

Learning Electrodynamics in Virtual Reality

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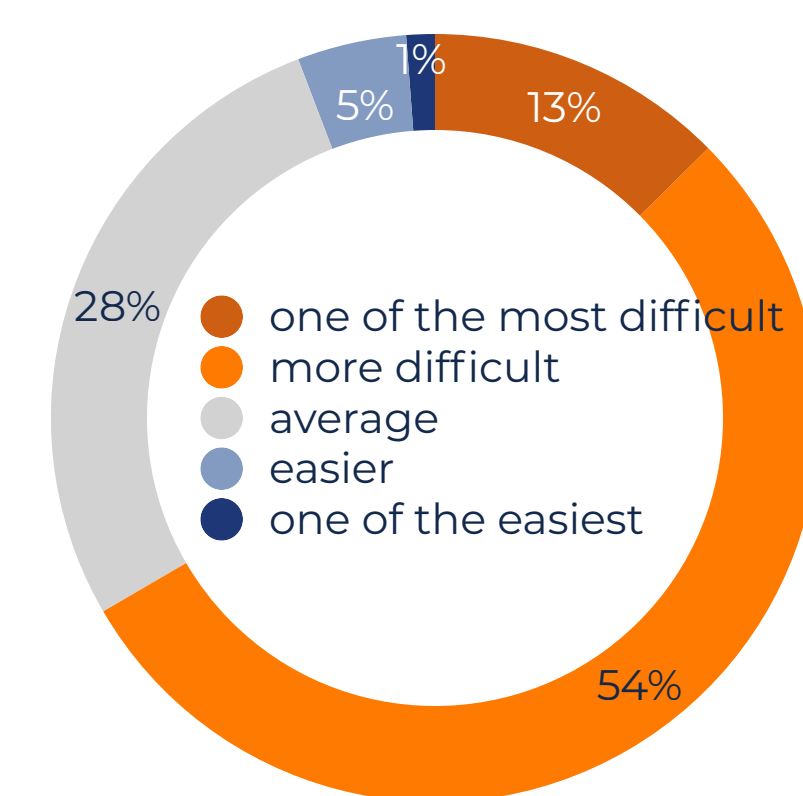
Immersive Learning Laboratory, University of Illinois at Urbana-Champaign

see videos at
ilie.ece.illinois.edu/immersive-learning-lab/explore-the-lab



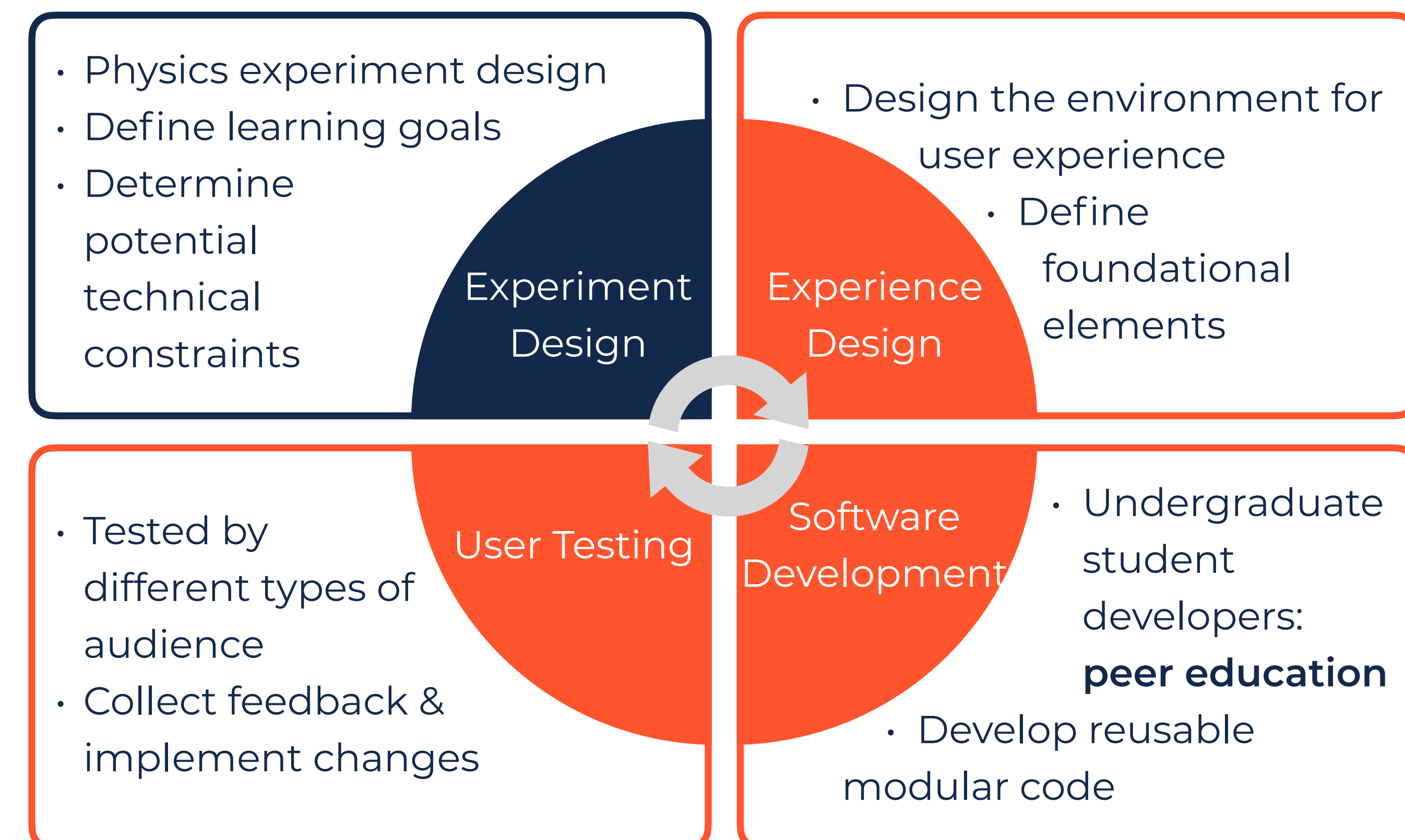
MOTIVATION

- Electricity & Magnetism (E&M) theory: **core** of EE education
- 2/3 of students found E&M more difficult than other courses at UIUC
- E&M concepts are challenging to learn
 - abstract concepts
 - a lack of intuition
 - 3D nature but 2D teaching
- Virtual Reality (VR):
 - a disruptive & vastly influential platform for teaching & learning
 - **immersive, realistic, interactive** 3D environment
- What we do:
 - create customized experiences (video games) to illustrate E&M concepts
 - numerically solve for Maxwell's equations & more
 - modularize shared concepts, such as scalar & vector fields

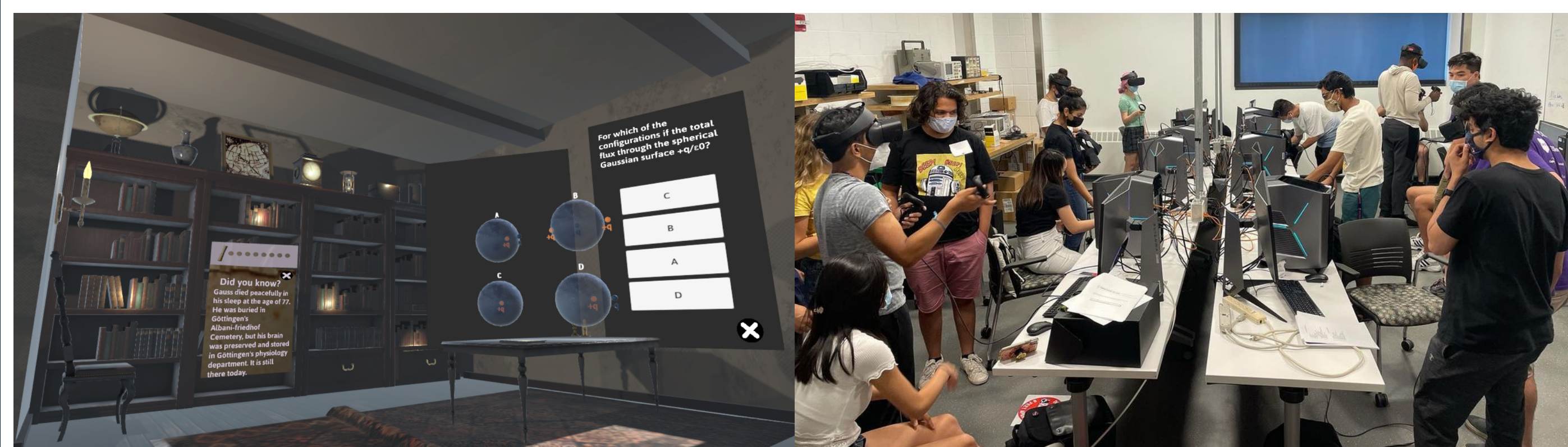


- Experience Age** prioritizes formative experiences
- Information Age** prioritizes information accumulation
- Industrial Revolution** one-size fits all teaching

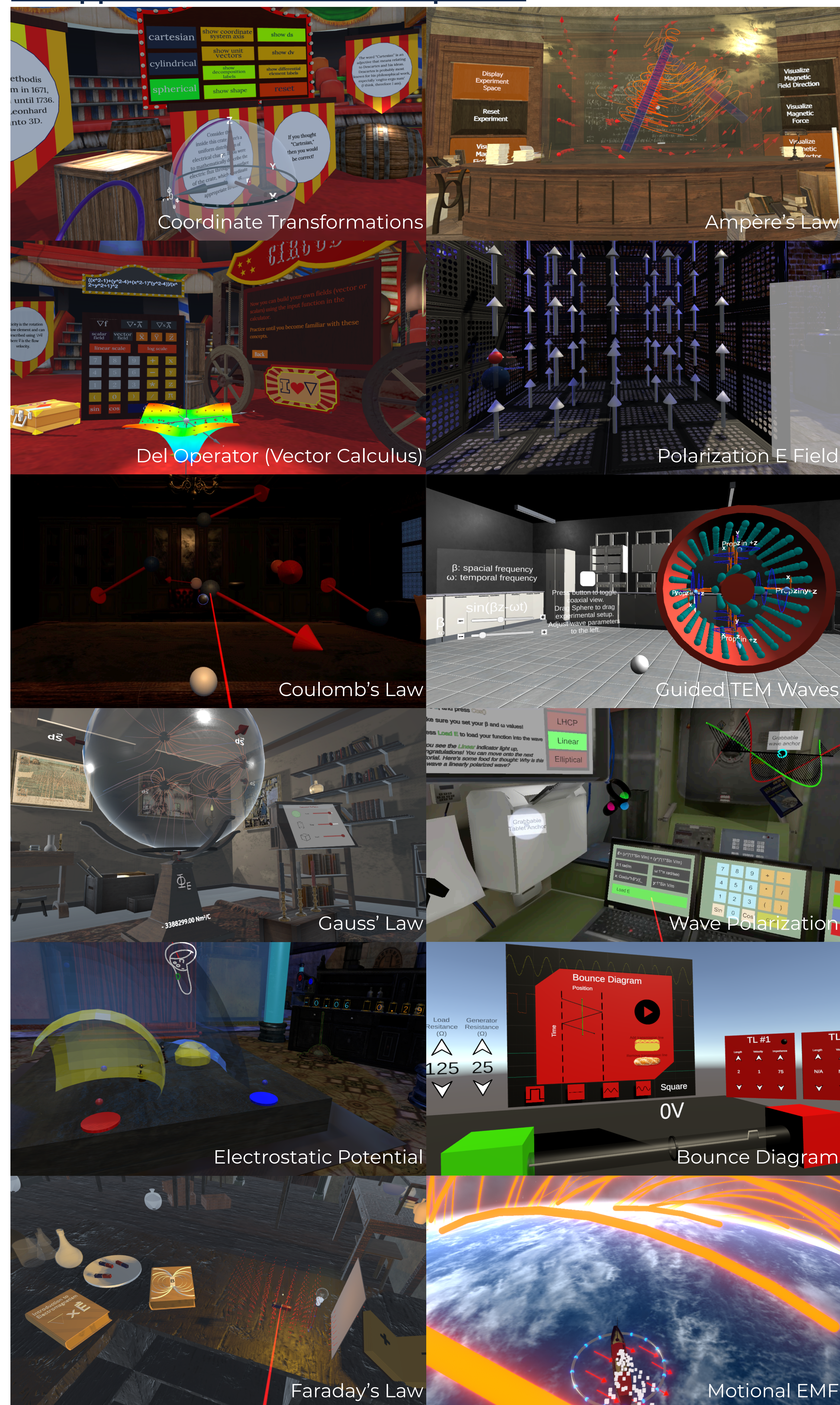
Software Development



- UIUC students are involved in 3/4 stages of development
- 73 undergraduate students from 6 departments have been involved in the VR development over 7 semesters
- ~300 students have enrolled in the lab sections to date
- Gamification: maximize the time spent in the lab learning & engaging with the experiment



VR Applications Under Development (not pictured: Laplace's Equation)



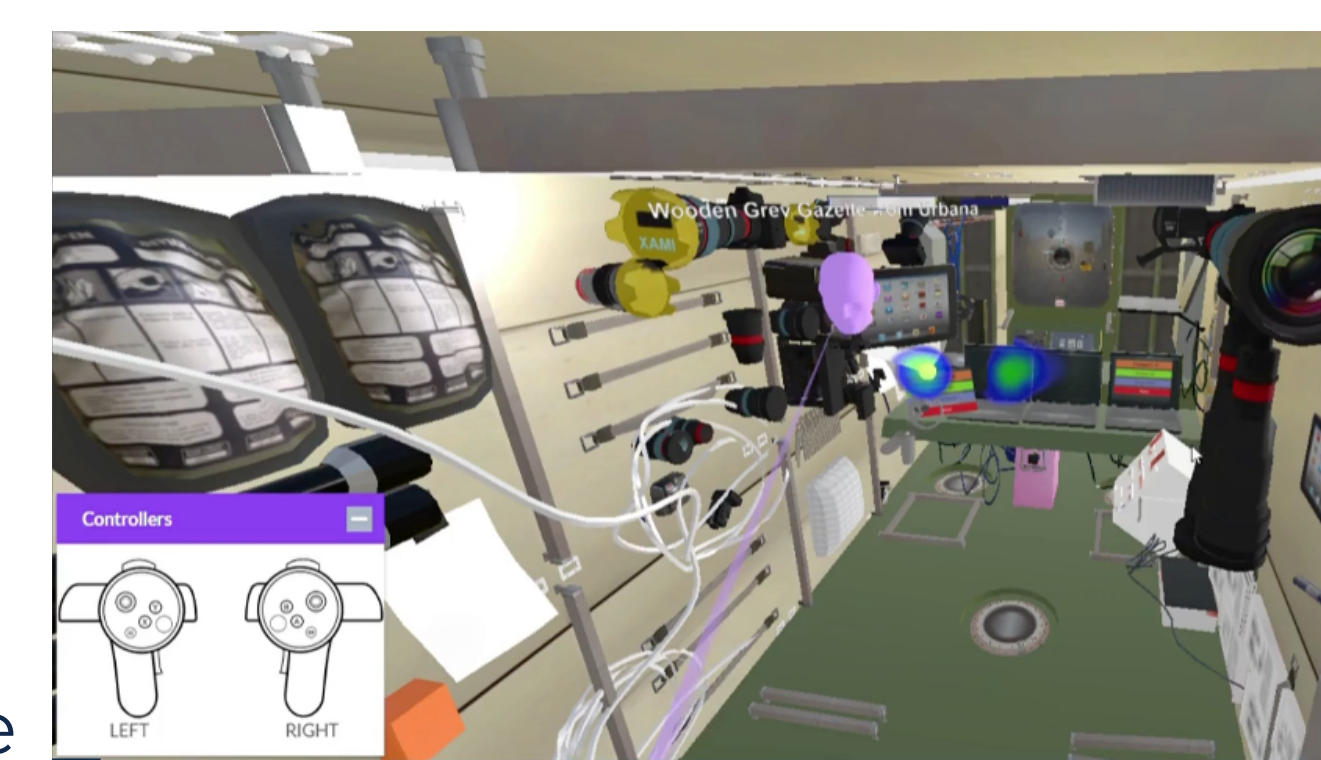
ASSESSMENT

1 (Strongly Disagree) to 5 (Strongly Agree)

Survey Question	avg	SD
After completing the Wave Polarization VR Lab, I think I acquired a good understanding of the linear polarization concept.	4.8	0.4
After completing the Wave Polarization VR Lab, I think I acquired a good understanding of the circular polarization concept.	4.6	0.49
After completing the Wave Polarization VR Lab, I think I acquired a good understanding of the elliptical polarization concept.	4.6	0.49
Visualizing the changing electric and magnetic field as the wave propagates helped me better understand the concept of wave polarization.	4.6	0.8
The VR environment enhanced your learning experience of wave polarization.	4.4	0.8
Did it help to see the Wave Polarization experiment in 3D?	4.2	0.98
The Wave Polarization VR lab helped you answer the quiz questions.	4.4	1.2

HEADSET TRACKING

- Gather data of user behavior inside the VR experience to assess where & how time is spent
- Deliver questionnaires directly for instant feedback:
 - reduces the time between usage & survey: more accurate



SUMMARY

- This multiple perspective-taking and immersion can aid students in better understanding 3D E&M concepts.
- The team is working on implementing software to track student behavior inside the VR experience to assess where and how time is spent.
- This project aims to build a learning infrastructure that would be adopted by physics and engineering departments across the country.

ACKNOWLEDGMENTS

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