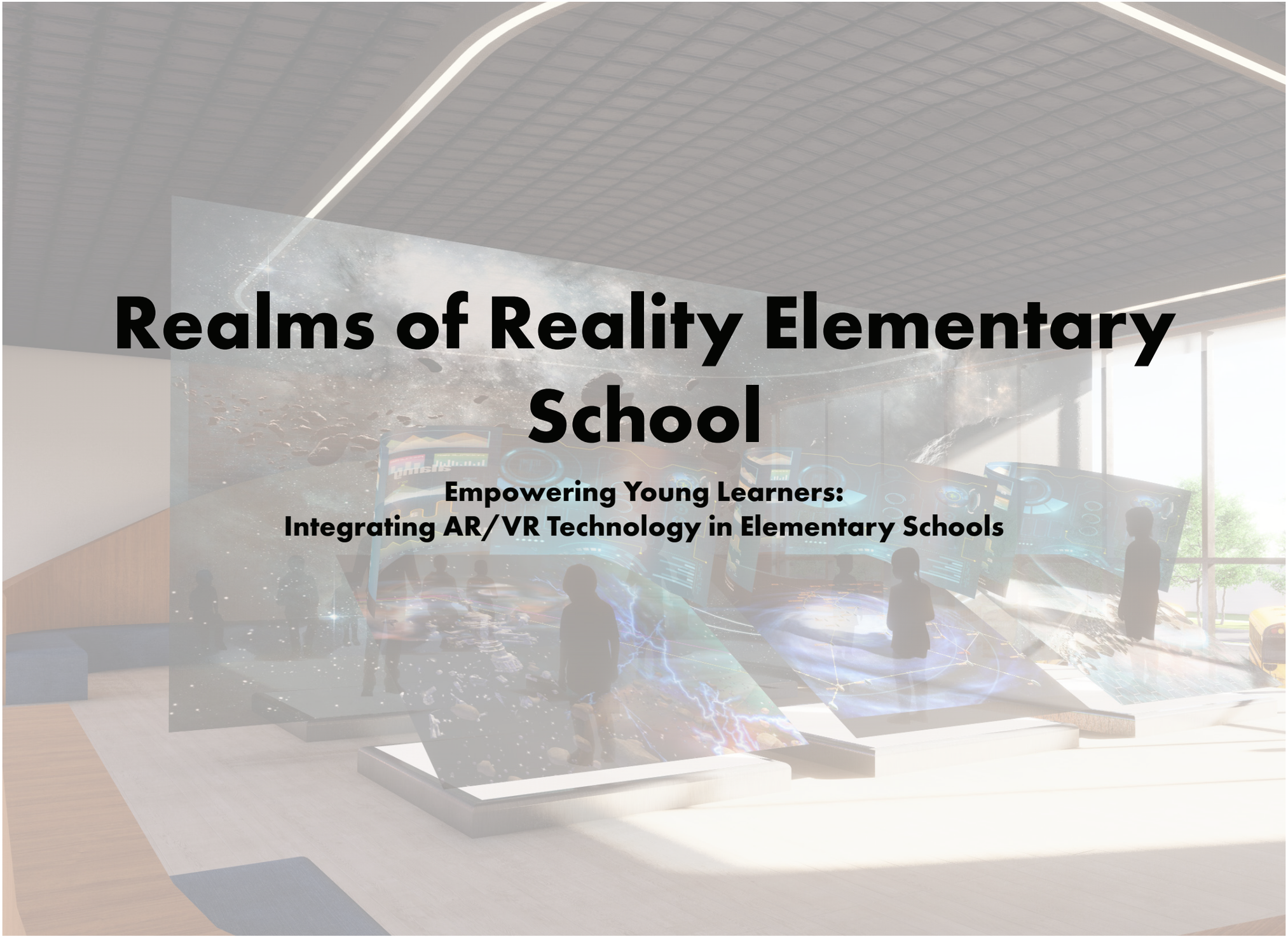


Realms of Reality Elementary School

Empowering Young Learners:
Integrating AR/VR Technology in Elementary Schools

Narrative

Over time, numerous changes have occurred, particularly in the technology field, which has experienced rapid growth in the 21st century. In recent years, Augmented Reality (AR) and Virtual Reality (VR) technologies have advanced significantly, and it's essential to equip the younger generation with the necessary tools to succeed in life. Ultimately, the objective of this project is to enhance students' spatial reasoning skills, which will have a positive impact on their overall education experience.

History of Virtual Reality (VR) and Augmented Reality (AR)

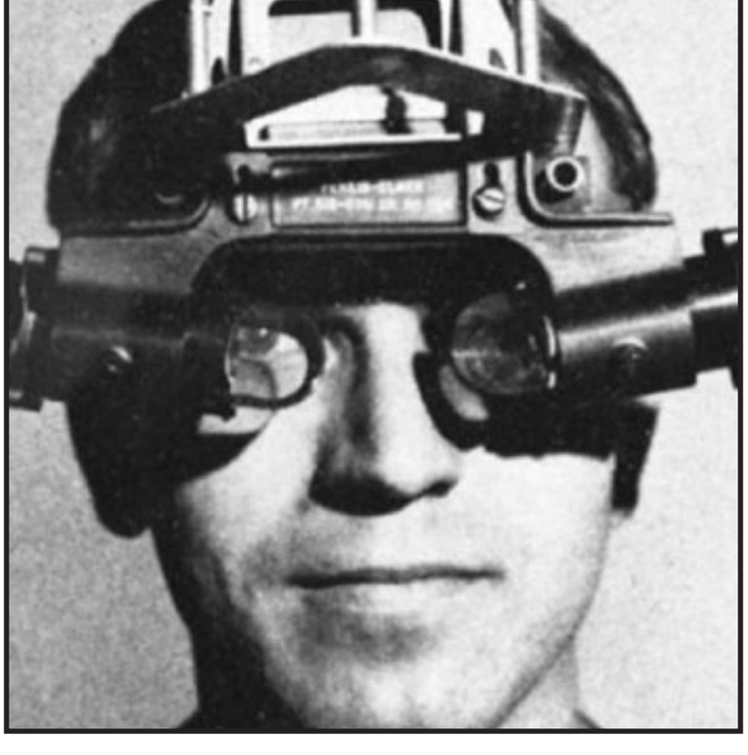
History

1956:

Sensorama

1968:

The Sword of Damocles



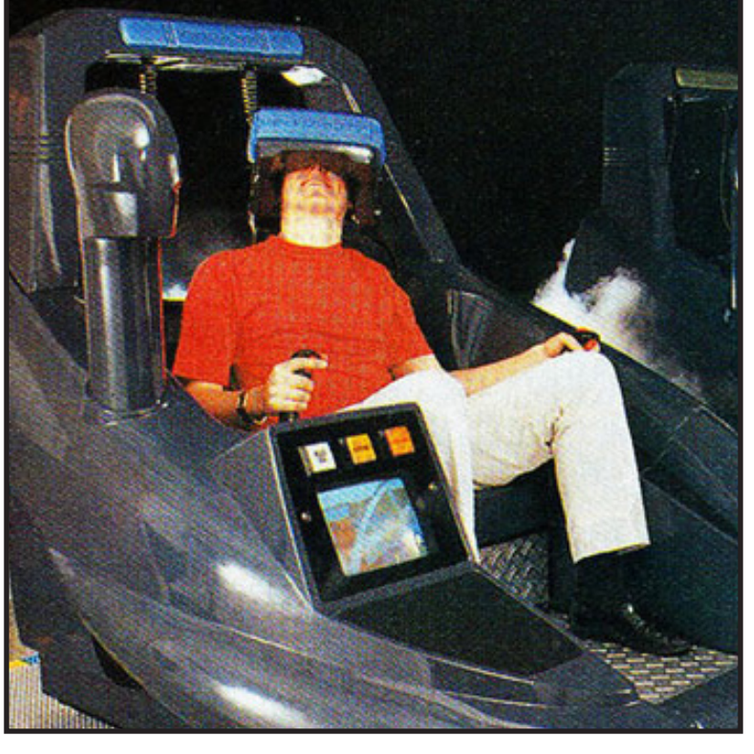
History

1985:

VPL Research, Inc.

1991:

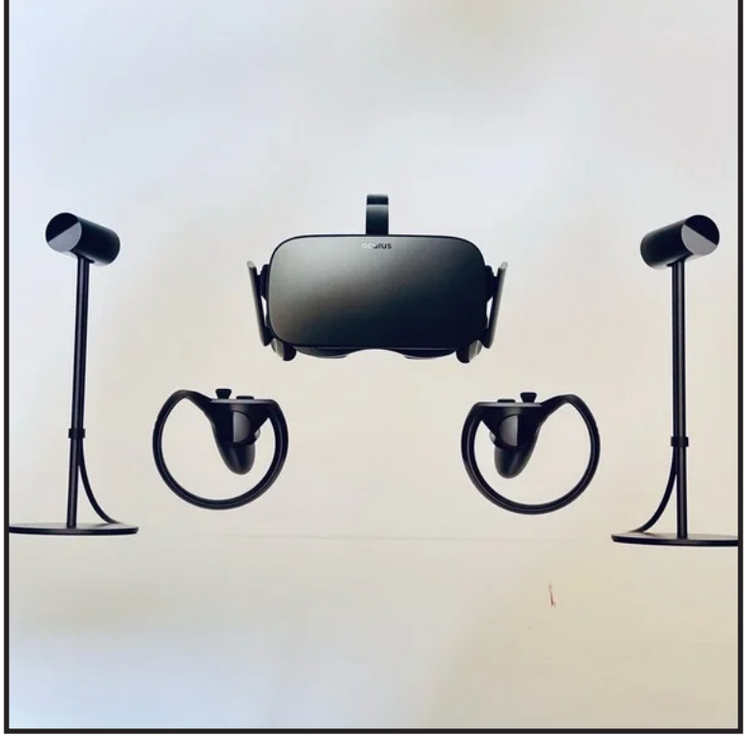
Virtuality



History

2012:

Oculus Rift Kickstarter



2019:

HoloLens 2

History

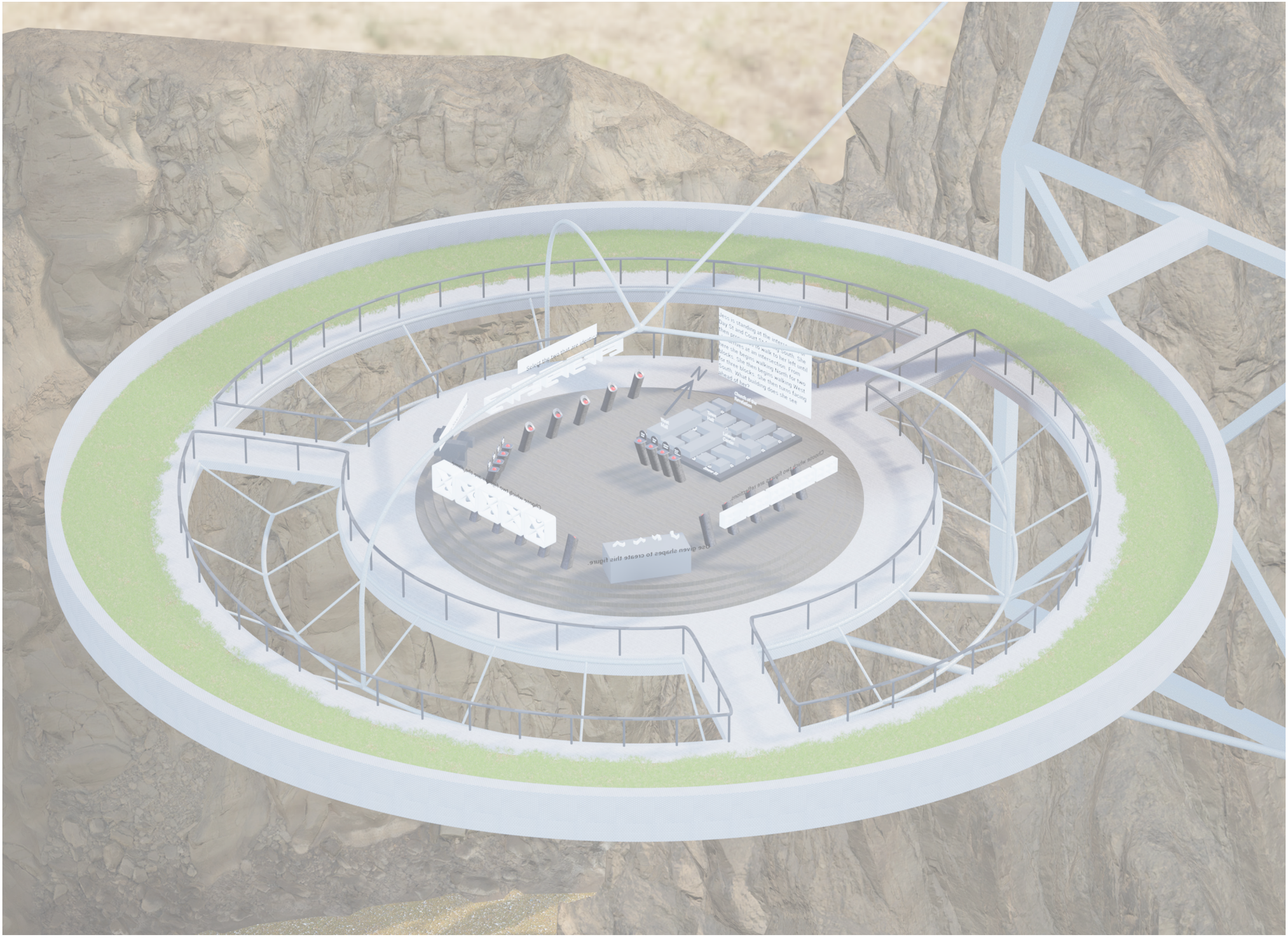
2020:

Oculus Quest 2

2023:

Omni One

Increasing Spatial Reasoning Ability: The Strengths and Weaknesses Between Virtual Reality and Paper/ Pencil Testing



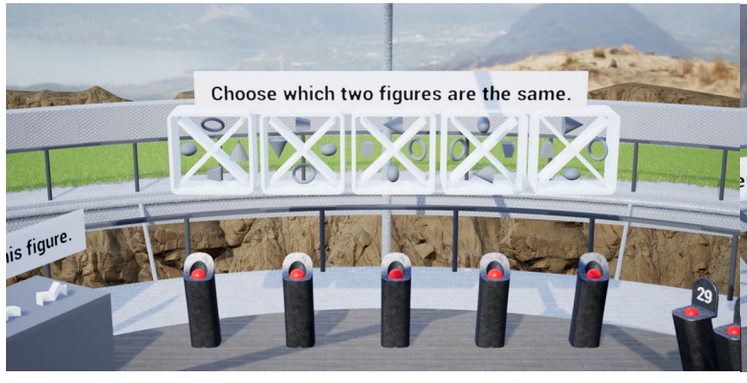
Virtual Reality Test

For the virtual reality test participants needed to complete six questions. Each of the questions was designed to activate participants' spatial reasoning skills.

Group Rotation (GR)
Reflections (RF)
Map/Plan (MP)
Block Counting (BC)
Visual Comparison (VC)
Combining Shapes (CS)

Participants were given the option to perform this test either standing or sitting. Once started the participants had ten minutes to complete all six questions. The multiple-choice questions had buttons that participants were able to press to finalize their answers. The combining shapes question required participants to pick up and manipulate objects to create a shape.

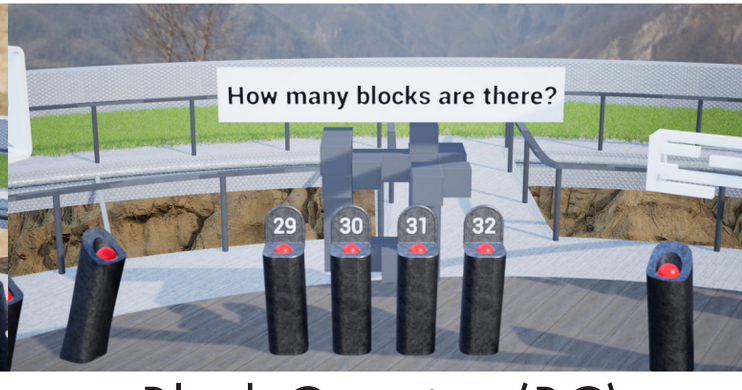
An advantage that the virtual reality test provides is its visualizations which aren't possible in the traditional classroom. Which increases the students' engagement and interest.



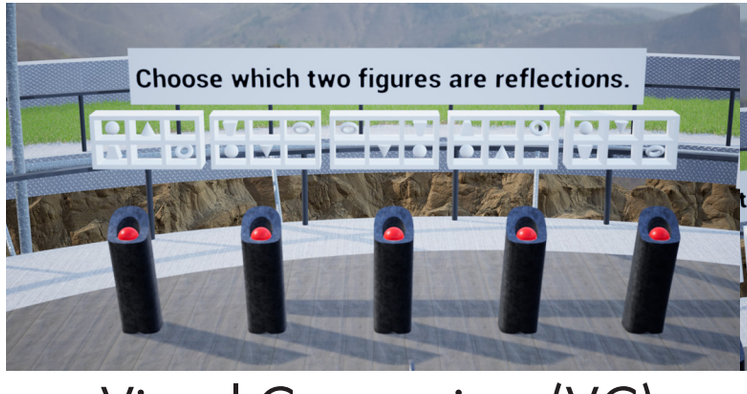
Group Rotation (GR)

Reflections (RF)

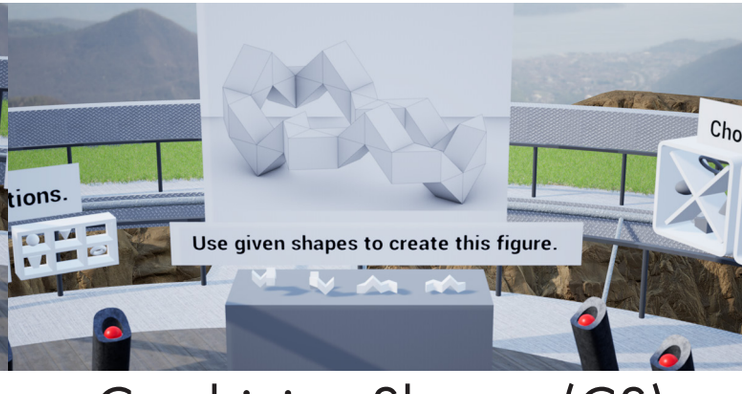
Map/Plan (MP)



Block Counting (BC)



Visual Comparison(VC)



Combining Shapes (CS)

Paper/Pencil Test

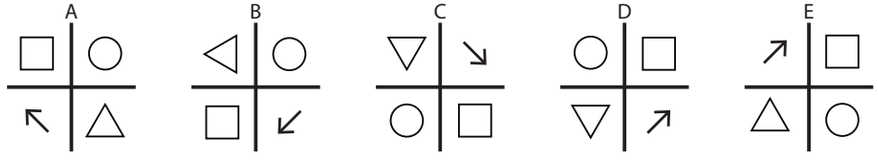
For the paper/pencil test, the participants had to complete the same types of questions from the virtual reality test.

The participants were given a ten-minute timer to complete the six questions. In order to compare their spatial reasoning skills. Participants were not allowed to draw notes on the test. This forced them to do everything mentally which is comparable to the virtual reality test.

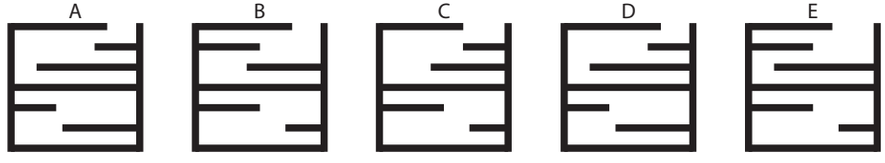
Half of the participants started by taking the paper-pencil test. This allowed for two groups of participants to form allowing for a deeper analysis of the data.

The entire experiment took thirty minutes. With a five minute introduction, ten-minute test, five-minute break, and final ten-minute test.

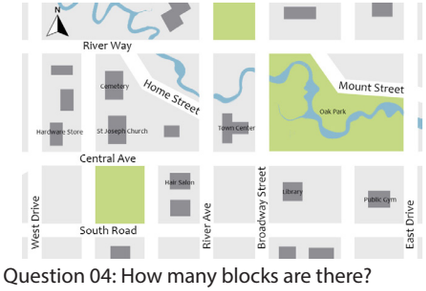
Question 01: Circle the two identical figures.



Question 02: Which two figures are identical?

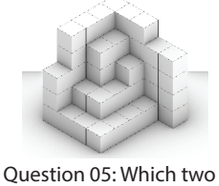


Question 03: Identify what building Lisa is in front of on the map.



Lisa is standing on Mount Street facing south. She then proceedes to walk to her left until she reaches an intersection. Upon reaching the intersection she begins walking along Oak Park the same way she has been until she reaches another intersection. From here she decided to walk a block south toward South Road. She then proceedes to walk west for three blocks. At the new intersection she begins heading north until she finds the first building to her east. What building is she in front of? _____

Question 04: How many blocks are there?



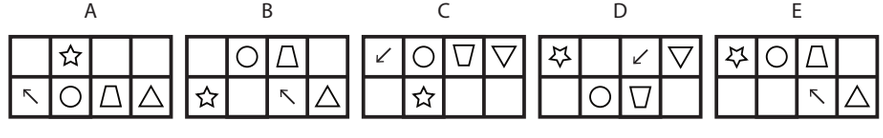
A.) 62

B.) 64

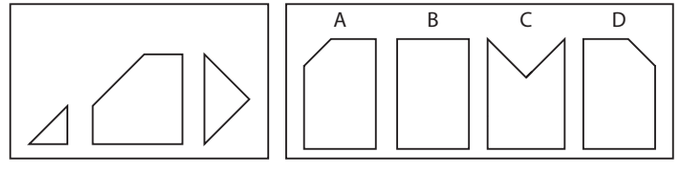
C.) 68

D.) 70

Question 05: Which two figures are the reflection of one another?



Question 06: From the given shapes what is the possible solution?



Research Results

Upon examination of the test as a whole. There is an unbalance of question composition for the type of combining shape. The paper test consisted of three simple 2D shapes that participants had to manipulate in their minds. In the virtual reality test, participants were given four complex 3D shapes they had to try and manually arrange.

Those who took the paper test first had higher scores on the virtual reality test when compared to participants that took the virtual reality test first.

Sixty-six percent of the participants scored better on the paper test, regardless of which test was given first.

Only one of the participants scored higher on the virtual reality test. He was the only participant to immerse himself in the virtual environment. This means he was standing up, walking around, and crouching. This was different from other participants who remained seated for the virtual portion

Paper Test

GR	VC	MP	BC	RF	CS
1	1	1	0	0	1
1	1	1	0	1	1
0	1	0	1	0	1
1	1	0	1	1	1
1	1	1	1	1	1
1	1	0	0	1	0
1	1	1	1	1	1
0	1	1	0	0	1
1	1	0	1	1	1
7	9	5	5	6	8

In the chart, the ones represent a question answered correctly. A total is then given below to help determine which test performed better.

For the paper/pencil test participants scored higher on the visual comparison, block counting, and combining shapes questions. However, the question of the combining shape is null.

VR Test

GR	VC	MP	BC	RF	CS
1	0	1	0	0	0
1	1	0	0	1	0
0	1	0	1	0	0
1	0	1	0	1	0
1	1	1	0	1	0
1	1	0	0	1	0
1	1	1	0	1	0
1	1	1	0	1	1
1	1	0	0	1	0
8	7	5	1	7	1

For the virtual reality test participants scored higher on the group rotation question. While tieing with the map/plan question.

Between the two tests. Only the paper/pencil test was able to achieve a perfect score. The type of question that was answered correctly for all participants was visual comparison.

Oculus Quest

Key Features:

- High Resolution
- 6GB RAM
- Touch controllers
- Hand tracking
- Wireless
- Oculus Link

Key Integration:

- VR Simulation Lab
- VR Digital Lab

HoloLens 2

Key Features:

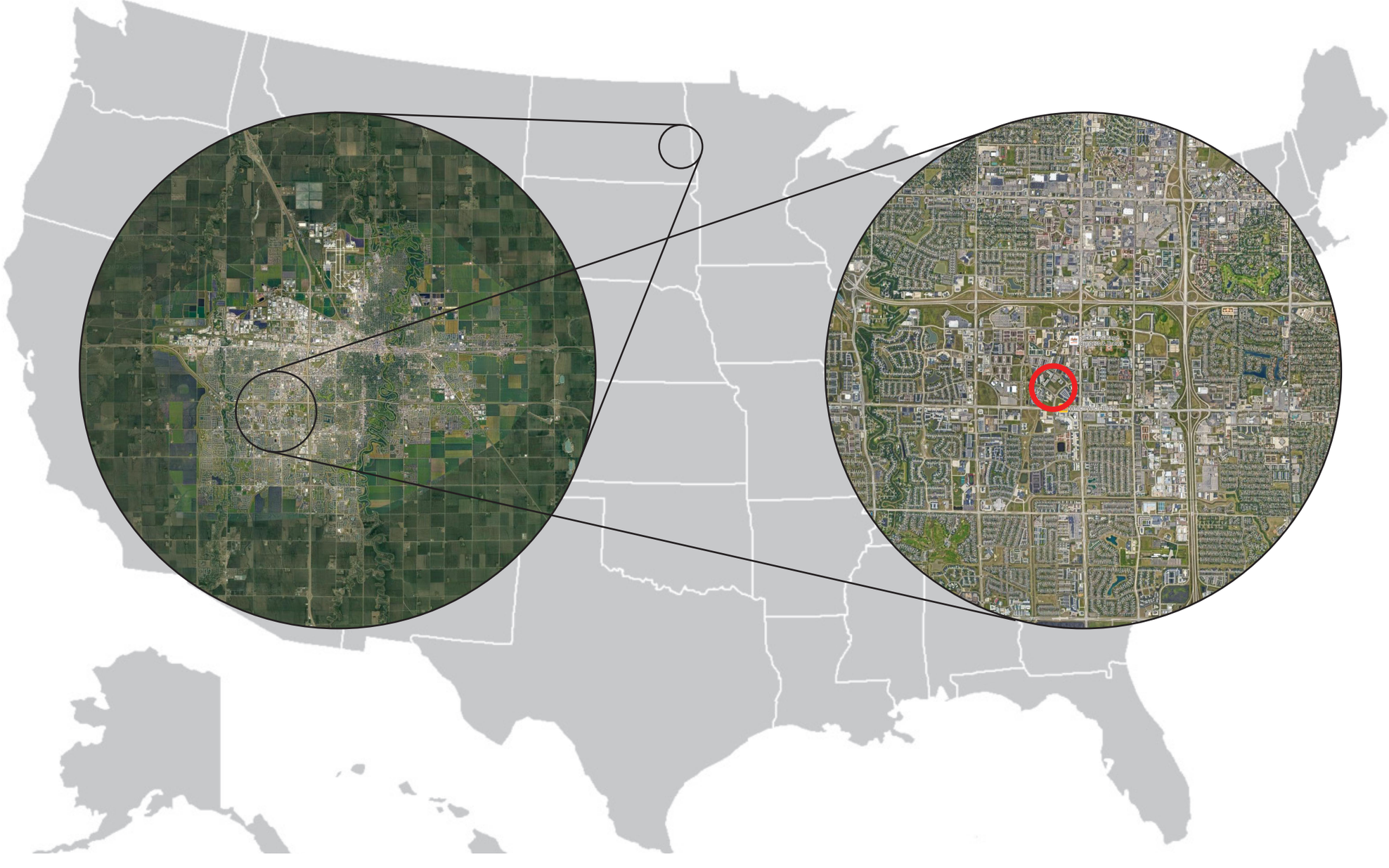
- Immersive display
- Hand and eye tracking
- Voice Control
- Lightweight and comfortable
- Long battery life

Key Integrations:

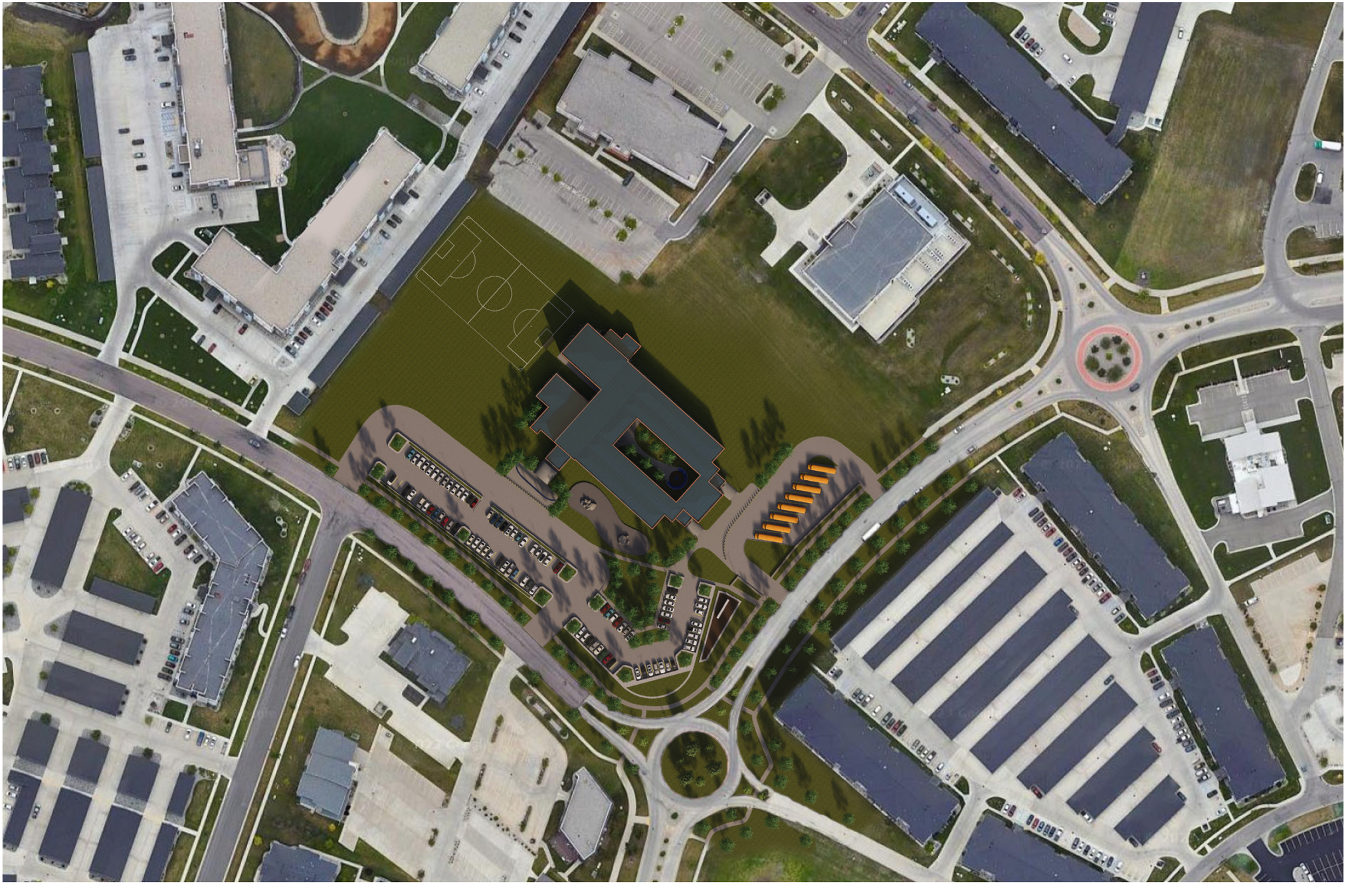
- Hallways
- Classrooms
- Labs
- Shared spaces
- Breakout spaces

Design Solution

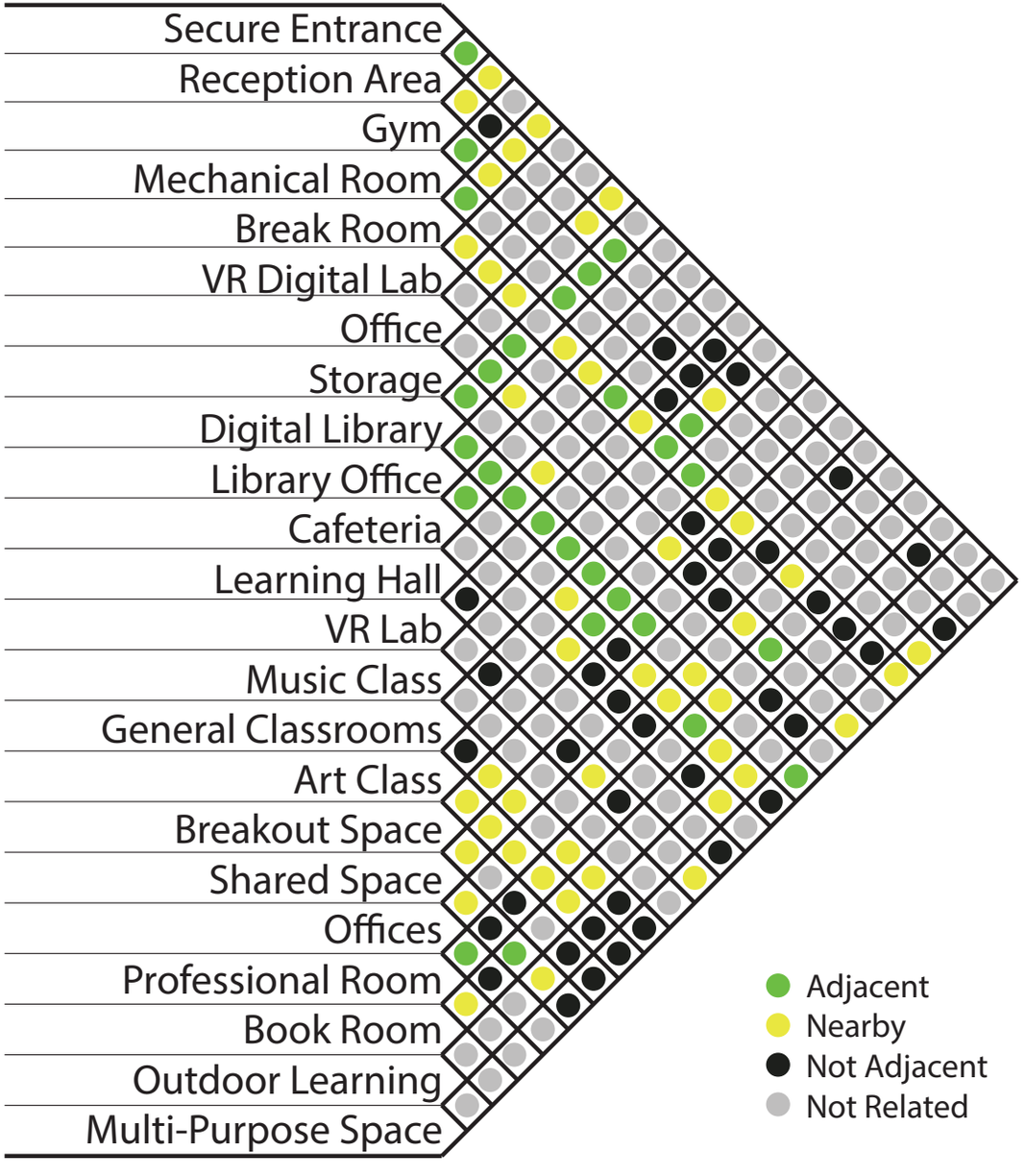
Location



Site



Program

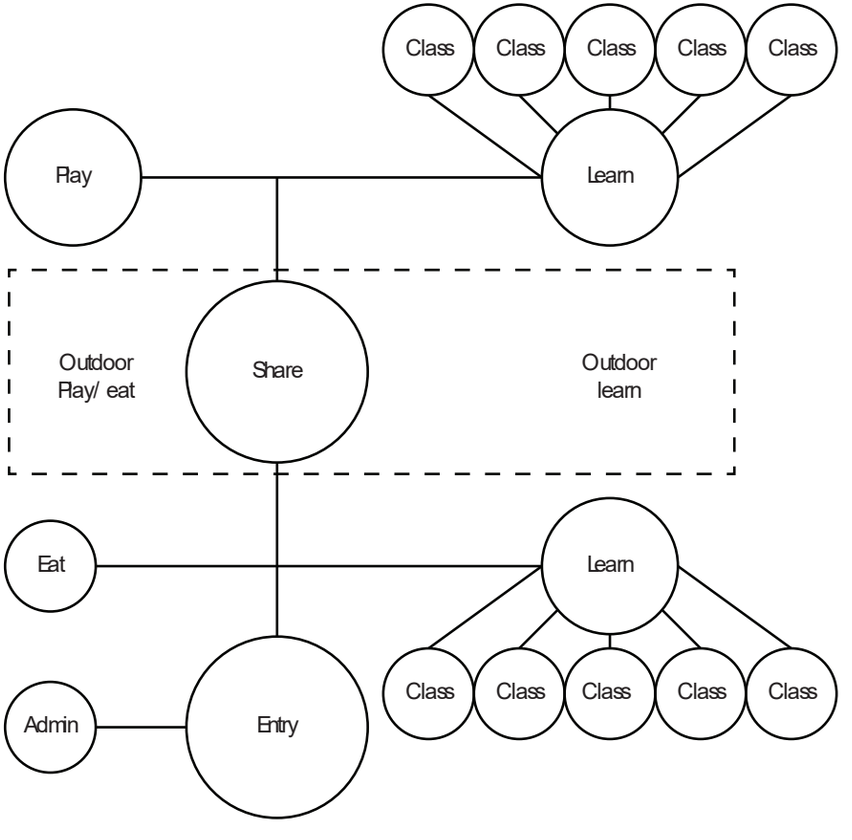


Spatial Interaction Matrix:

- Aided in determining the placement of spaces

Streamline Version:

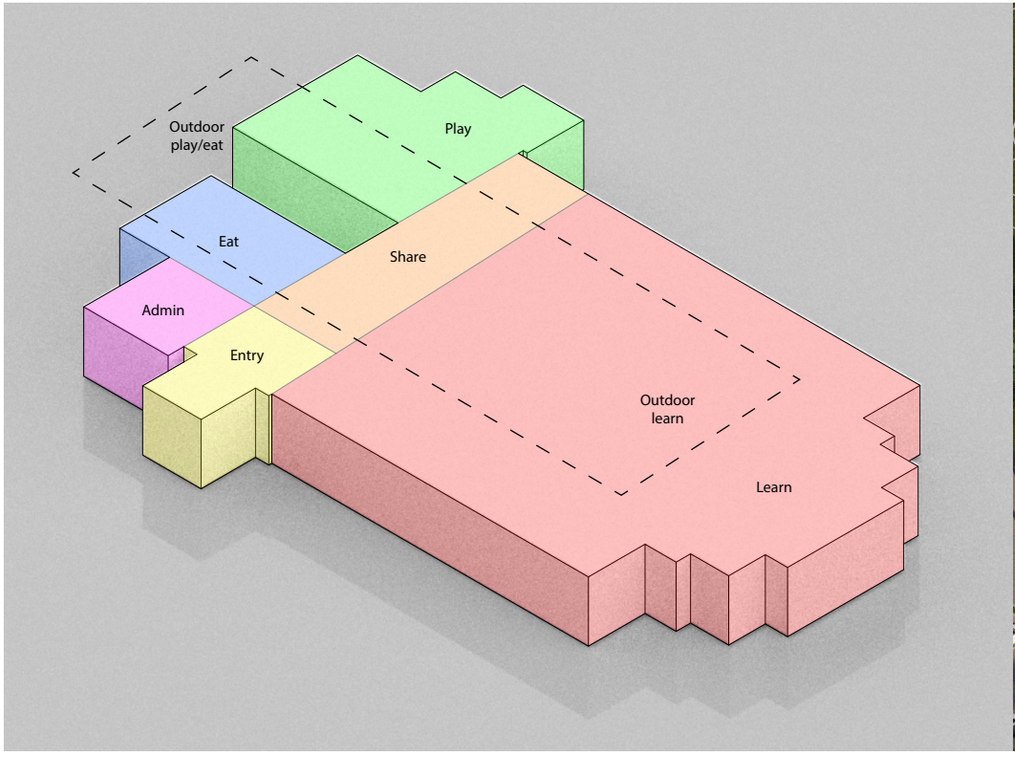
- Simplify the program into core areas
- Expand the core areas into the program needs



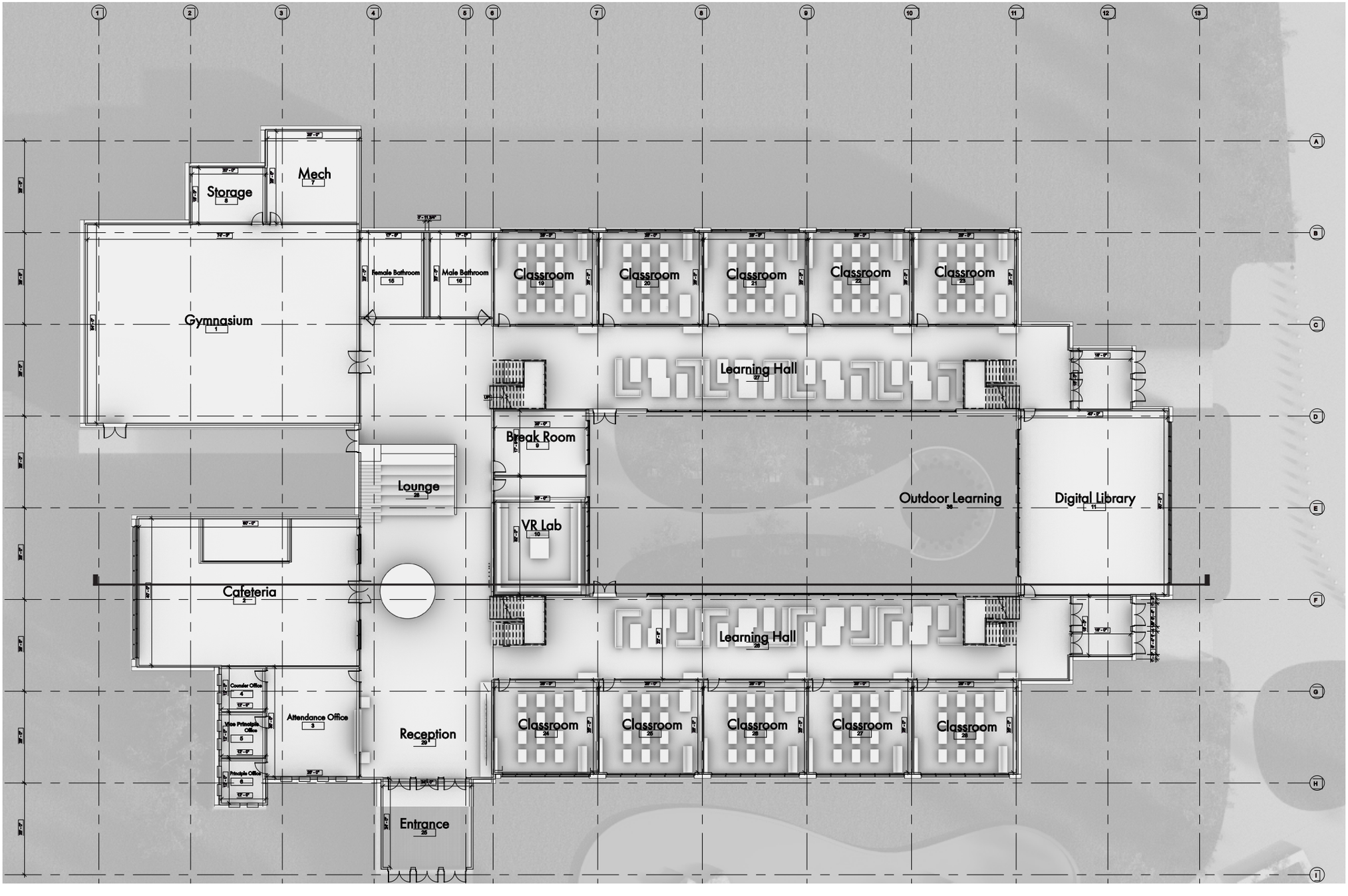
Spatial Concept

Key Areas:

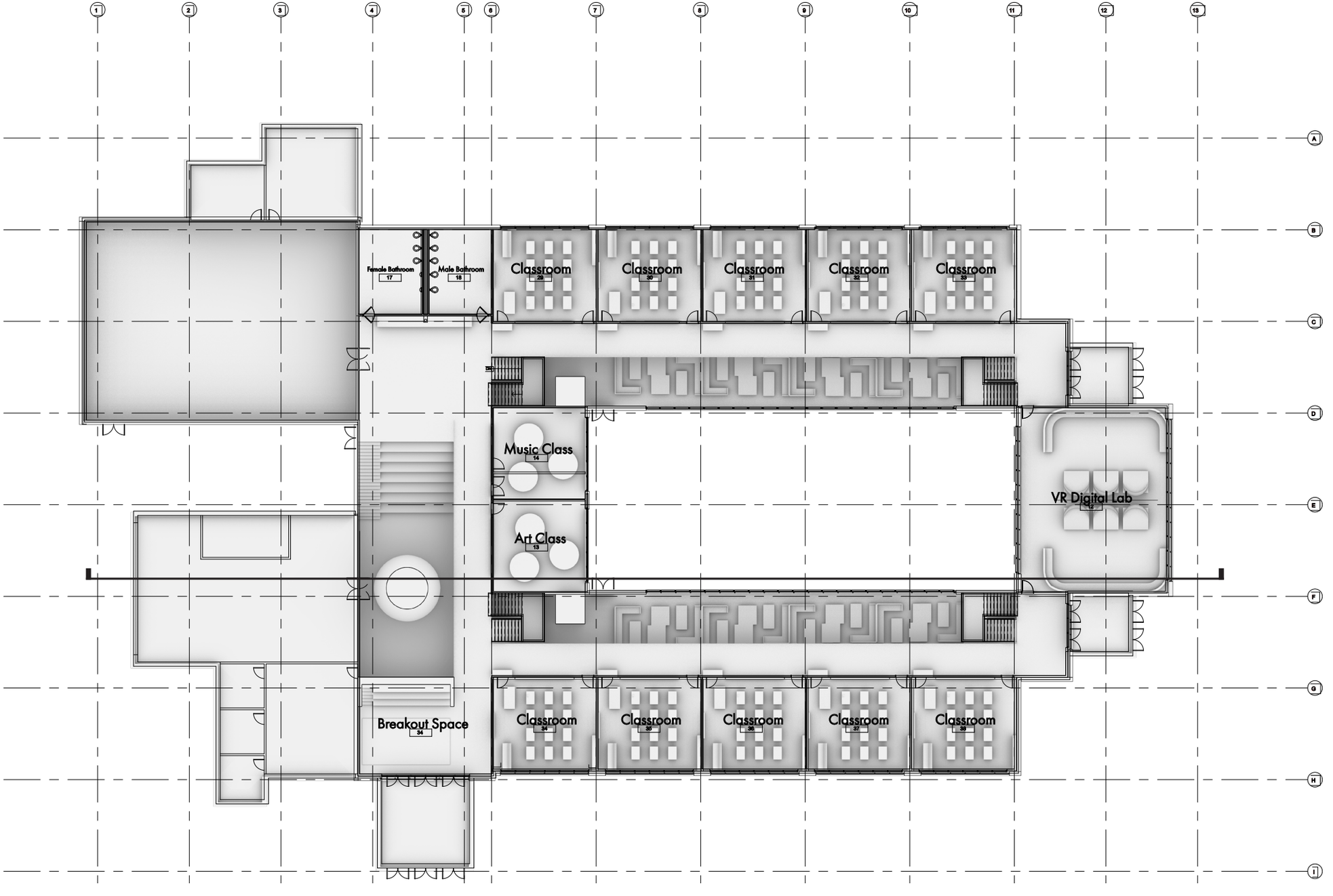
- Sharable spaces are placed centrally
- Learning area placed equal distance from the bus and parent drop off
- Play area placed north-east corner with access to green space
- The administration is located next to the main entrance to ensure security
- Outdoor learning is placed within the learning core area



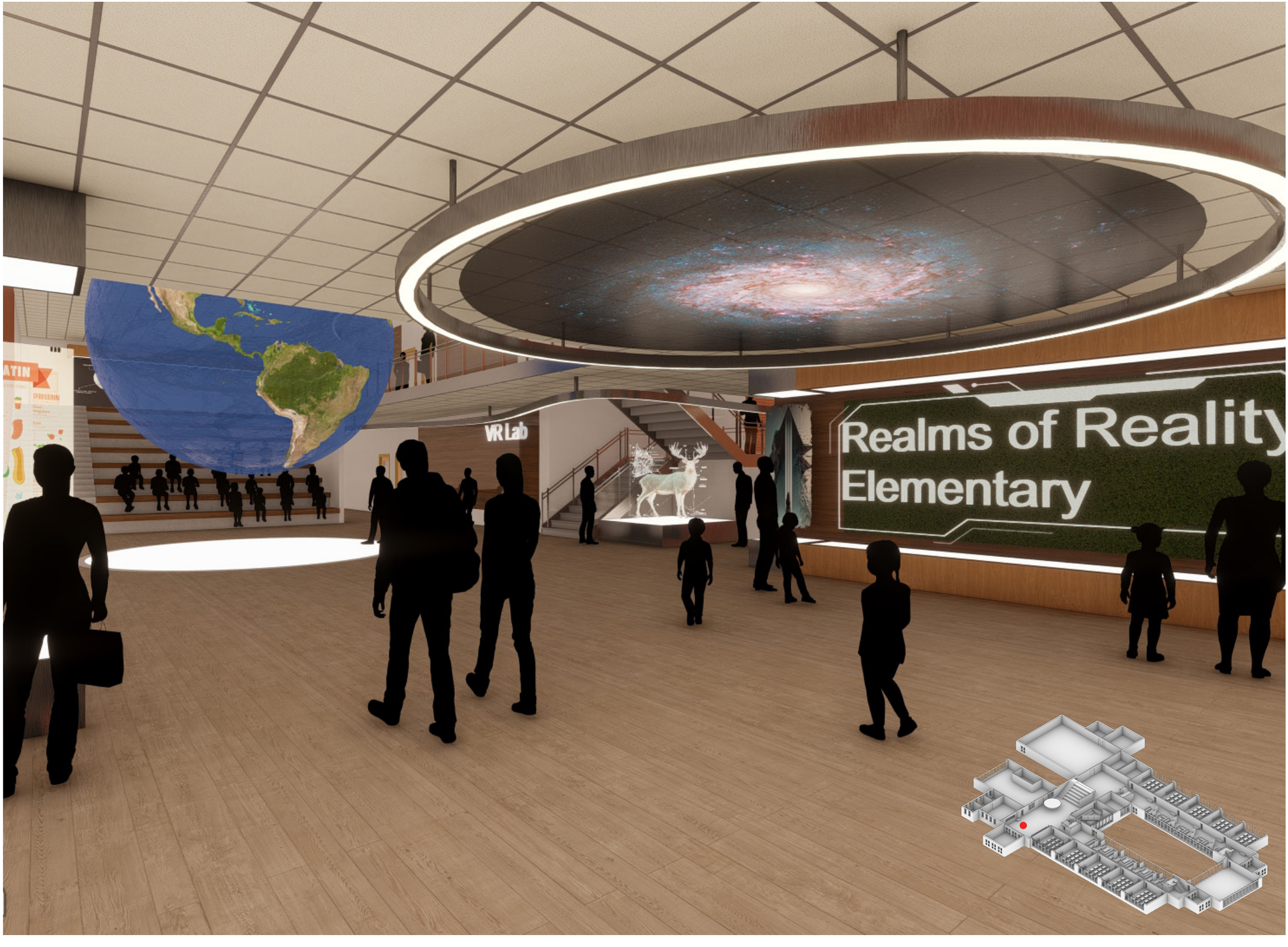
Level 01 Floor Plan



Level 02 Floor Plan



Key Integrations of AR and VR Technology



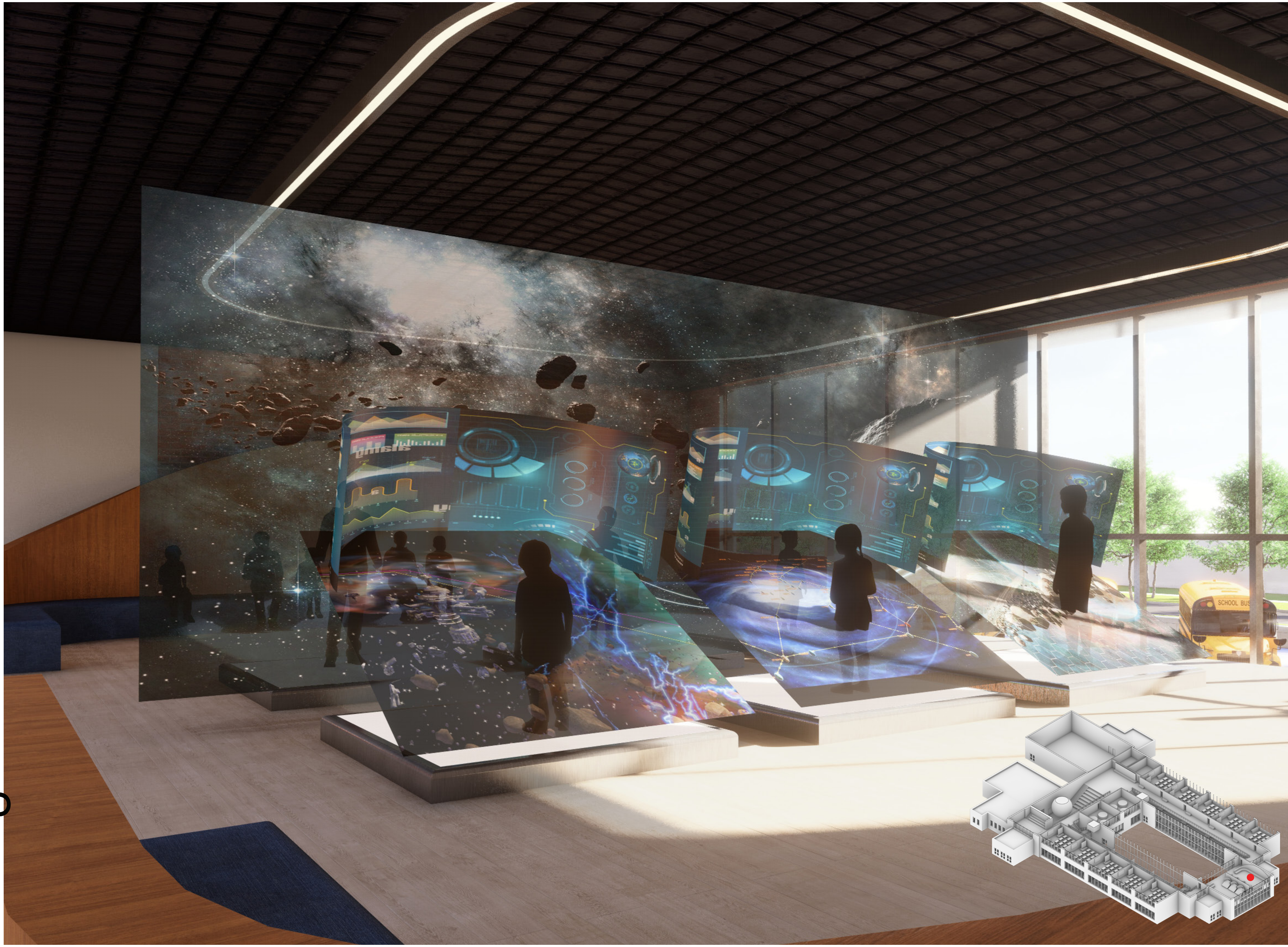
Entrance

Learning Hall

Learning Hall

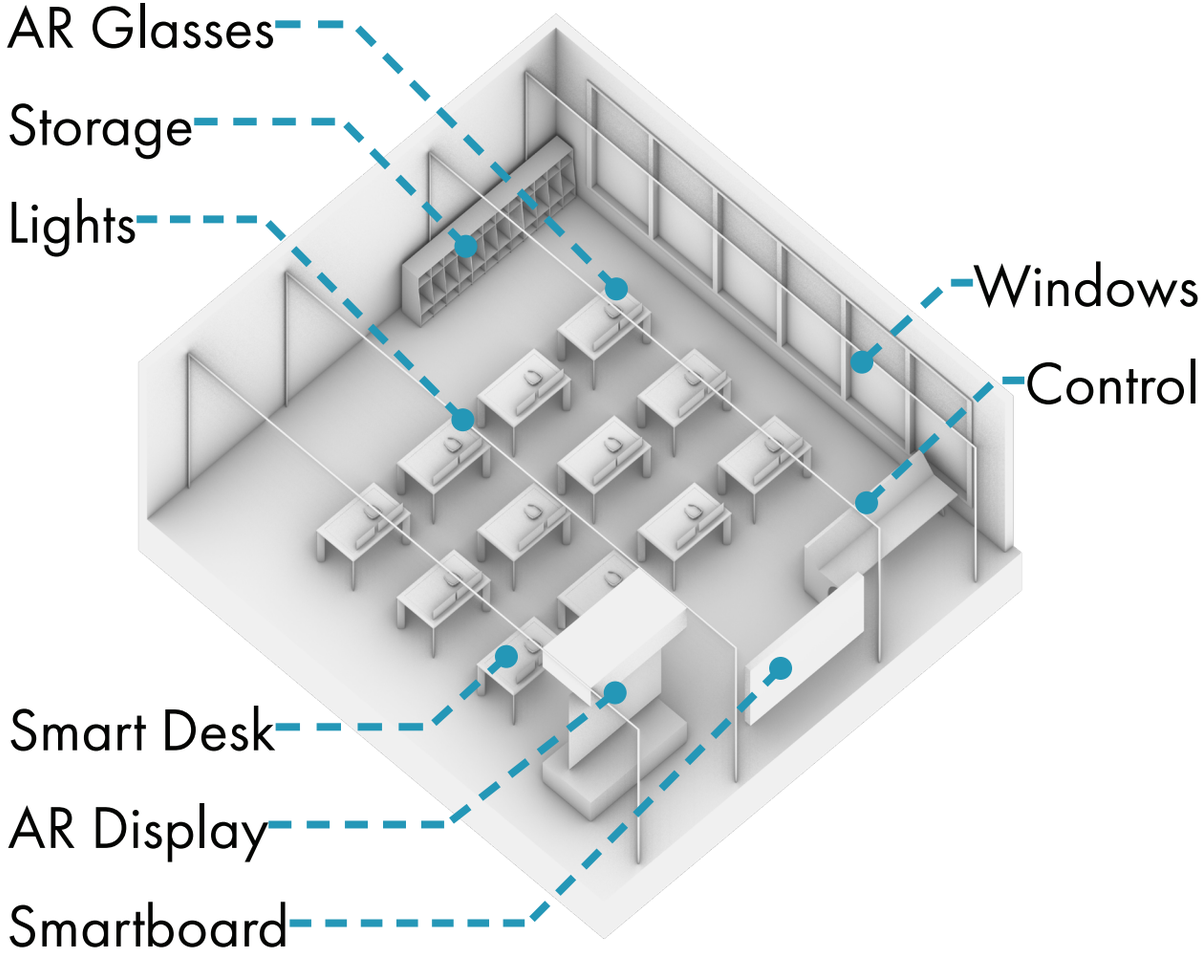
Outdoor Learning

VR Digital Lab



AR Classroom

Students have AR glasses that project to two monitors at the edge of their smart desks. The smart desk has a digital touch screen for taking notes. The teacher is able to control the students' glasses and smart table from the control panel on their desks. Ensuring that students stay interested in the learning topic. An AR display is placed at the front of the classroom where the main portion of the learning will take place. With the student's AR glasses, they are able to have 3D objects of the learning material in front of them while being able to manipulate what they see.

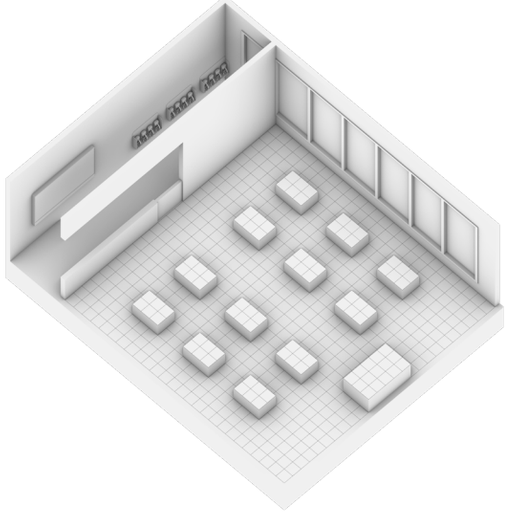


AR Classroom

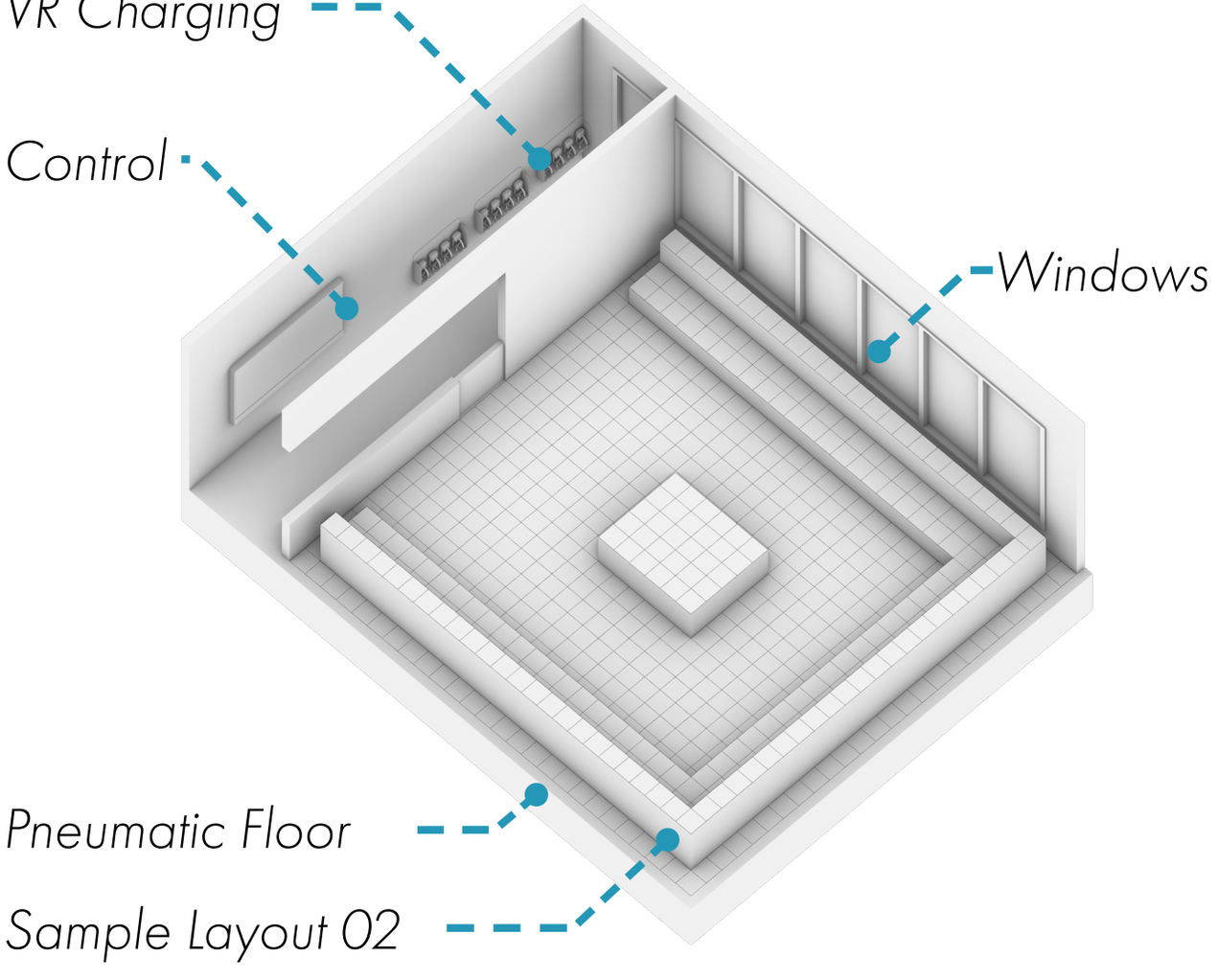
VR Simulation Lab

This lab is designed to create an adaptive room that works in tangent with VR headsets. The floor is comprised of 1'x1' square tiles that can be controlled to create new seating. At the control panel teachers are able to set the layout of the room from a preset list. Types of classes that would use this lab include science, social studies, language arts, and math.

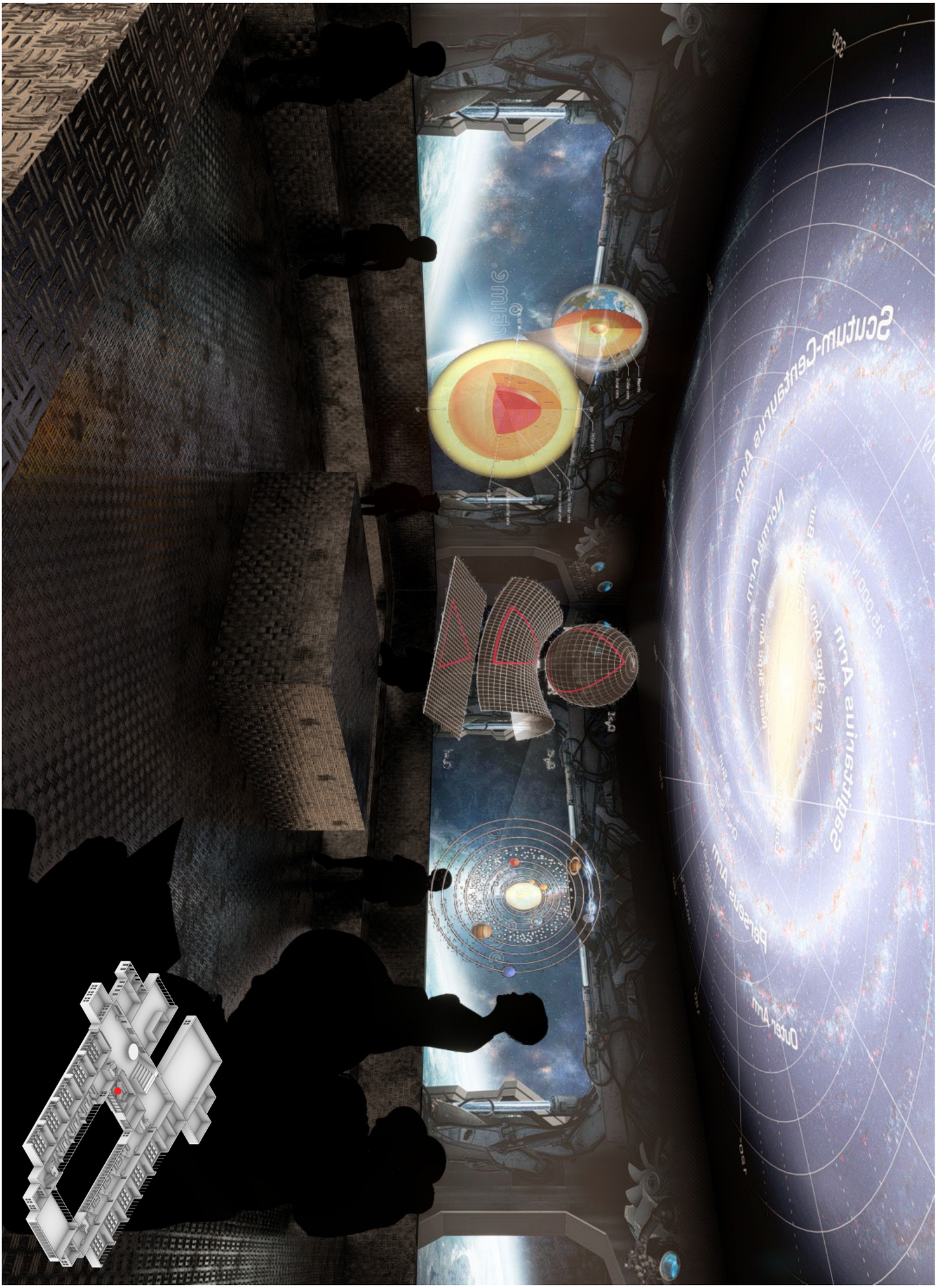
Grid Layout



Cricle Layout



VR Simulation Lab



Conclusion

Integrating AR and VR technologies into elementary schools offers enhanced learning experiences, increased student engagement, and improved learning outcomes. These technologies provide access to remote learning opportunities, exposure to potential career paths, and the development of spatial reasoning abilities through interaction with digital 3D objects. Overall, integrating AR and VR technologies into elementary schools creates a more engaging and effective learning environment that prepares students for the future.

Questions?