# Using Smartphone-Based Augmented Reality for Asynchronous Learning:

# A Case Study
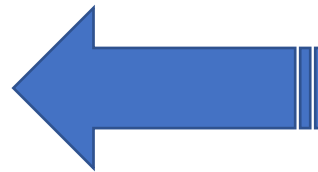
Isaac Chang @ Technology

Jeritt Williams @ Technology
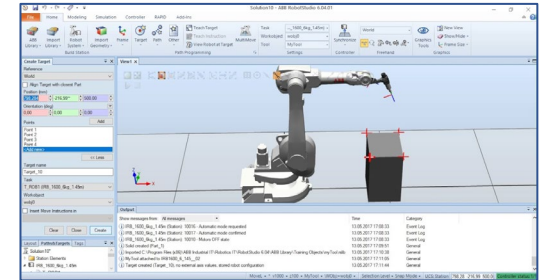
# Programming Industrial Robots



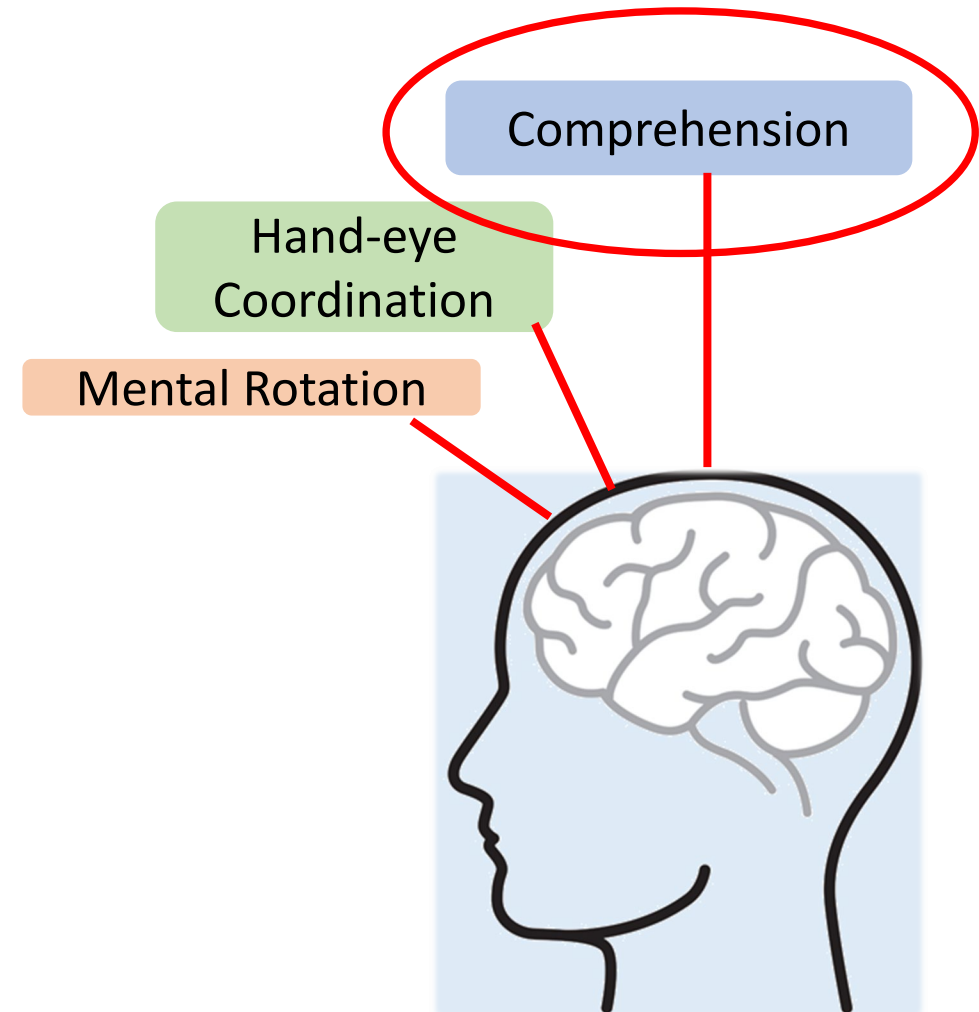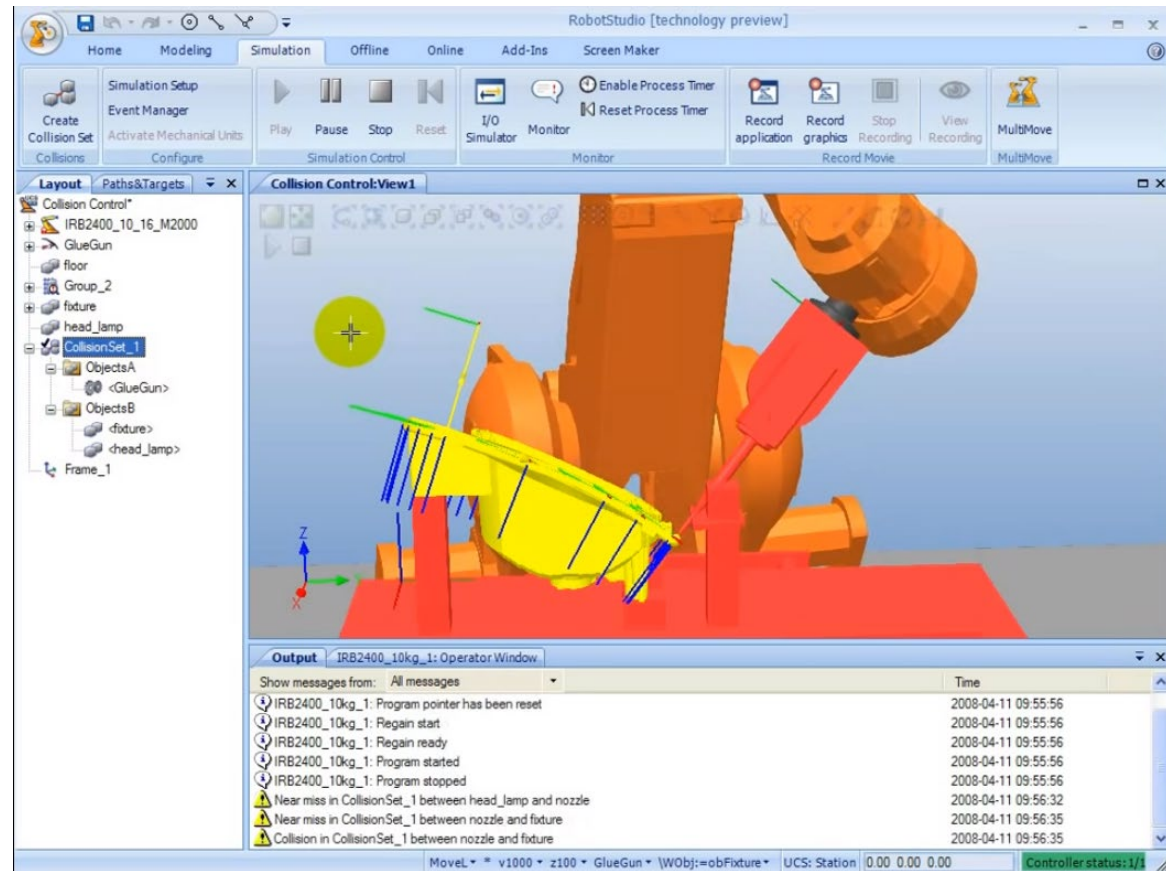**Manual** Programming:
**Intuitive**, but
**Slow & Tedious**

**VR-assisted** Programming:
**Immersive and straightforward**, but
**Limitation on Precision/Receptiveness**

**Desktop** Programming:
**Fast**, but
**High Cognitive Load**

# Do they REALLY get it?



Comprehension

Hand-eye Coordination

Mental Rotation

# Text-based Project Instruction
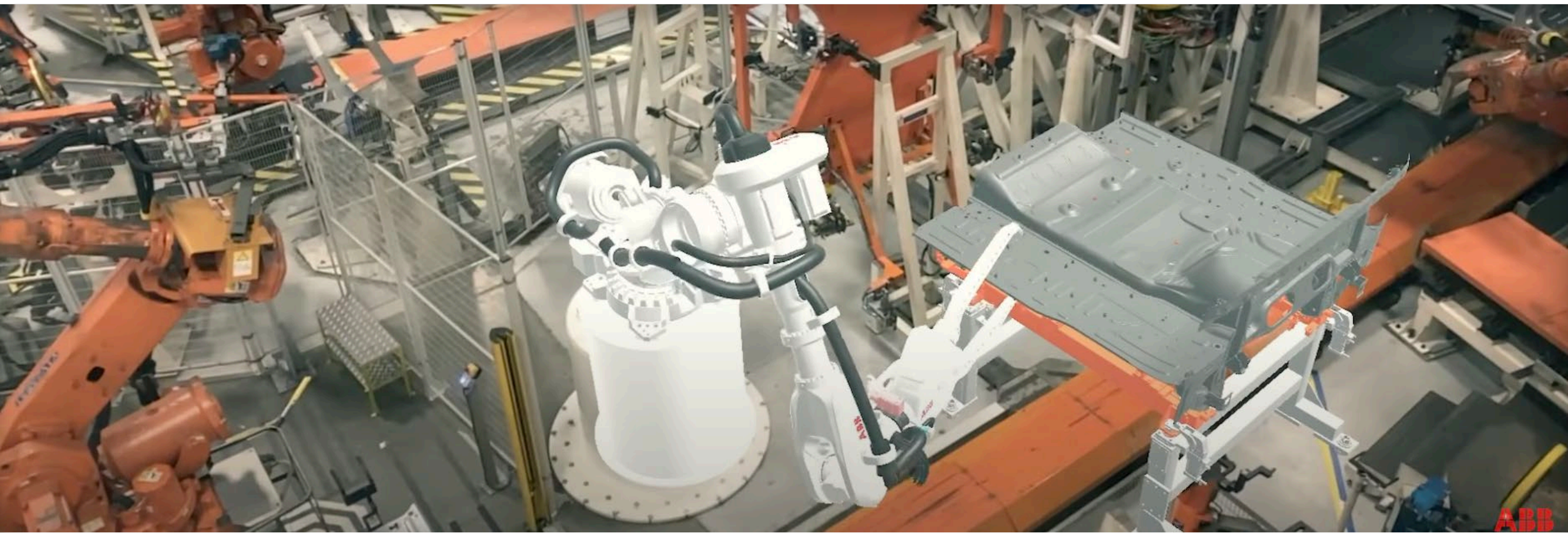
***Overview***

*Your final project is to create an automatic block sorting station that uses an industrial robot integrated with PLC sensors to sort blocks into one of two configurations, as determined by a work cell operator.*

*The robot will pick up blocks one by one from the Grabber Slope, sort them by size as identified by the Sensor Post, and then proceed to arrange them in a vertical stack (tower) of either short-to-long (vee) or long-to-short (pyramid). The PLC wiring and programming have already been completed for you. However, you will need to ensure that your RAPID program sends and receives the proper I/O signals to ensure that everything works as expected. In your virtual station, a "digital twin" of the PLC sensors signals exchange has been configured so that you can test the functionality offline before deploying your application on a workstation containing a real robot and real PLC.*
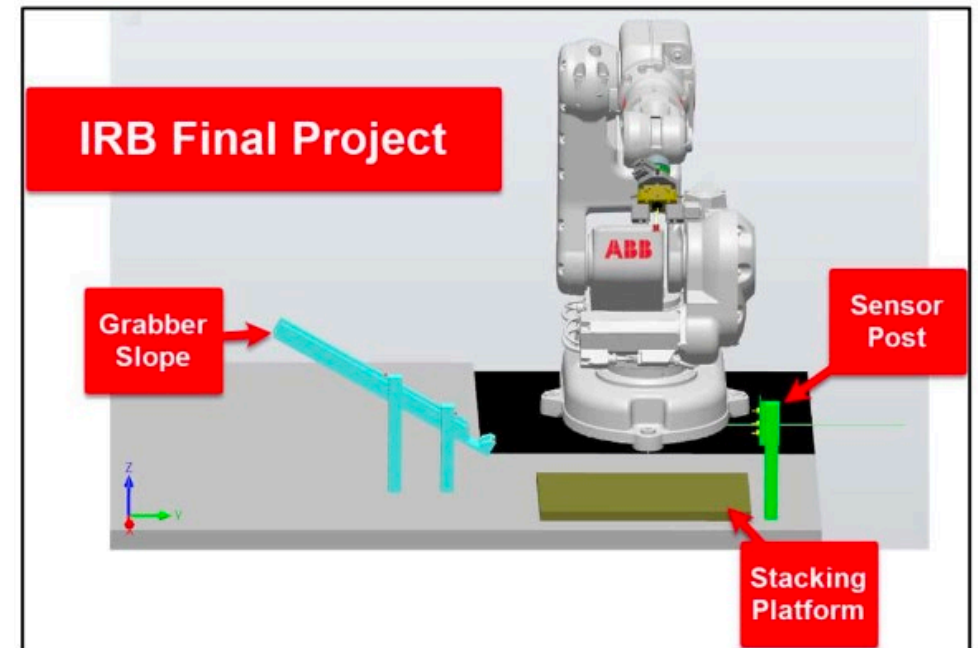
# Smartphone-based Augmented Reality

- Computer-generated image overlays
- Marker-based vs. Markerless AR – QR Code
- App-based vs. Web-based – Visual Display follows users
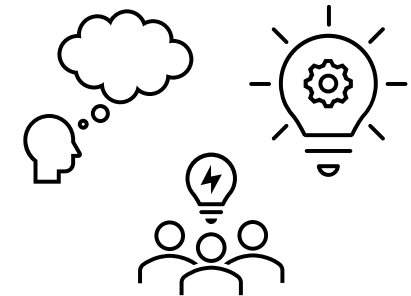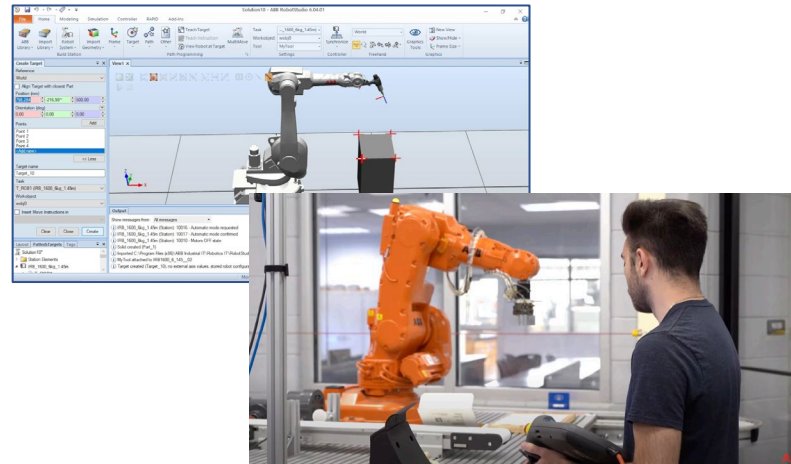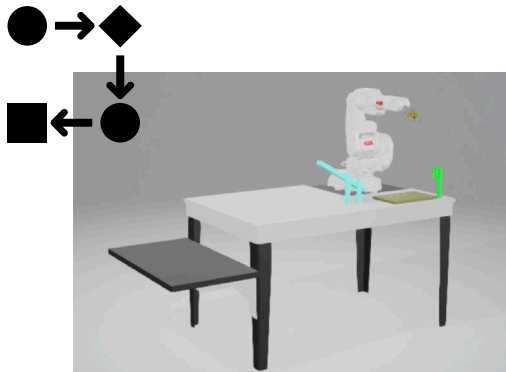
# What do they see?

**Pre Survey**
- Project Overview
- AR models

**Project**
- Desktop programming
- Test with actual robots

**Post Survey**
- Troubleshooting
- Technology Utilization
- Preferences

# Pre-project Survey

- Plan your work and list tasks needed
    - Bulleted points
        - Actual tasks
        - RAPID commands
        - Outcomes
        - Model performance

- Describe additional important details noticed
    - Bulleted points or paragraph
        - Detailed how the robot and object interact
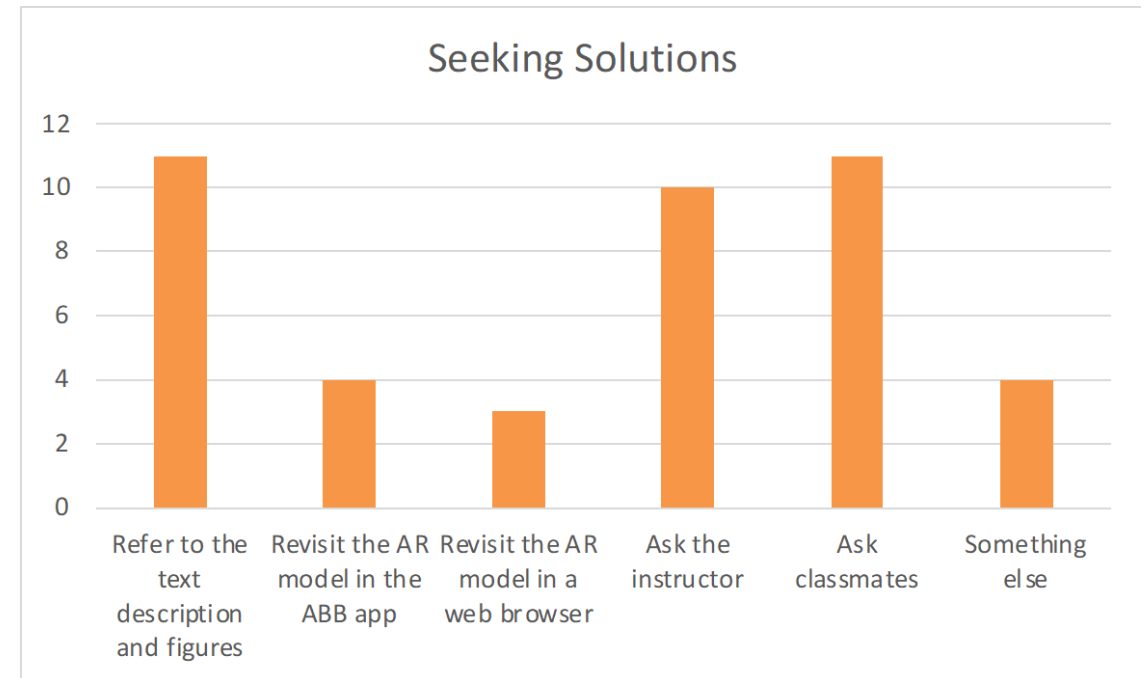        - Different focuses
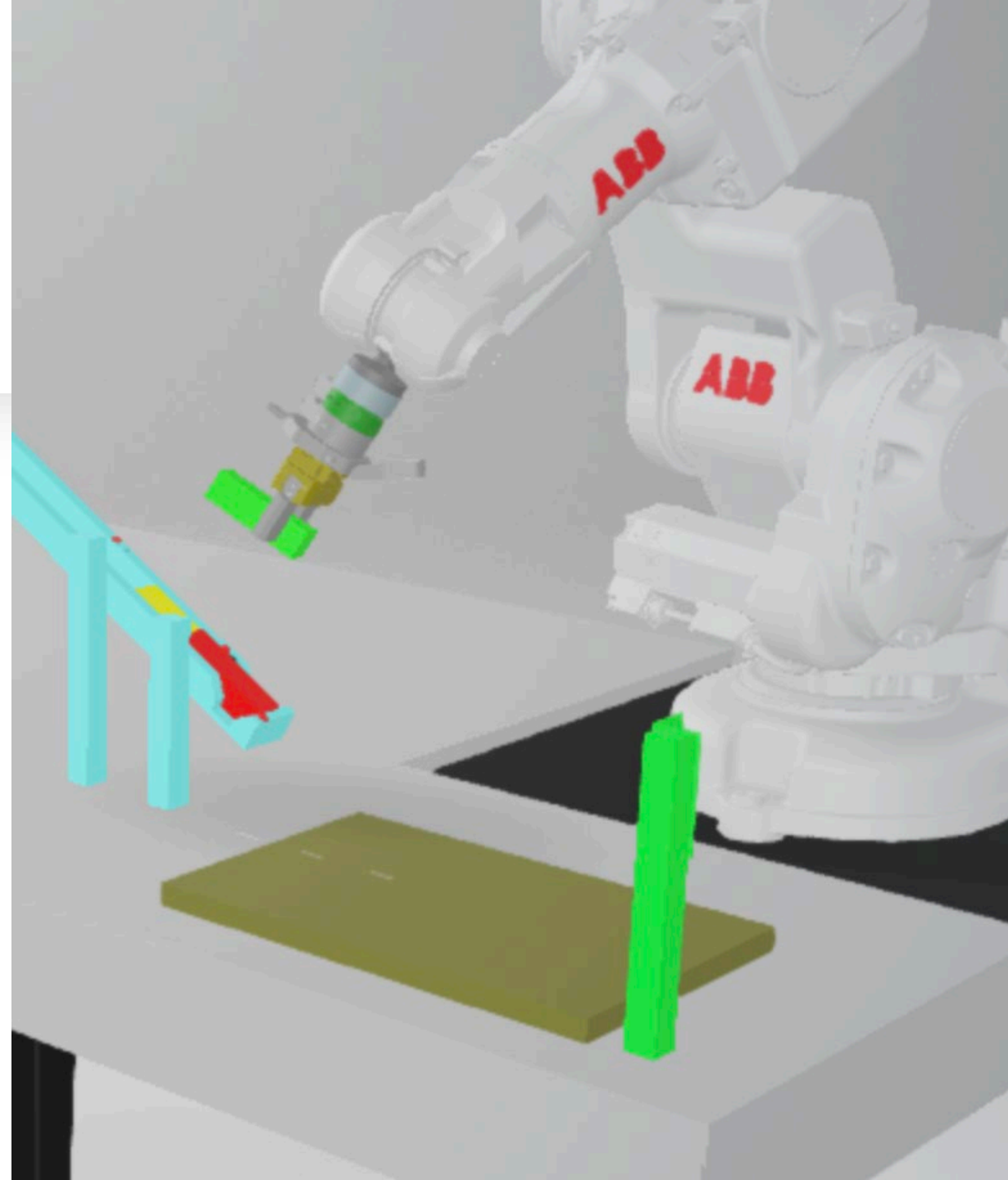
# Post-project Survey

- Based on your experience, which is more valuable to help you **comprehend** the project deliverables?
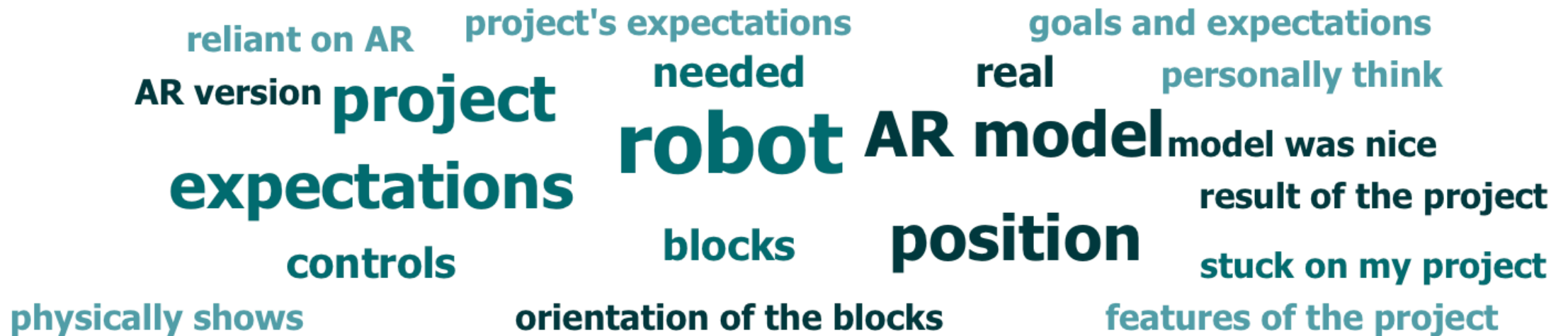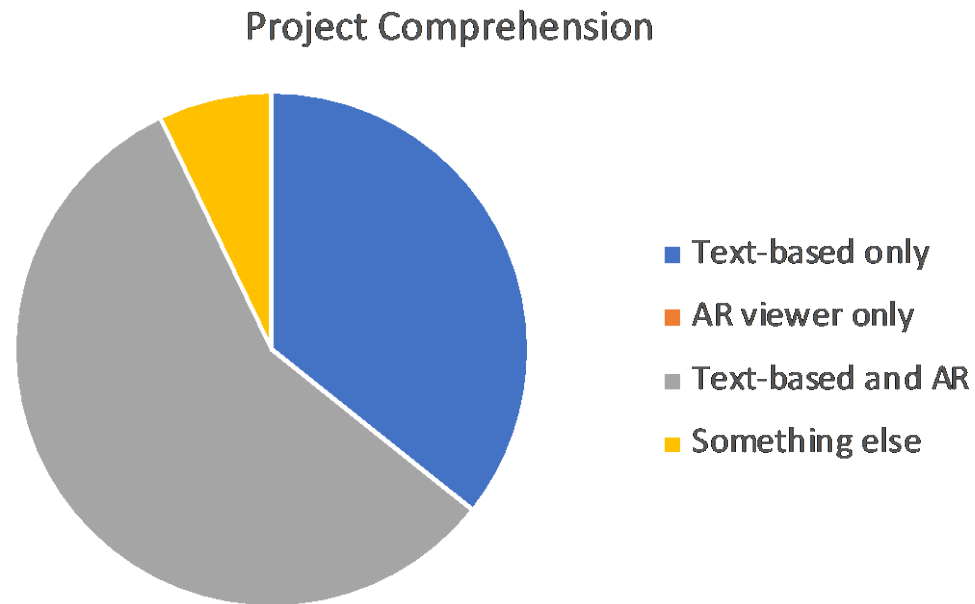
- What did you do during the project when you were **unsure** how to proceed or what the next step would be? (Multi answers)



Project Comprehension

- Text-based only
- AR viewer only
- Text-based and AR
- Something else



Seeking Solutions

# The usefulness of AR

- Do you think the AR model helps convey the project's **expectations**?
  - Yes – 8
  - No – 2
  - Good but no need – 4

# The next step

- Identify the **phenomenon** from existing qualitative data (both pre- and post-project surveys)

- **Larger** sample size (e.g., data collection through multiple semesters)

- Identify the **correlation** between student's project performance and their AR use