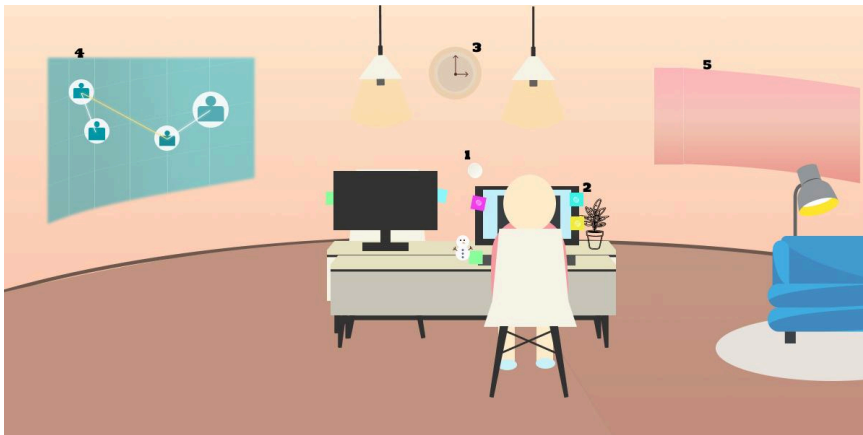
Why it matters:

Girls often disengage when they feel pressured to make precise or premature choices. Organizing careers by broad themes first allows exploration to begin with curiosity, lowering the psychological cost of choosing and reducing the fear of choosing “wrong.”

Inside a Career Space: Software Engineer (conceptual example)

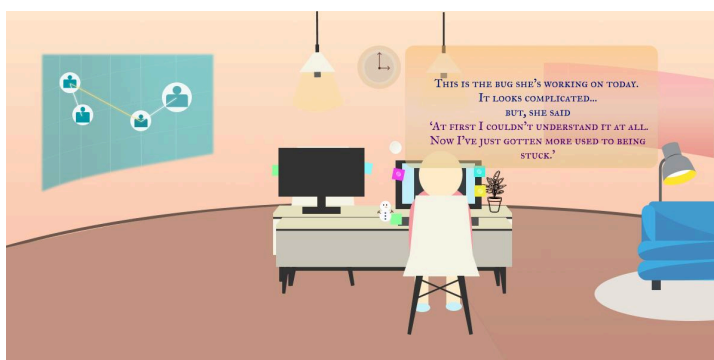
Environment:

A modest virtual workspace with a desk, a computer, scattered sticky notes, and a window.



Interactive Object 1: Code Window — Learning to sit with confusion

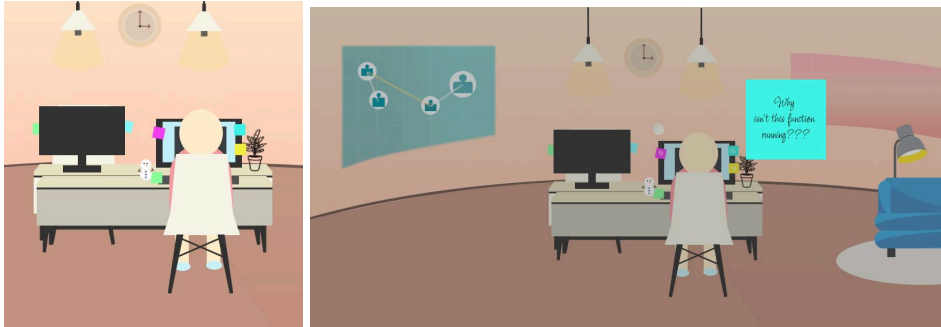
- Clicking the floating code window reveals a snippet of unfinished code.
- A text bubble appears, sharing a short reflection that helps the user understand what the work actually feels like, rather than what it is supposed to look like.



- Design intent: Not understanding is not an anomaly, but perhaps a normal part of the work.

Interactive Object 2: Sticky Notes — Learning is not enduring alone

- Sticky notes scattered across the workspace display fragmented thoughts and reminders from her day:
 - “3:00 PM code review nervous”
 - “Why isn’t this function running???”
 - “Remember to ask a senior about how to use that API”



- Design intent: Getting stuck is not something to be endured alone. Progress often happens through asking questions, seeking help, and making small attempts over time.

Interactive Object 3: Window / Clock — Time Passes Even When You Are Stuck

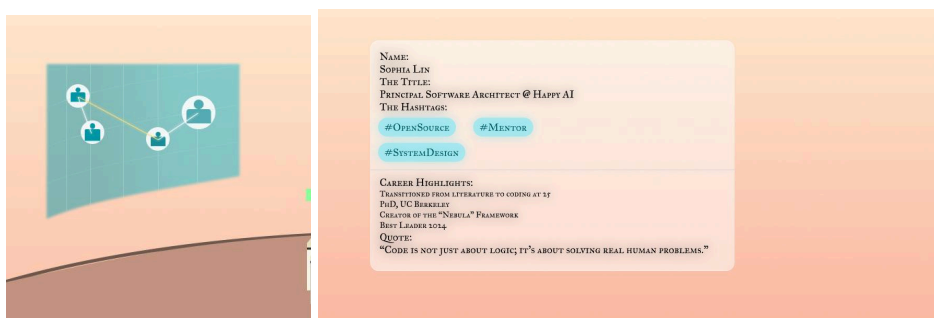
A subtle time-lapse animation shows the workspace shifting from morning to afternoon and into evening.

- Design intent : Growth is not a sudden breakthrough, but something that unfolds over time.

Interactive Object 4: Role Model — Belonging Through Identification

This object presents a relatable role model to help users feel they belong, even when they are unsure.

- It displays the role model’s information, such as name, role title, background, and a personal quote.



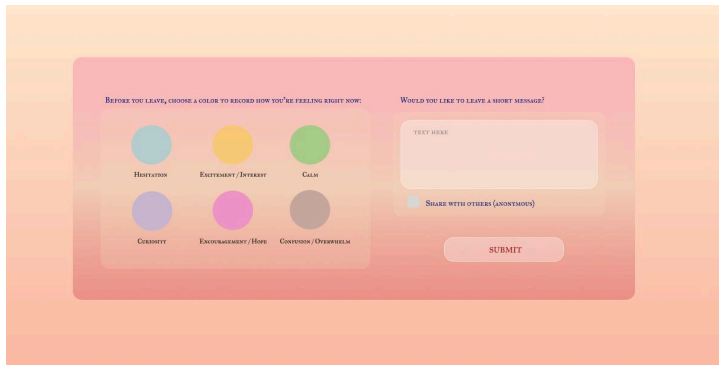
Interactive Object 5 — Community Space Board

This space visualizes the emotional traces left by others who have explored the same career.



- **Observe collective patterns:**
She sees that she is not alone. A color-based distribution reveals that many others also felt uncertain (blue, gray), curious (yellow), or hopeful (green) during their exploration.
- **Read anonymous experiences:**
On the left side, she can tap individual colored lights to read short reflections shared anonymously by others (when users have chosen to make them public).
On the right side, she can view an overview of collective comments, emphasizing shared emotional presence rather than individual stories.
- To transform individual emotions into a sense of collective presence, allowing users to recognize shared feelings without comparison, ranking, or social pressure.

Step 3: Reflection - Non-Verbal Emotion



User action:

She chooses one color intuitively. She may optionally write a short anonymous comment. No explanation is required, and there is no correct answer.

System intention:

To enable low-effort acknowledgment of internal responses without turning reflection into evaluation. Color-based input reduces language barriers and performance pressure.

Why it matters:

Uncertainty and hesitation are often internalized as personal failure. Non-verbal reflection allows these feelings to exist and be recognized without judgment.

SWOT Analysis

Strengths

- **Early-point intervention**
The project intervenes not at the stage of choosing a major, school, or job, but at an earlier and often overlooked moment—when girls begin to withdraw before exploration has even begun.
- **Non-evaluative, non-directive design**
The system avoids tests, rankings, or career recommendations, reducing performance pressure and aligning with the developmental needs of adolescents aged 12–18.
- **High accessibility through WebXR**
The experience runs in a web browser without requiring VR hardware, lowering

technical and economic barriers and increasing access across socioeconomic backgrounds.

- **Emotion-centered rather than ability-centered**
Feelings such as uncertainty, fear, and hesitation are treated as normal parts of exploration, rather than indicators of personal inadequacy.
- **Anonymous, low-comparison social design**
Anonymity and non-quantified sharing reduce comparison, competition, and exposure anxiety, supporting psychological safety for young users.

Weaknesses

- **Impact is difficult to measure using traditional KPIs**
Outcomes such as psychological safety, willingness to explore, and sustained engagement are not easily captured by grades or enrollment metrics.
- **Higher initial content development cost**
Creating immersive spaces, role models, and narrative contexts requires interdisciplinary effort and upfront investment.
- **Lack of explicit career guidance**
The absence of direct recommendations may not align with expectations from some parents or educational institutions seeking clear outcomes.

Opportunities

- **Strong alignment with educational trends**
The project aligns with exploratory learning, gender equality education, and Social-Emotional Learning (SEL).
- **Scalability across cultures and gender norms**
The system can be adapted to different cultural contexts and broader discussions of gendered expectations beyond STEM.
- **Potential for cross-sector collaboration**
Future partnerships with women founders, technology companies, and non-profit organizations can enrich content authenticity.
- **Addressing an institutional blind spot**
The project targets “invisible attrition”, a form of disengagement that current systems and policies struggle to detect or address.

Threats

- **Risk of being perceived as a showcase experience**
Without clear framing, the project may be misunderstood as a technology demonstration rather than an educational intervention.
- **Expectation creep**
The system may be expected to function as formal career counseling if boundaries are not clearly communicated.
- **Over-complexity risk**
Excessive technical or interaction complexity could undermine the project’s low-pressure design principle.

Influence

The project's influence lies not in immediate career outcomes, but in extending the time girls are willing to remain engaged in exploration. By normalizing uncertainty as a shared and acceptable experience and **making it visible through collective reflection**, the system reduces premature self-exclusion and supports more open-ended educational trajectories over time.

Impact and SDGs Alignment

SDG 5: Gender Equality

- Shifts focus from “fixing individuals” to redesigning exploration environments.
- Addresses early gender-based disengagement in STEM by targeting invisible attrition during the exploration phase.

SDG 4: Quality Education

- **Supports inclusive access to exploratory learning regardless of background.**
- Promotes inclusive access to exploratory learning by addressing emotional and experiential gaps not covered by formal education.

Why Now & Why Us

Why Now

- STEM and innovation fields continue to expand, yet gender-based disengagement persists.
- Most existing interventions occur after choices have already narrowed or disengagement has occurred.
- WebXR technology has matured enough to deliver immersive experiences without increasing access barriers.

Why Us

- The team integrates perspectives from technology, design, and gender studies.
- The project begins not with how to push girls into STEM, but with why they leave before they ever begin.
- Design restraint is intentional: uncertainty is respected rather than prematurely resolved.

Development Roadmap

Short-term:

- Build and test a functional prototype to evaluate engagement and emotional safety during exploration.

Mid-term:

- Partner with schools and educational organizations to integrate the system into exploratory curricula.

Long-term:

- Enable all young people—regardless of gender—to freely choose paths aligned with their interests, including choices that challenge traditional gender expectations.

Core Position

This project does not pursue superficial equality. Instead, it acknowledges that different genders experience different social expectations and constraints. The goal is not to erase differences, but to ensure that no one is excluded from exploration before they have the chance to choose.

Conclusion

This project doesn't try to change girls to fit STEM. Instead, it reshapes exploration to better match the uncertainty that naturally comes with learning.

By intervening at the earliest moment of disengagement and treating uncertainty as acceptable rather than failure, Career Elevator keeps girls in STEM pathways who would otherwise have left, not due to lack of ability, but lack of support during the most vulnerable phase of exploration.

The gender gap in STEM does not begin at selection. It begins when girls remove themselves from consideration. This project intervenes precisely at that moment.