INTOVISION CUBES

An EdTech toy that teaches spatial visualization and STEM concepts

Senior Design Team 43
By Rachel Sharpe, Elle Sandifer, Paul Tapsall, Aaron Key, and Nick Ortiz

Product and Team Overview

Product Description

Engineering students are entering universities not proficient in the fundamental skill of spatial visualization. As 96% of universities do not address this skill, students are left lacking a building block of their engineering education. The IntoVISION Cube is an EdTech toy that addresses this problem proactively by teaching spatial visualization and STEM skills prior to the moment that students enter college. These interactive cubes are sold in expandable sets of 9 or 36 and are paired with activity cards that use methods proven to effectively teach spatial visualization. This intentional focus on teaching spatial visualization proactively sets us apart from our competitors and addresses an unmet need in K-12 education. At IntoVISION, we believe every engineering student deserves to enter college confident and equipped with the skills necessary for success.

The Team

At IntoVISION, our team is well-equipped to disrupt the EdTech toy market by addressing an unmet need in pre-engineering education. With our extensive experience in entrepreneurship, human centered design and manufacturing, we understand all aspects of this product. As recent graduates of engineering, we understand the importance of spatial visualization and are working to improve the education of the generations following us.

Medtronic

Elle Sandifer

Project Manager

Elle was the Program Manager for the Engineers Without Borders CU team and led the design of a latrine for a school in rural Nepal. Through this experience she learned about human-centered design and how to steer a team through unexpected challenges.

sphero

Rachel Sharpe

Systems & Test Engineer

Rachel has spent over 1,000 hours in K-12 classrooms, TA'd for CU Boulder's spatial visualization course, and worked for one of the top EdTech companies in Boulder. Additionally as a graduate from the accelerator CatalyzeCU she brings her entrepreneurial expertise.

DESIGN FOR COMMUNITY

Aaron Key

Logistics Manager

Aaron's creativity has been a vital component to the success of IntoVision's prototyping and product design phases. These skills were developed through his work at AECOM where he shadowed a lead mechanical designer overseeing the construction of a 2 million dollar HVAC system.

DESIGN FOR COMMUNITY

Paul Tapsall

CAD Engineer

Paul brings his entrepreneurial experience founding a non-profit organization that has raised money to help with the development of after school programs in Alviso, California. This paired with his experience with CAD has made him an excellent manufacturing lead for the team.

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Nick Ortiz

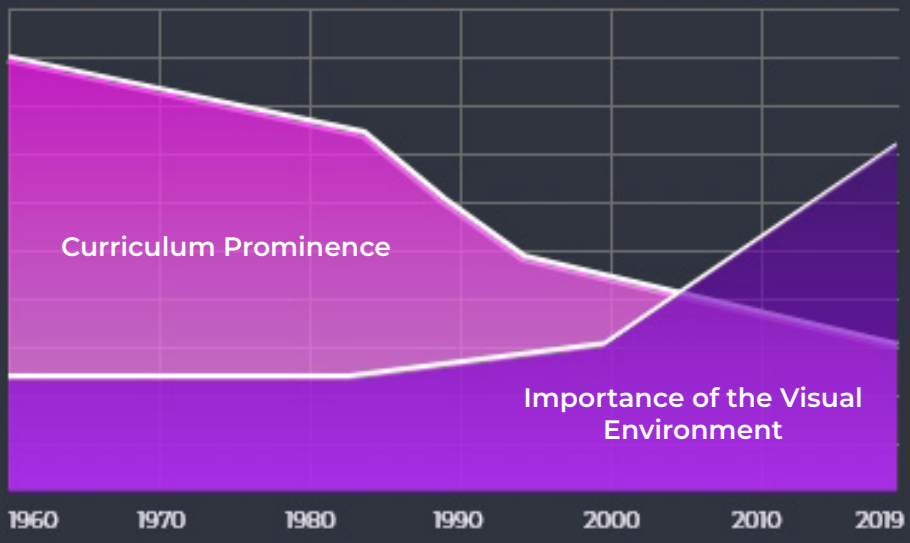
Financial Manager

Nick has four years of manufacturing experience in the medical device industry. He is interested in design for manufacture and the communication of intent on engineering drawings. He has been responsible for evaluating project cost for the business plan.

THE PROBLEM

The development of 3-D spatial visualization skills is a foundational element of engineering education. Significant technological advances in engineering require visualizing designs. This includes the design of the steam engine, the discovery of the helix DNA structure, and the development of the AC generator. Historically, in engineering education, spatial visualization was learned in drafting and project courses. As engineering colleges were required to condense the number of credits for graduation, these courses were squeezed out of the curriculum. In modern-day engineering education, the development of this skill is primarily left to chance. Studies show students are not acquiring this skill from a single semester of computer-aided design. This leaves engineers unprepared for the workforce and increases inequity among minorities such as women. Thirty-nine percent of women are projected to enter engineering not proficient in this skill. That percentage is three times higher than their male counterparts.

Spatial Visualization Prominence



*"Curriculum today is **diverging from its artistic and visual beginnings**, our curriculum today relies too heavily on analytical methods and **not enough on tactile**, visual perception"*

-Sheryl A. Sorby, author of "Developing 3-D Spatial Visualization Skills"

Three-Fold Problem

Only 4% of US universities explicitly teach and test for spatial visualization skills.

This skill is often addressed too late, leaving undergraduates to play catch up.

Current curriculum is dated, leaving students uninspired to practice outside the classroom.

SPATIAL VISUALIZATION

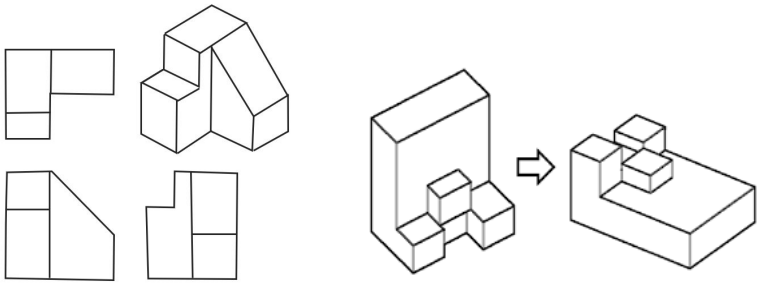
What is Spatial Visualization?

Spatial visualization is the ability to imagine and manipulate 3D objects in your mind. It is the foundational skill that allows engineers to translate 2D drawings into 3D objects and vice versa. This skill underpins nearly everything we do in engineering.

How is it being taught?

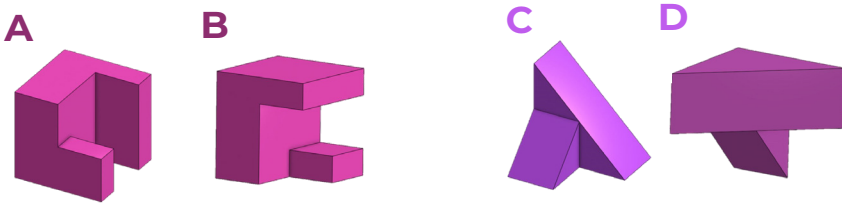
Three primary activities are taught to develop spatial skills

1. Deconstructing a 3D object into top front and side views
2. Visualizing the new state of an object rotated about one axis
3. Visualizing the new state of an object rotated about two axes



Test yourself!

True or False? A is rotated to B as C is roated to D.



Spatial Context

Boeing 787

There are 2.3 million individual parts within a Boeing 787.

Jet Turbine

There were 25,000 drawings and assemblies needed to construct this turbine.

Toyota 4runner

There are 30,000 parts within a Toyota 4runner, all with their own geometric constraints.

CUSTOMER DEVELOPMENT

Interviews

4 Teaching Assistants & Instructors

10 Spatial Visualization Students

5 Pre-College STEM Instructors

Current Educational Tools

Key Findings

The IntoVISION team conducted interviews with CU Boulder's spatial visualization students and instructors. They also had the opportunity to connect with local pre-engineering programs in Colorado high schools. From the conducted interviews, the team learned that the current curriculum is effective; however, it comes too late and participants feel that the activities are outdated. Customer development interviews revealed the curriculum is leaving students uninspired to practice outside the classroom.

Interview Quotes

"There are few tools for teaching rotations"
-SV Instructor

"Tools felt remedial"
-Current SV Student

"I would not use these tools outside of class"
-Current SV Student

Product Goals

EFFECTIVELY teach spatial visualization.

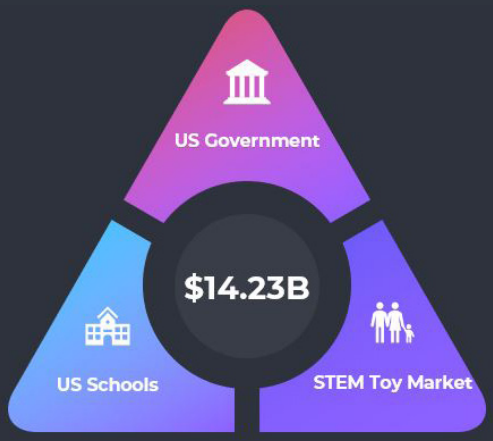
INCREASE ENGAGEMENT from users.

PROACTIVELY teach spatial visualization.

PROVIDE VERSATILITY for parents and teachers.

THE OPPORTUNITY

Spending in K-12 Education



In the last four years, the demand for engineers has nearly doubled. As a result, in 2019, Edtech spending for K-12 schools was up $1.17B in the US. Every year within the US, $14.23 Billion is spent on tools to teach STEM concepts. By addressing middle school and high school households within the US, with a parent interested in encouraging their child to pursue a STEM related career, there is a total addressable market of $2.1 billion.

The Opportunity

What if the $14.23 billion could be spent on ensuring students have the ***foundational skills*** *they need to excel in college engineering programs? Further, could* ***retention be increased*** *for women in engineering if they entered college on equitable playing fields in regards to the fundamental skill of spatial visualization?*

Next Generation Science Standards

NEXT GENERATION * SCIENCE STANDARDS
For States, By States

The time for the product is now. For the first time in history, all K-12 educators must meet the Next Generation Science Standards. Engineering design is a prominent aspect of those standards. This means millions of educators and parents in the US, many without an engineering background, could benefit from educational tools.

THE SOLUTION

The Product

Standard Set 9 Cubes, $160	Educational Set 36 Cubes, $450

The IntoVISION Cube is sold in a set of 9 to parents and 36 to educators. Standard and Educational IntoVISION Cube sets come with five activities cards that focus on teaching the fundamental skills necessary to learn spatial visualization. Out of the box, they come pre-programmed to teach spatial visualization, but have the capacity to be re-programmed using the Arduino coding language. In this way, IntoVISION Cubes can be creatively utilized to incorporate STEM concepts in an infinite number of ways, at home or in the classroom. In the future, the IntoVISION team plans to build a virtual community through the IntoVISION website where new activities, projects, and curriculum are released to parents and educators monthly.

Sustainable Competitive Advantage

This product stands apart from other products on the market because it is as engaging as it is educational. When it comes to effective spatial visualization curriculum, Higher Ed Services provides educational material for college students that is proven to close the gap. LEGO products are highly engaging, but they don't specifically address the foundational elements that effectively teach spatial visualization. There is no product on the market that is highly effective and engaging for middle school and high school users that teaches STEM and spatial visualization. This is the balance IntoVISION Cubes strike.

Sales Channels

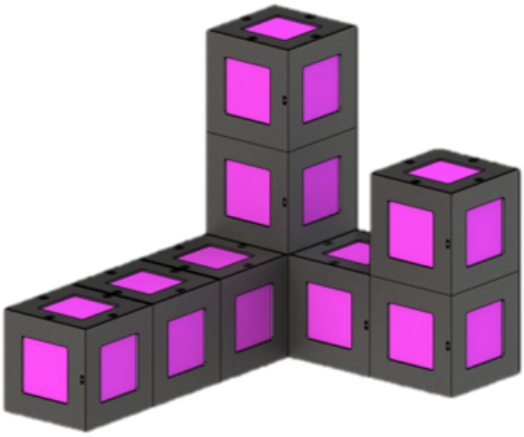
The team plans to initially sell these cubes direct-to-consumer (parents), to after school STEM programs, and to pre-college programs. In the coming summer months, these channels, in addition to selling to educators, will be further explored.

PRODUCT FEATURES

IntoVISION Cubes Features

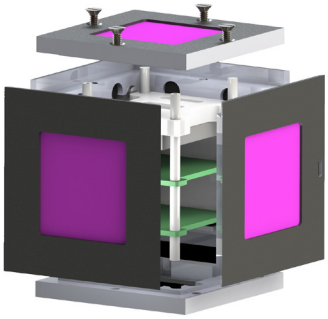
Tactile, Magnetic
Every cube is equipped with powerful neodymium magnets allowing the user to combine them in any configuration.

Interactive, Capacitive Touch
Responds to touch producing an infinite number of colors and a variety of sounds.



Visual, Projectable
Every cube is equipped with a motion co-processor PCB that allows the user to project a real time 3D image of that cube onto a screen.

Easy to Learn & Hard to Master, Programmable
Cubes come pre-programmed to correspond with activities, but they can be re-programmed to teach computer science using Arduino.



Effective, Defined Activities
Every set of IntoVISION Cubes comes with a user guide and pack of pre-made educational activity cards.

CONCLUSION

Where we are now

The IntoVISION team has two primary goals moving forward. The first is to refine our technical product through further iterations in response to information gained from functional testing. We expect at least three design iterations of the product before we are ready to launch our Kickstarter in August 2020. The second goal is to interact with as many potential customers as possible. This will not only spread the word about IntoVISION Cubes but also give us crucial insight into our sales strategy and how to improve the product for the end user and customer. Prior to COVID-19, we were pursuing user test sessions with the Boulder Public Library, Cu's Teach Engineering Program, and with local high schools. The team is still working with these programs to determine how these might be possible given the lockdown.

Our Ask

If you are interested in this product or learning more about the impact of spatial visualization please contact us at eleanor.sandifer@colorado.edu. This is an entrepreneurial team that plans to continue working on IntoVISION post graduation.

We want your help! Please contact us by emailing eleanor.sandifer@colorado.edu if:

1. You have a child in middle or high school who would be willing to test our product
2. You work in K-12 education and have students you could connect us with for user testing
3. You are a parent of a K-12 student, an educator, or a student interested in STEAM and are willing to do a 15-minute customer development interview with us

Thank you!