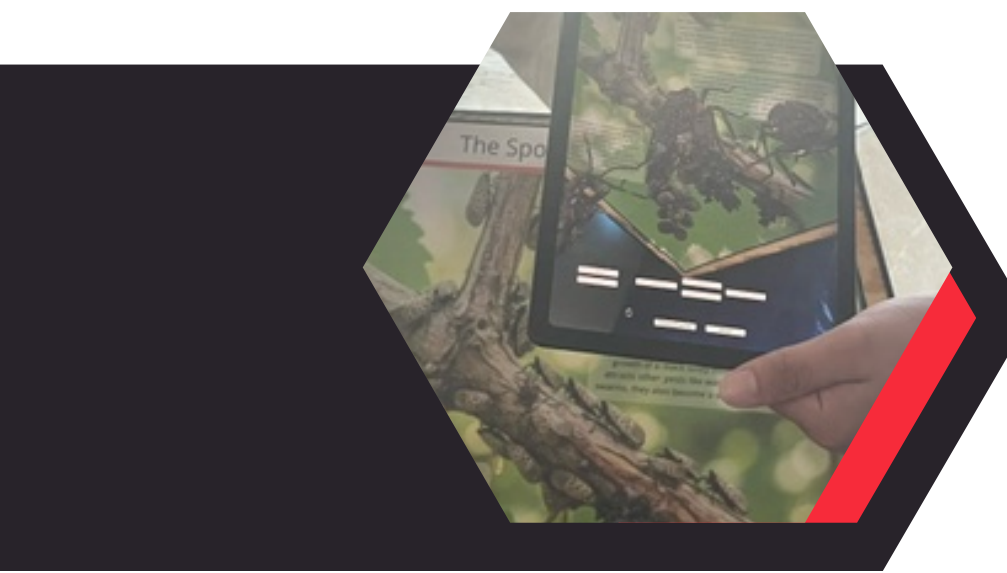


# AR-Enhanced Sustainability Learning

## INTRODUCTION

This project implemented an AR-based invasive species education module in ETDD 3366 at Sam Houston State University. Students developed AR content using Unity, deployed image-target-based educational overlays, and engaged with public participants to assess usability, ecological understanding, and sustainability communication effectiveness.

- SHSU is expanding sustainability-focused engineering education and XR (AR/VR) technologies.
- This project integrated the Engineering for One Planet (EOP) Framework into ETDD 3366: Introduction to VR/AR.
- Students developed AR modules to communicate ecological systems, focusing on invasive beetle species that threaten forests and agriculture.
- The project promotes sustainability literacy, systems thinking, and responsible technology development through immersive learning.



## Methods

Students used Unity, image-target libraries, and interactive 3D models to build AR visualizations illustrating invasive species pathways, host tree damage, and environmental impact. A physical 12-sided dodecahedron AR station was created with panels placed around each face, enabling users to scan targets and access an AR-enhanced educational experience. Students participated in structured EOP-aligned learning tasks, including systems mapping, problem framing, and sustainability-focused communication. To evaluate the learning experience, a 10-item Likert-scale instrument measured interactivity, clarity, realism, usability, and perceived ecological relevance.



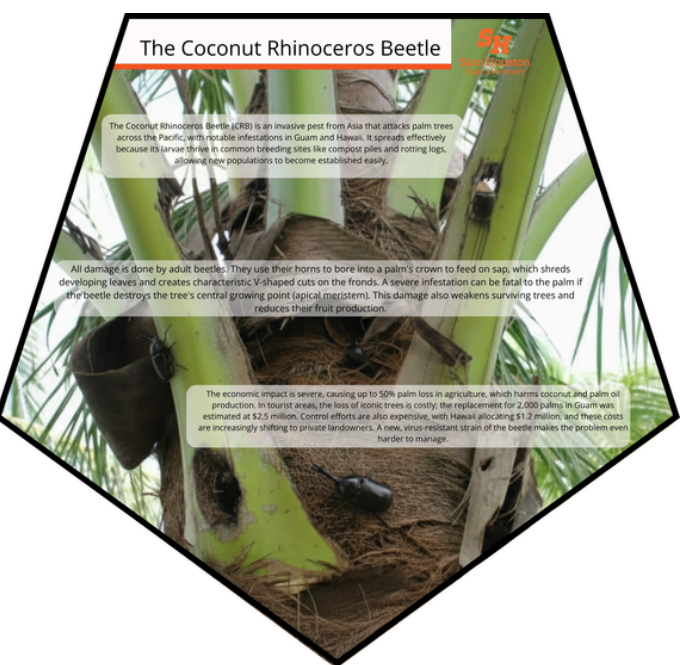
## Progress & Scaling Up

The AR sustainability module was successfully piloted in ETDD 3366, with students completing functional AR scenes, deploying them in Unity, and participating in on-campus public outreach. Early results demonstrate strong student interest in sustainability topics when presented through immersive media. Multiple students expressed interest in continuing AR outreach work beyond the course. The project will scale to ETDD 4339 (Advanced CAD & Modeling), where students will produce optimized 3D assets and extended AR content. Additionally, this work will be integrated with a USDA-funded regional outreach effort, expanding the AR station to visitor centers across Texas and supporting broader public education around invasive species management.



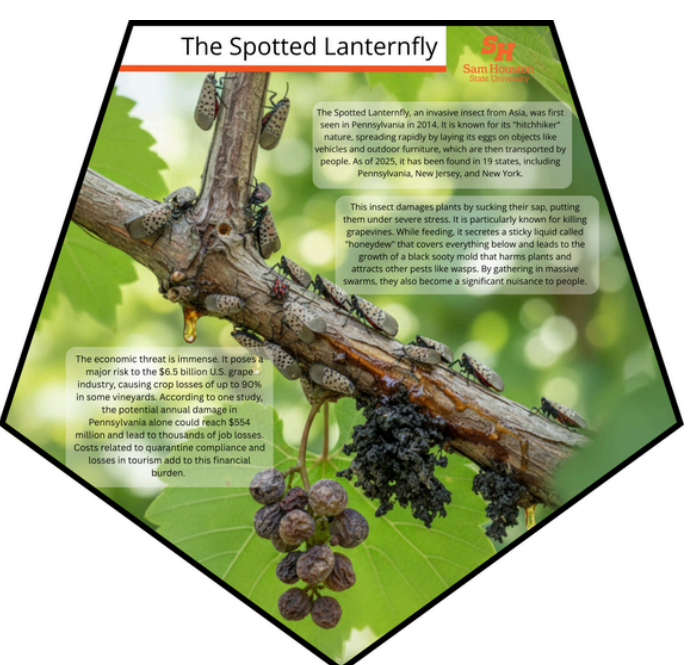
## Evaluation & Impact

Survey data indicate that students found the AR experience visually clear, engaging, and effective in communicating environmental concepts. Many reported improved understanding of the ecological consequences of invasive species and how technology can support sustainability communication. Public participants also responded positively, noting that the AR content made scientific information accessible and memorable. The project demonstrated the value of pairing physical installations with AR overlays to support multimodal learning. On the instructional side, this project helped SHSU expand the integration of the EOP Framework, fostered interdisciplinary collaboration, and encouraged further curricular innovation in sustainability-focused engineering design.



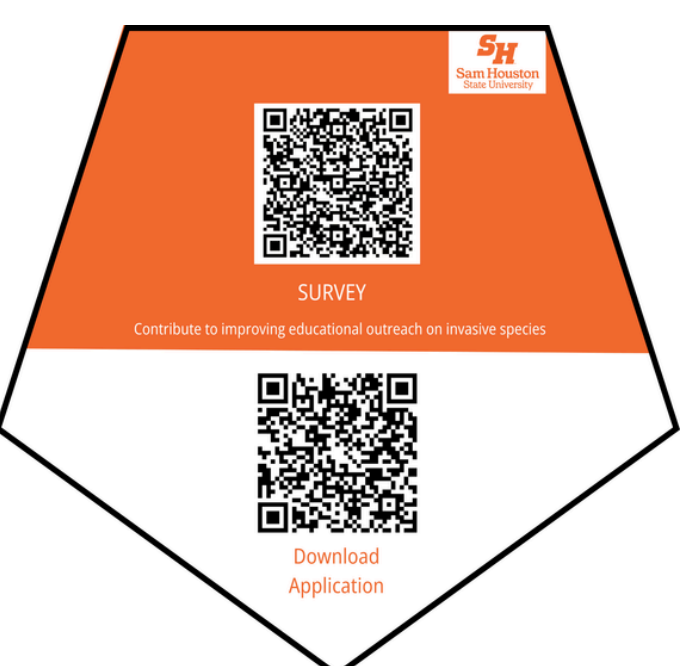
## Future Work

Next steps include adding new AR modules covering additional pests, ecological resilience, native species, and climate-related environmental threats. Updated assessments will incorporate Cronbach's alpha reliability analysis and expanded survey items. Through USDA outreach, the AR station will be deployed for public use at visitor centers across Texas. A long-term plan includes developing a suite of immersive modules that integrate sustainability across multiple engineering design courses, allowing SHSU to establish a scalable and reusable library of AR sustainability education tools.



## References

- The Lemelson Foundation (2022). The Engineering for One Planet Framework: Essential Sustainability-Focused Learning Outcomes for Engineering Education.
- SHSU AR Invasive Species Learning Materials (2025).



## Acknowledgements

